MANUAL OF VOICE TREATMENT

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Clinical Competence Series

MOYA L. ANDREWS

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MANUAL OF VOICE TREATMENT

Pediatrics Through Geriatrics

Moya L. Andrews
Professor of Speech Science
Indiana University

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Illustrations by
Jim Hull
Graphics Services, Indiana University
Bloomington, Indiana

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CONTENTS

FOREWORD

com·pe·tence (kom′pə təns) *n.* The state or quality of being properly or well qualified; capable.

Clinicians crave competence. They pursue it through education and experience, through emulation and innovation. Some are more successful than others in attaining what they seek. This book, **Manual of Voice Treatment: Pediatrics Through Geriatrics,** is one of several in the Singular Clinical Competence Series. It is designed to move each of us further along the path that leads to clinical competence. It covers a variety of voice disorders in children and adults. If we master its content, we will increase what we know and improve what we do. Its purpose is to create competent clinicians who know the profession's current body of knowledge; have the ability to add continuously to that knowledge; and can apply it in their appraisal, diagnosis, and treatment. These clinicians will know that no principle or technique is true or useful until it has been tested; that tests do not diagnose, and treatment programs do not treat — clinicians do. Dr. Moya Andrews has developed these traits — she is a competent clinician. Her book conveys what makes her that way. Your attention to what she provides indicates your competence and your effort to improve it, because competent clinicians seek competence as much for what it demands as for what it promises.

Robert T. Wertz, Ph.D.
Series Editor

PREFACE

During the years I have worked with people with voice problems, I have always enjoyed opportunities to see what other clinicians do. Observation of others and mutual sharing of experiences and insights contribute so much to our professional development. Also, like most clinicians, I have eagerly combed the literature and attended meetings in the unending quest to find information that I can apply to my own clients. Thus, the major aim of this book is to disseminate material that is clinically relevant. I realize that reading about clinical interactions is never as satisfying as actually experiencing them. It is impossible to capture in print the essence of each unique relationship between client and clinician. Nevertheless, there is always a need for a comprehensive reference that busy clinicians can use as they design their own individualized programs. Thus, the material in this book has been drawn from a variety of disciplines, and the most frequently used approaches to voice treatment are delineated. In addition to describing what is currently known about the nature of the various disorders, the rationale for selecting intervention strategies, as well as illustrative examples, are provided. Treatment issues are approached from a developmental perspective so that intervention is meshed with individuals' needs in relation to life stage. Although most voice symptoms are not confined to only one age group, people need to be treated differently at various stages in their life span.

There is a separate appendix for each chapter in the book. The appendixes include additional information for clinicians, practice materials, handouts, and worksheets. Much of the material in the appendixes has been, or is being, used at our Voice Clinic at Indiana University, Bloomington, They are not intended to be viewed as models, but rather as examples to assist clinicians in designing personalized materials for their own clients.

ACKNOWLEDGMENTS

My own clinical skills with adult patients have been enhanced by my association with many gifted professional colleagues. I am especially indebted to Dr. Robert Thayer Sataloff whose knowledge and generosity is legendary in the field of voice science and care. As a Lilly Fellow in 1991, I benefitted immeasurably from visiting his practice for an extended period. His partner, Dr. Joseph Spiegel, and his associates Reinhart Heuer, Rhonda Rulnick, Margaret Baroody, Mary Hankshaw, and Cheryl Hoover taught me so much. Additionally, I have been greatly influenced by the example and writings of Arnold Aronson, Daniel Boone, Diane Bless, Quinter Beery, Erick Blom, James Case, Janina Casper, Raymond Colton, John Haskett, Ari Kane, Christy Ludlow, Richard Saniga, Joseph Stemple, and Kris Ward. I have drawn heavily on the works of these colleagues and many others whose contributions are cited in the various chapters of this book. I am particularly grateful that Ronald Baken was my professor in graduate school and remains my mentor and friend.

I have learned a great deal about the treatment of children by collaborating with my colleagues in the Monroe County School Corporation. Thurman Gordon, Linda Plaford, Anne Summers, and Paula Swander are extraordinary clinicians who always provide me with stimulation and help. I have enjoyed generous support also from my Chair, Phil Connell, and my departmental colleagues. I particularly want to thank Karen Forrest, Mary Gospel, Pat Cromer Grossman, and Charles Schmidt who routinely provide me with answers to my questions. I am fortunate to be surrounded by good-humored and encouraging students and associates. Terry Wertz (series editor) and Marie Linvill, Angie Singh, and Sandy Doyle of Singular Publishing Group, have provided me with exemplary editorial support. I have also been blessed to have Debi Giddens work with me on this project. Her commitment to excellence and superior secretarial and computer skills have been invaluable. Finally, my husband, Stan Stockton, and my son, Alistair Andrews, have been remarkably, but characteristically, tolerant and supportive during the time I have been working on this book.

CHAPTER

1

Assessment

I. PERSPECTIVES ON VOICE ASSESSMENT

A. Multidisciplinary Perspectives

Optimally, assessment of a voice disorder involves a number of specialists. Each has a different role and adopts different approaches to data gathering, problem solving, diagnosis, and referral. Thus, comprehensive description of a voice disorder depends on synthesis of varied data obtained from different sources. The speech pathologist or physician may serve as the assessment coordinator and facilitate communication among members of the assessment team.

1. **Professionals Concerned with Voice.** The composition of the team consulting on a voice case is determined by the type of client, the setting, and the available resources.

   a. A **medically oriented team** may include a family practice physician, otolaryngologist, neurologist, orthodontist, radiologist, respiratory therapist, plastic surgeon, nurse, voice scientist, social worker, psychologist, and psychiatrist, in addition to the speech pathologist.

b. An **educationally oriented team** may include a teacher, school psychologist, school nurse, coach, music and drama specialists, physician, audiologist, counsellor, and aide, in addition to the speech pathologist.

c. A **team oriented toward professional voice users** may include an otolaryngologist with musical or dramatic training, nurse, gastroenterologist, singing teacher, drama coach, voice scientist, allergist, pulmonary specialist, and psychologist with training in arts medicine, in addition to the speech pathologist.

2. **Role of the Speech Pathologist.** The initial contact and referral shapes the subsequent pattern and sequence of the data gathering process.

a. When the speech pathologist sees the client first, he or she can streamline communication and assume a **proactive role as case coordinator.**

b. When the client is referred to the speech pathologist after previous assessments by other specialists, the speech pathologist's **role** may be **defined by others' expectations or requests.** When the speech pathologist is responding to another professional's request for a consultation, it is necessary to:

(1) Request copies of all previously obtained findings and reports.

(2) Communicate directly with the specialist who has assumed the case manager role (usually a physician).

(3) Respond to specific requests but not assume a purely reactive professional posture.

(4) Provide succinct reports of findings and recommendations (see Appendix A).

(5) Ask for clarification of critical evidence or issues.

(6) Suggest treatment options and specify prognostic considerations.

(7) Talk with family members and significant others.

(8) Use forms and checklists designed to elicit specific information from other team members (see Appendix A).

B. Methods of Approching Voice Assessment

Voice production is a multisystem activity. The respiratory, phonatory, neurologic, cognitive, and digestive systems all participate, yet no body part or system is totally dedicated to voice production. Voicing is a secondary function that involves integration and coordination of the movements of different structures. It is influenced by the overall health of the body, the mind, and the emotions. It is influenced also by the external environment, and it is perceived in different ways by different listeners. Because voice production is a dynamic rather than static phenomenon, it can be described and analyzed in different ways. Typically, integrity of structure and function can be ascertained using a number of techniques. Each technique provides different types of information.

1. Instrumental Analysis of the Production

a. **Electromyographic assessment** of muscle activity (e.g., to differentiate between vocal fold fixation and paralysis).

b. **Aerodynamic assessment** of respiratory and phonatory patterns (e.g., airflow and pressure readings can confirm velopharyngeal and laryngeal inadequacy).

c. **Direct and indirect still photography** (e.g., to confirm the presence of laryngeal lesions).

d. **Flexible videoendoscopy** of respiratory tract (e.g., to identify airway obstruction).

e. **Laryngeal mirror examination** (e.g., to show actual size, color, and relationships of laryngeal and hypopharyngeal structures).

f. **Transnasal, flexible, fiberoptic videoendoscopy** (e.g., to document velopharyngeal sphincter action).

g. **Transnasal, flexible, videoendoscopic laryngeal examination** (e.g., to document laryngeal movement patterns during speech and singing).

h. **Stroboscopic laryngoscopy** with a rigid endoscope inserted orally for placement in the pharyngeal cavity (e.g., video recording to document regularity of vocal fold vibration and closure patterns during isolated vowels).

2. **Behavioral Analysis of the Production**

a. Positioning and posture of torso, neck, and head

b. Oral-peripheral examination

c. Elicitation of reflexes (oral, laryngeal, gag)

d. Resonance

e. Swallowing patterns

f. Respiration

g. Articulation

h. Prolonged vowels, reading, spontaneous speech

Direct behavioral observations and inferences support judgments concerning structural integrity and function. Trained perceptual analyses of behavior is the core of the assessment process.

3. **Analysis of the Product**

Acoustic analysis of the voice signal allows inferences to be made about vocal fold movement. For acoustic analysis signal processing techniques (such as CSpeech [Milenkovic, 1987] designed for an IBM PC-AT) can be used.

a. **Measures of frequency** of fold vibrations include average fundamental frequency and variability, frequency range, and frequency stability from cycle to cycle (perturbation or jitter).

b. **Measures of the amplitude** of fold vibrations include average sound pressure level and variability, amplitude range,[1] and amplitude stability from cycle to cycle (perturbation or shimmer).

c. **Measures of aperiodicity** of fold vibration include signal-to-noise ratios and spectrograms. Noise may be generated by leakage of air or by irregularities in laryngeal structure.

d. **Measures of coordination and timing** include maximum phonation time[2] (duration of sustained voice on one breath), rise or fall time (onset and cessation of voice), number of interruptions of voice continuity (breaks and unintentional shifts in frequency and amplitude); overall phonation time ratio; and the identification of patterns in variation of fundamental frequency or amplitude (tremor).

4. Analysis of the Producer

The characteristics of the person producing the voice are important considerations during assessment. Initial, infant vocalizations are reflexive, but through trial and error, imitation, and learning, individuals gradually develop vocal patterns that are appropriate in their culture. Idiosyncratic aspects of human vocal behavior are due to individual differences. Some of these differences are due to environmental or psychosocial influences. Although all human voices have much in common, every person's voice is unique. Analysis of personal (or producer) variables also provides information concerning the extent to which an individual's drives and needs are related to voice use.

a. **Medical history and status** provide information concerning general physical health as well as the structure and

[1] A phonetogram is a plot of the dynamic range of the voice as a function of fundamental frequency. Thus, it provides a combined frequency and intensity profile and defines the limits of the voice. See Pabon (1991).

[2] This measure is obtained with the use of a stopwatch. It is therefore a timing measure that is different from the others listed in **d.**

function of the systems that contribute directly or indirectly to voice production.

(1) Structure and condition of the **upper respiratory tract and the vocal mechanism.** The influence of factors, such as environmental pollutants, allergens, medications, hydration, nutrition, fatigue, and alcohol and drug use, that may impinge on function are considered.

(2) Contributions of relevant **associated systems** such as digestive, pulmonary, neurologic, and sensory (e.g., hearing) are assessed.

(3) General physical state, level of development, maturity, or degeneration as well as systemic diseases and chronic or acute conditions, the influence of pain or insomnia affecting function, energy level, and concentration are assessed.

b. **Psychosocial history and status** provide information concerning general psychosocial function as well as an estimate of how important various levels of vocal skill are to an individual. Personality type; amount and level of vocal training and expressiveness; family dynamics; voice goals and models; and occupational, recreational, and societal demands are considered. Cognitive ability, economic and emotional security, and levels of anxiety and stress are also pertinent.

(1) The client's **self-concept** and **emotional stability** are evaluated during questioning concerning the nature of the problem and its effect on the way the client feels and functions.

(2) The amount, type, and quality of **social interactions** engaged in prior to and since the onset of the voice problem are reviewed. Life-style factors that may be pertinent include vocally demanding activities, role in social groups, role in family, and interpersonal relationships at work.

(3) The individual's **educational, cognitive, and motivational level** are ascertained as well as the financial

and human resources available for support. Factors that may be relevant include incentive for changing behaviors, learning style, receptiveness to suggestions, ownership of the problem, knowledge and training level, and life experiences demonstrating commitment and persistence.

5. Analysis of the Processor

The **characteristics** of the person listening to a voice affect the way that voice is perceived. Training, as well as many personal characteristics, contribute. A severe voice disorder is usually noticed immediately, even by a naive listener, confirming the truism that a disorder is a disorder if it calls attention to itself. However, a subtle voice disorder may exact a negative reaction to a speaker without the listener's conscious awareness that the reaction is related to voice. All speakers' and listeners' personal characteristics, training, and experience influence the reception as well as the production of vocal messages. Additionally, the magnitude of a voice deviation demonstrated by a speaker dictates the level of skill a listener must have in order to identify it. For example, a subtle symptom may not be noted by an untrained listener. Analysis of the perception of vocal behavior includes consideration of visually transmitted information, auditory signals, self-perception, and the reactions of a variety of other listeners.

a. The **client's description** of the sound of his or her voice as it is, was, and should be provides invaluable insights concerning self-awareness and attitudes. Explanations and descriptions of the onset and escalation of voice symptoms may also indicate the client's level of observational skill and the ability to relate cause and effect systematically. The client should be given sufficient uninterrupted time to tell about personal perceptions of the voice disorder. Nonintrusive prompting by the clinician elicits how the problem is perceived to have started and progressed; how it affects intimate, casual, and professional interactions; how it alters feeling states and confidence levels; and what specific signs or symptoms are most or least troubling. Descriptions of the perceived reactions of other listeners and how those reactions are judged to influence the vocal behavior are illuminating, because these data are not available from any other source. Additionally, the client is encouraged to speculate concerning possible causes, antecedent or contiguous events, coping strategies, and severity and type of communicative disruption relevant to the voice changes. The severity of the types of communicative disruption experienced by the client may be obtained using rating scales (see Appendix A).

b. **Self-perception scales** (Haskell, 1988) may also be administered to obtain ratings of other specific aspects of voice such as gender appropriateness, effectiveness, authority, variability, pitch, rate, loudness, and quality. Unidimensional scales can be constructed for any aspect or attribute using magnitude estimates, paired comparisons, or equal appearing intervals with bipolar anchors. Multidimensional scales (Gelfer, 1989) also may be administered. Published data are available on a variety of voices rated by listeners without voice problems. Clients with disordered voices can rate tapes of voices, and their judgments can be compared with those of trained and untrained raters. Perceptual scales are used as a way of quantifying differences in perceptions of specific aspects of voice by different individuals (e.g., client versus other listeners) or by the same individual at different times (e.g., client pre- and post-treatment). Gerratt, Kreiman, Antonanzas-Barroso, and Berke (1993) and Kreiman, Gerratt, Kempster, Erman, and Berke (1993) provide guidelines for perceptual evaluations of voice quality.

c. **Others' perceptions** include the trained observations of the clinician, both informally during conversation and history-taking and during formal testing. Reports of other listeners' perceptions of the voice and how it is used in a variety of contexts and interactions include those of physicians, family members, teachers, coaches, nurses, bosses, co-workers, strangers, and peers. During the assessment process, the clinician seeks to determine the extent of overlap that exists when various trained and untrained listeners describe their perceptions of the client's voice. The consistency in the reports provides documentation of atypical vocal behavior. Usually, a person with a voice disorder demonstrates discernible differences on a number of vocal characteristics across time. When more than a standard deviation from societal norms relative to age and gender occurs, the perceptual judgments of a sample of listeners usually confirms it.

II. DIAGNOSIS OF VOICE DISORDERS

A. Organization and Synthesis of Diagnostic Data

1. Medical Profile

Case history and examination results must be organized to confirm or reject specific diagnostic hypotheses. A team approach to diagnosis has the advantage of providing a composite of perspectives on a disorder and a variety of test results that can be compared to normal values. The clinician uses both subjective and objective data to collect evidence relevant to specific etiologies. Medical profiles are compiled by the physician or by the speech pathologist using history and medical reports. A summary sheet (see Figure 1-1) can help to organize pertinent information.

B. Age-Referenced Data on Normal Phonatory Function

In addition to the health and medical status of the voice user, other factors pertinent to clinicians' decisions concerning the normalcy of vocal behavior include age, gender, amount of speaking and singing training, and the ethnic and racial characteristics of both the client and the examiner. Ideally, when assessing the vocal characteristics of a client, an examiner should also have access to a comprehensive database of normal phonatory function across the life span.

Bless, Glaze, Lowery, Campos, and Peppard (1993) reported on an initial step in the process of establishing a comprehensive normative sample of adult speakers. All speakers in their study were native Midwesterners, in good health, using General American English dialect, and over 95% were Caucasians. Thus, the authors caution against overgeneralization of these data. Nonetheless, this study provides preliminary information that is useful for voice clinicians. Sixty-seven male and 79 female normal speakers

Are the vocal mechanisms and associated systems intact and functional? Yes ☐ No ☐

(Describe anatomical and physiological constraints, surgeries, effects of intubations, trauma, etc.)

____

____

Note presence of local conditions in the tract

Edema ____________________

Upper respiratory infection ____________________

Allergies ____________________

Temporomandibular joint syndrome ____________________

Tension headache ____________________

Head and neck tension ____________________

Irritants (specify) ____________________

Sensations (pain, fatigue, obstruction, etc.) ____________________

Lubrication and mucus (specify) ____________________

Gastroesophageal reflux ____________________

Note presence of significant associated conditions

Obstructive pulmonary disease ____________________

Neuromuscular conditions (e.g., post CVA) ____________________

____

Parkinsonism, focal dystonias, demyelinating diseases ____________________

____

Connective tissue disorders (e.g., Rheumatoid arthritis) ____________________

____

Cardiovascular disease (e.g., enlarged heart, fluid retention) ____________________

____

Endocrine/hormonal influences (e.g., Hypothyroidism) ____________________

____

Substance use (specify) ____________________

Dysphagia ____________________

Other ____________________

____

Note medication used

____

____

____

Note closure and vibratory patterns seen

____

____

____

Check examination techniques used to date

Mirror exam ____________________

Flexible endoscopy with continuous light ____________________

Rigid stroboscopy with interrupted light ____________________

Flexible stroboscopy with interrupted light ____________________

Electromyography ____________________

Other ____________________

Questions yet to be answered ____________________

____

Referrals ____________________

Figure 1-1. Physiologic profile.

participated in the study. The age range varied from 16 to 92 years. There was no history of speech, voice, or hearing problems and the speakers had no formal speaking or singing training.

1. **Videostroboscopic Data**
   Three raters viewed videostroboscopic tapes of each subject and rated 97% of the females and 89% of the males as having normal vocal fold appearance. However, later laryngoscopic examinations revealed that many subjects had deviations (e.g., slight edema, incomplete closure, etc.) from what might typically be described as normal. Excessive amounts of mucus were noted in 60% of the females and 78% of the

males. Stroboscopic ratings of movement patterns suggested that variability in visual-perceptual measures was more strongly attributable to changes in chronological age than were other physiologic or perceptual voice measures. All subjects displayed significant age-related changes in supraglottic activity, vibratory amplitude, mucosal wave, and phase symmetry. The females also showed changes in vibratory periodicity significantly correlated with age. Glottal gaps, or incomplete approximations of the folds during closure, were noted in subjects of both sexes, suggesting that there is a wide range of physiologic patterns within the normal population who have no voice complaints. Indeed, different types of incomplete glottal closure were noted among females and males, and some degree of incomplete closure may be common among adult females (Biever & Bless, 1989).

Table 1-1 shows the mean, standard deviation, and absolute range of vibratory measures taken from the videostroboscopic analysis. Seventy-eight percent of females and 27% percent of males had a posterior glottal gap. Other closure patterns (e.g., anterior and spindle-shaped gaps) were noted in some males of all ages, but only in older females. Figures 1-2 and 1-3 illustrate typical stroboscopic equipment used in clinical settings.

Table 1-1. Stroboscopic vibratory features (6-point scale).*

	Males (N = 64)				*Females (N = 73)*			
	Mean	*SD*	*Min.*	*Max.*	*Mean*	*SD*	*Min.*	*Max.*
Supraglottic activity	.47	.66	0	3	.39	.66	0	3
Vocal fold edge	.47	.21	0	1	.19	.39	0	1
Amplitude	.36	.55	0	2	.28	.59	0	2
Mucosal wave	.31	.47	0	1	.22	.48	0	2
Nonvibrating portion	0	0	0	0	.01	.11	0	1
Phase closure	.68	1	−1	3	−.05	.99	−3	3
Phase symmetry	1.9	1.7	0	5	1.9	2.0	−1	5
Periodicity	1.7	1.6	0	5	1.5	1.8	0	5

Source: From Bless et al. (1993). Stroboscopic, acoustic, aerodynamic, and perceptual analysis of voice production in normal speaking adults. *NCVS Status and Progress Report, 4,* 121–134, with permission.

* Ratings made from 0 (normal appearance and movement) to 5 (most abnormal)

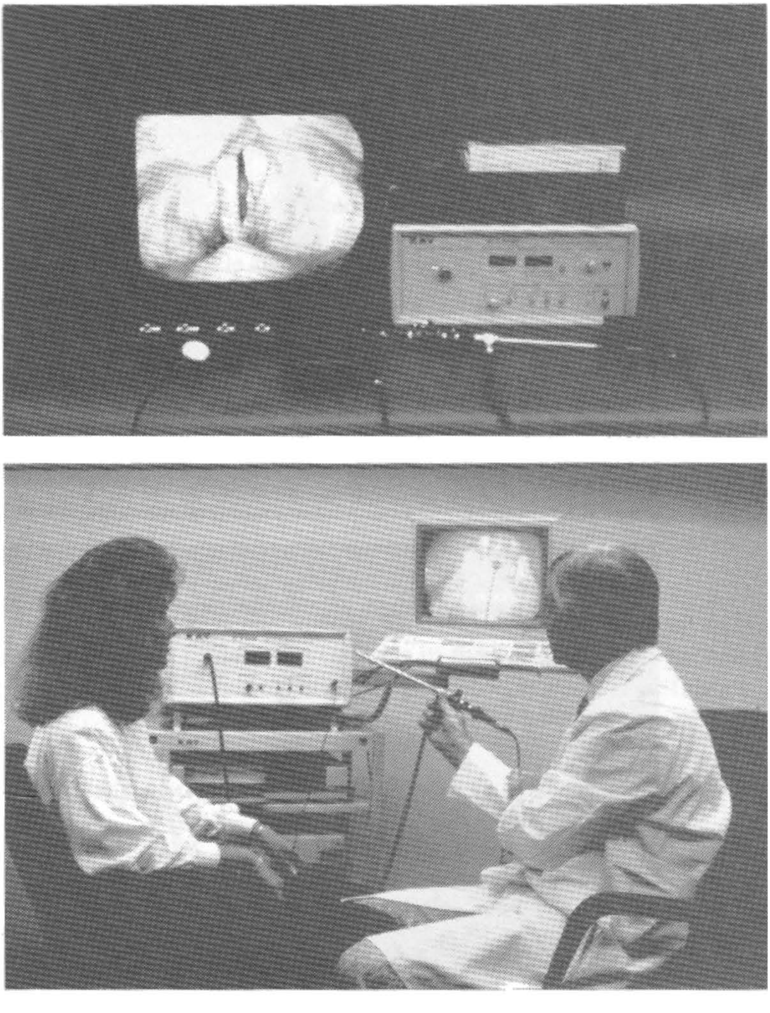

Figure 1-2. Pictures of Kay Elemetrics stroboscopy unit.

2. Acoustic Data

Bless et al. (1993) describe the procedure used to obtain their acoustic normative data in the following way:

Acoustic recordings were conducted with subjects seated in a sound-proof booth, using a Nagra LVII reel-to-reel tape recorder (Model No. 1716903) and a cardioid microphone (Model No. 666)

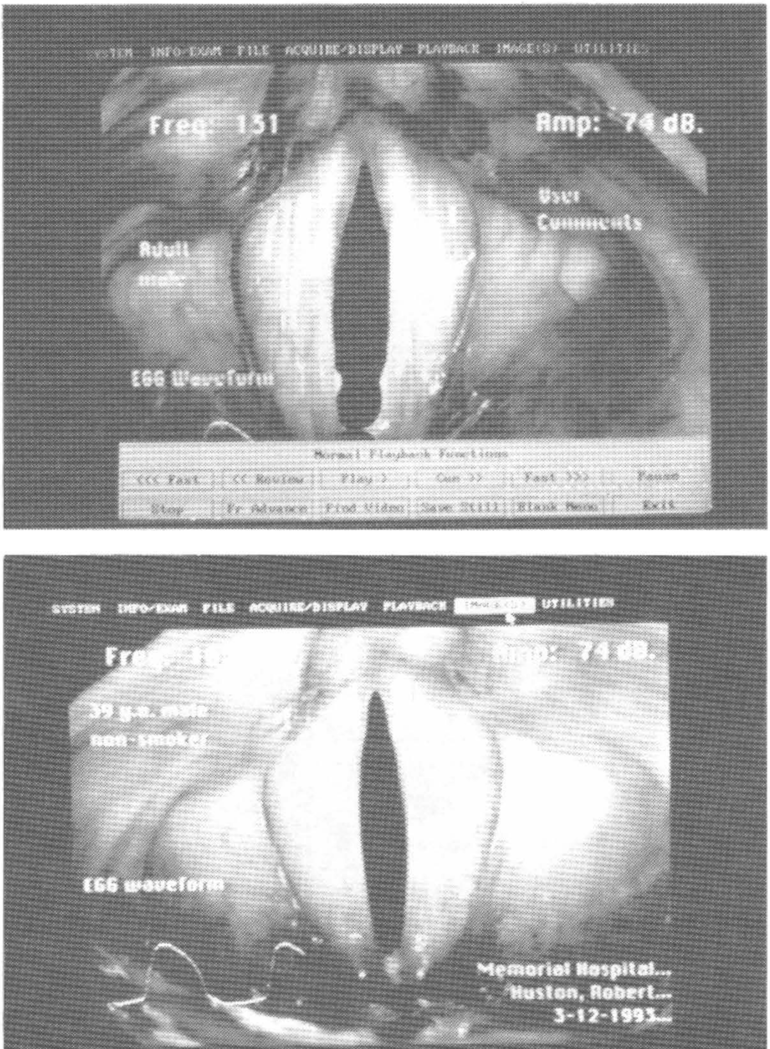

Figure 1-3. Stroboscopic views of the larynx. (Courtesy of Kay Elemetrics Corp.)

with a constant mouth-to-microphone distance of 12 inches. The voice sample included sustained vowels /o/ and /i/ at comfortable pitch and loudness, maximum and minimum pitch and loudness levels, conversational speech, description of the standard "Cookie Theft" picture (Goodglass & Kaplan, 1972) and repetitions of the sentence "the blue spot is on the key again."

> . . . tape recordings were digitized from a Sony reel-to-reel playback (TC-654-4) using CSpeech (Milenkovic, 1987) a signal processing technique for an IBM PC-AT. Acoustic analysis of sustained /o/ and /i/ vowels were conducted using one-second-length midportions of the sustained vowels. Means, ranges, and standard deviations were derived for frequency, jitter, shimmer, and signal-to-noise ratio. Also, the difference between the highest and lowest frequency was calculated and converted to a semitone range. Table 1-2 displays the male and female acoustic measures with the mean, standard deviation, and absolute and interquartile ranges given. There were significant differences in frequency range, mean, and range of intensity, and mean jitter, shimmer, track, and err for females as a function of age. Male effects were limited to frequency and semitone ranges and mean intensity, with no significant changes in perturbation measures with age. There was wide variability in task performance, with perceptually normal speakers yielding measures as much as two standard deviations from the mean. (p. 123)

3. Aerodynamic Data

Bless et al. (1993) report wide variability on aerodynamic measures of sustained vowels in the presence of consistently normal perceptual ratings of the subjects' speaking. Table 1-3 displays their data.

C. Comparison Data on Pathologic Voices

Hirano, Tanaka, Fujita, and Terasawa (1991) presented information comparing fundamental frequency and sound pressure levels in both normal and pathologic phonatory function. They studied 40 normal adults and 1,563 voice patients. Eight parameters were investigated:

F_0 for the habitual pitch of phonation = F_{0HAB}

F_0 for the lowest physiologic tone = F_{0L}

F_0 for the highest physiologic tone = F_{0H}

Physiological F_0 range of phonation = F_0Rg

SPL for the habitual loudness of phonation = SPL_{HAB}

SPL for the softest tone = SPL_S

SPL for the loudest tone = SPL_L

SPL range of phonation = SPL Rg

Table 1-2. Male and female acoustic measures.

	Mean	SD	Min.	Max.	I[a]	III[a]
Vowel /ɑ/			Males (N = 58)			
F_0 (Hz)	106	18	74	171	94	117
Jitter (msec)	.07	.07	.01	.50	.03	.06
Shimmer (%)	4.9	5.5	1.4	41	2.7	5.5
SNR (dB)	17.2	3.8	7.2	27	14.8	19.7
Min. track	.45	1.6	0	11	0	0
Max. track	7.8	26	0	166	0	3
Min. error	.05	.39	0	3	0	0
Max. error	.80	2.9	0	19	0	0
Vowel /i/						
F_0 (Hz)	112	20	74	185	98	121
Jitter (msec)	.05	.05	.01	.33	.03	.05
Shimmer (%)	3.26	2.6	.80	15.5	1.4	3.8
SNR (dB)	19.5	3.7	10.7	27.6	17.2	22.1
Min. track	.3	1.2	0	7	0	0
Max. track	5.15	23	0	170	0	2
Min. error	0	0	0	0	0	0
Max. error	2	9	0	67	0	1
High F_0 (Hz)	482	244	33	1190	278	640
Low F_0 (Hz)	77	33	25	225	55	92
Semitone range	31	12.6	7	66	22	40
Intensity (dB)[b]	70.5	4	62.5	85.5	68	73
High Io (dB)	985	3.6	86	110	96	101
Low Io (dB)[b]	62	4.3	60	80	60	65
Vowel /ɑ/			Females (N = 61)			
F_0 (Hz)	193	27	117	262	178	211
Jitter (msec)	0.6	.14	.01	.98	.01	.03
Shimmer (%)	4.7	6.3	1.1	37	2.2	4.1
SNR (dB)	18.3	4.05	6.6	25	16	21
Min. track	.5	1.8	0	12	0	0
Max. track	14	52	0	306	0	1
Min. error	.03	.25	0	2	0	0
Max. error	1.43	4.4	0	19	0	0
Vowel /i/						
F_0 (Hz)	202	28	132	284	183	223
Jitter (msec)	.03	.06	.008	.4	.01	.02

	Mean	*SD*	*Min.*	*Max.*	*I*[a]	*III*[a]
Shimmer (%)	2.5	2.3	.80	14	1.3	2.8
SNR (dB)	22	3.6	10.6	31	20.9	24.5
Min. track	.39	1.5	0	10	0	0
Max. track	8.81	31	0	163	0	1
Min. error	.01	.13	0	1	0	0
Max. error	4	14	0	73	0	0
High F_0 (Hz)	634	228	185	1190	439	758
Low F_0 (Hz)	137	45	34	226	112	163
Semitone range	26	10	7.5	51	17	34
Intensity (dB)[b]	68	4	60	82	66.5	72
High Io (dB)	94	6	80	106	90	98
Low Io (dB)[b]	61	1.7	60	70	60	62

[a] Values which fell at the first and third interquartile ranges.

[b] Intensity measures (dB SPL) made on Nagashima PS-77 Phonatory Function Analyzer are restricted to a lower limit of 60 dB. Therefore no statistical results are influenced by machine limits.

Source: From Bless et al. (1993). Stroboscopic, acoustic, aerodynamic, and perceptual analysis of voice production in normal speaking adults. *NCVS Status and Progress Reports, No. 4,* 121–134, with permission.

Table 1-3. Aerodynamic measures.

	Mean	*SD*	*Min.*	*Max.*	*I*[a]	*III*[a]
Males (N = 67)						
Flow rate /ɑ/[b]	119	62	30	320	80	150
Flow rate /i/[b]	140	89	20	540	90	171
DDK /i/[c]	5	0.9	3	8	46	5.6
DDK /hi/[c]	5	1.3	2	9	4	6
Females (N = 78)						
Flow rate /ɑ/[b]	115	48	10	220	80	155
Flow rate /i/[b]	113	51	8	250	80	140
DDK /i/[c]	5	1.2	2.5	9	4.3	5.7
DDK /hi/[c]	4.9	1.5	1.8	9	4	6

[a] Values which fell at the first and third interquartile ranges.

[b] Flow rates are measured in cc/second.

[c] Diadochokinesis rates measured on rapid repetitions of syllables /i/ and /hi/.

Source: From Bless et al. (1993). Stroboscopic, acoustic, aerodynamic, and perceptual analysis of voice production in normal speaking adults. *NCVS Status and Progress Reports, No. 4,* 121–134.

Measurements of the eight parameters were made using the Nagashima PS-77H, with simultaneous recordings of air flow, air volume, F_0, and SPL. The investigators noted that the use of a mouthpiece did not significantly influence the values of the F_0-related parameters, but did affect the SPL-related parameters. When a mouthpiece is used, SPL_S is greater by approximately 2 dB, SPL_L is smaller by approximately 8 dB, and SPL Rg is smaller by approximately 10 dB than measures made without a mouthpiece. The investigators summarize the clinical application of their findings in the following way.

> F_{0H}, F_0Rg, SPL_L, and SPL Rg were decreased in many disease groups. F_{0HAB} and F_{0L} varied. SPL_{HAB} and SPL_S were increased in some disease groups. The F_0- and SPL-related parameters reflected effects of treatments. Therefore, measurements of F_0 and SPL in voice patients are recommended in order to evaluate the degree of disorders in some aspects of vocal function and to assess the effects of treatments. (pp. 126–127)

Shown on the following pages, in Figures 1–4 through 1-9 are graphs reprinted (with permission) that display some of the data reported by Hirano, M., Tanaka, S., Fujita, M., and Terasawa, R. (1991). Fundamental frequency and sound pressure level of phonation in pathological states. *Journal of Voice, 5*(2), 120–127.

1. Overview of Technology

The availability of personal computers and high-quality recording systems (audio, video, FM, and digital) has revolutionized voice assessment during the past two decades. It is now possible for clinicians to document both the assessment of voice and the efficacy of treatment using a variety of measures of voice function (e.g., physiologic movement patterns, acoustic and aerodynamic measures). However, there are still no international guidelines to standardize the selection and implementation of the wide variety of vocal function tests that may be used. Bless and Baken (1992) note that

> There is a wide assortment of variables that are possible targets for quantification. Potentially relevant phenomena and indices include, to name a few, F_0, vocal intensity, mean glottal airflow, instantaneous glottal volume velocity (via inverse filtering), air pressure, vocal fold motions (via stroboscopy), frequency and intensity perturbation, vocal fold contact area (via electroglottography), and the laryngeal electromyograms. The lack of international agreement

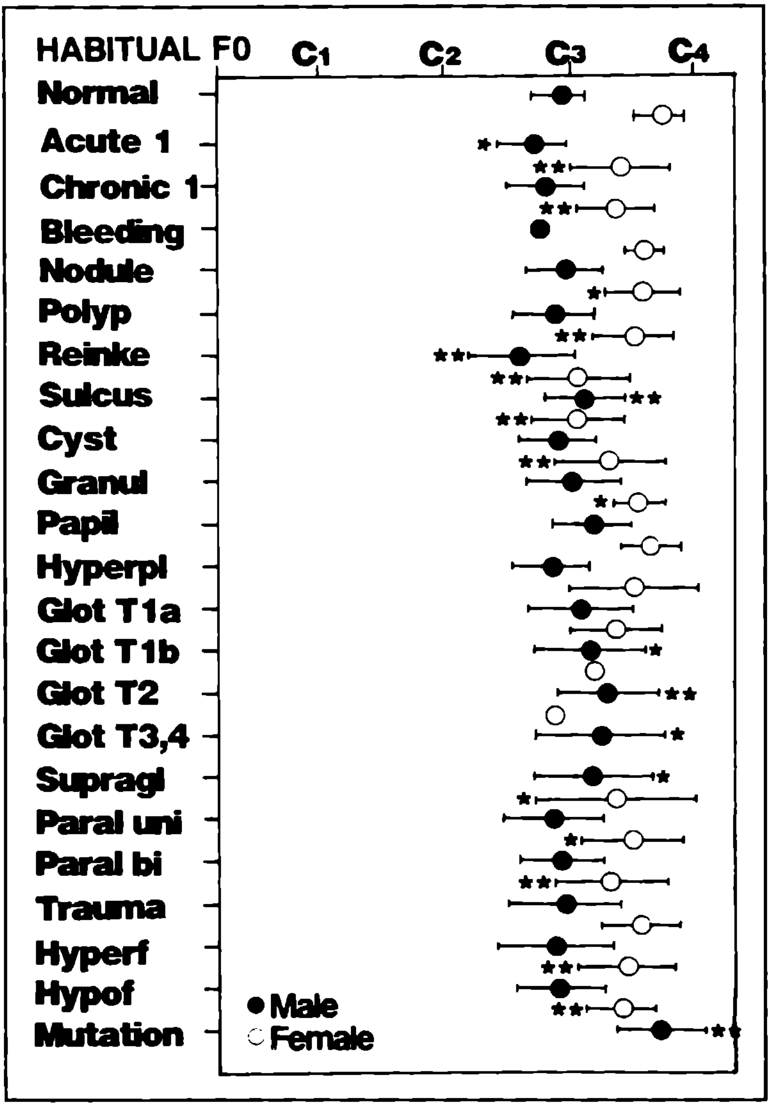

Figure 1-4. Fundamental frequency (F_0) for habitual pitch of phonation for each group. Circle: mean; bar: SD; *p < 0.01; **p,< 0.05.

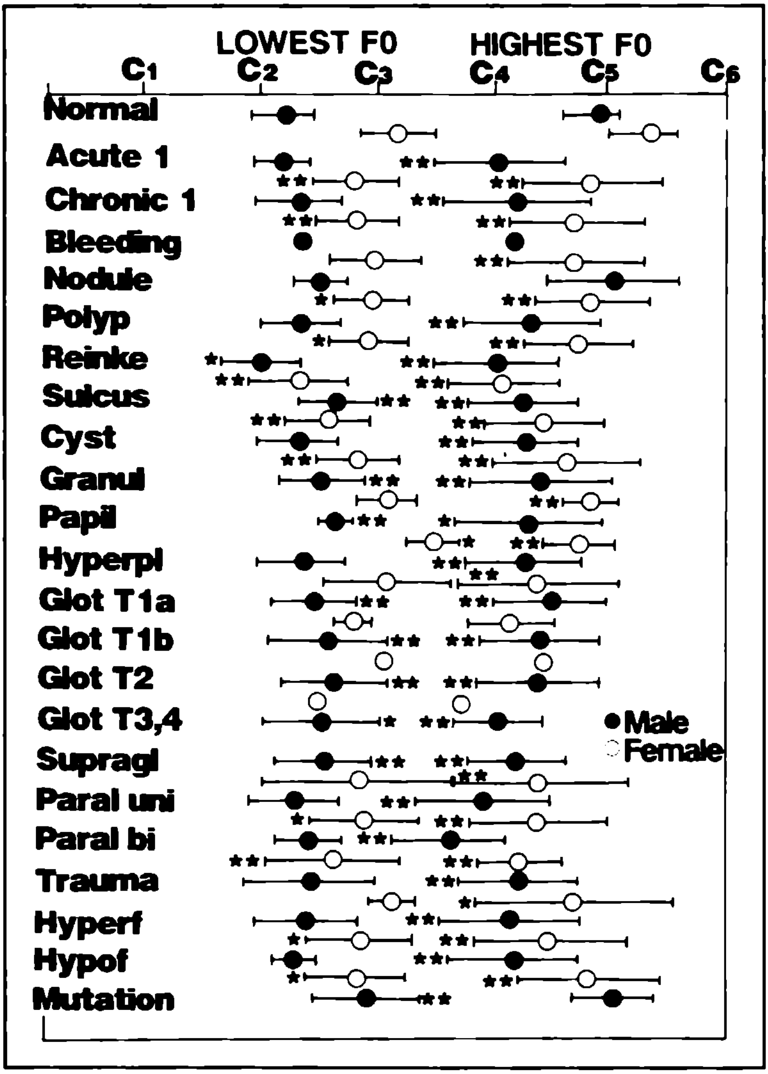

Figure 1-5. Fundamental frequency (F_0) for the lowest and the highest physiological tone for each group.

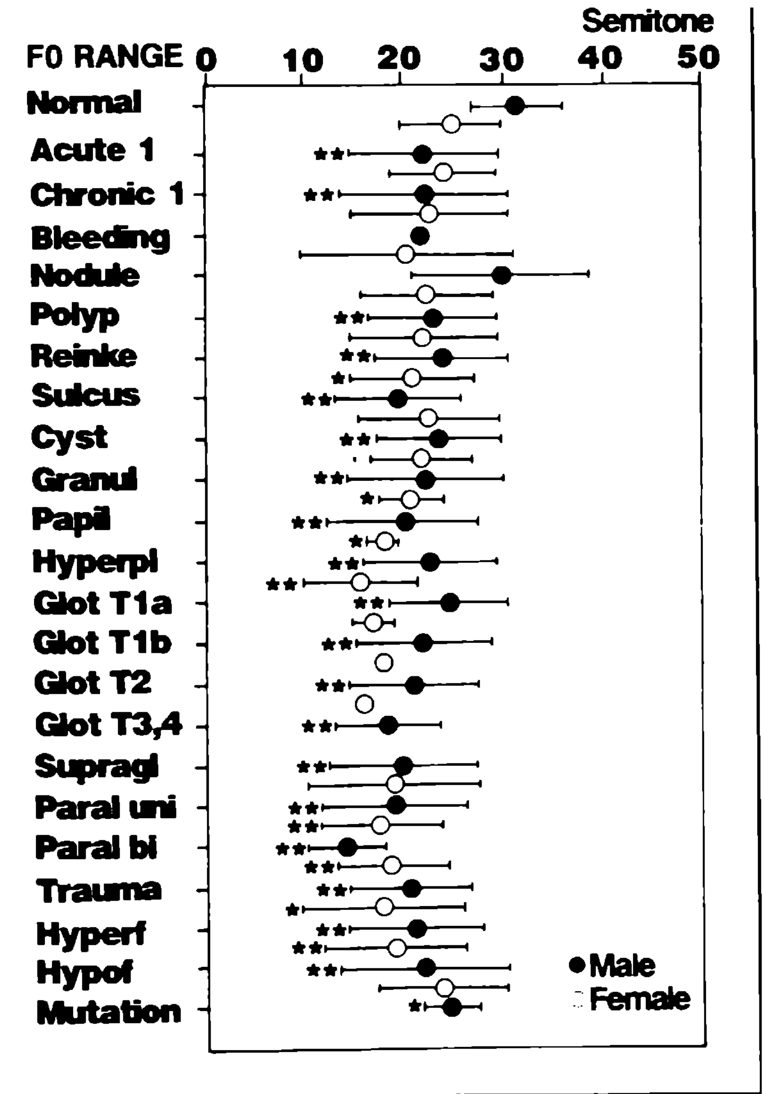

Figure 1-6. Fundamental frequency range of phonation for each group.

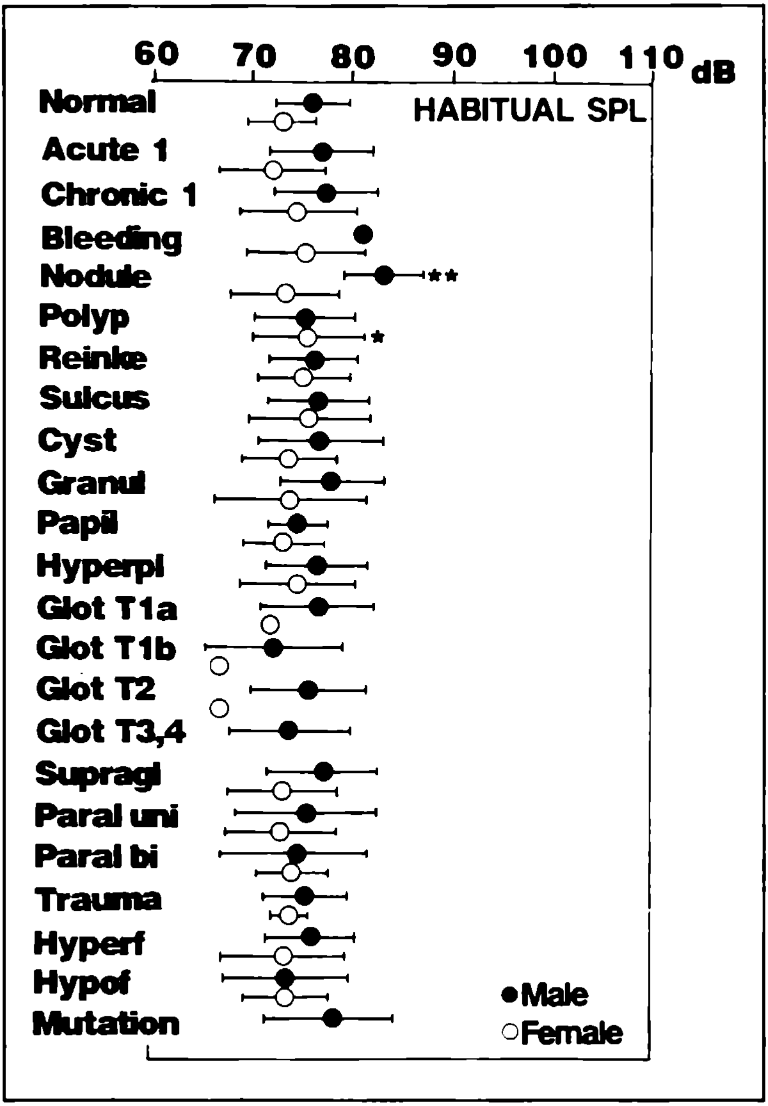

Figure 1-7. Sound pressure level (SPL) for habitual loudness of phonation for each group.

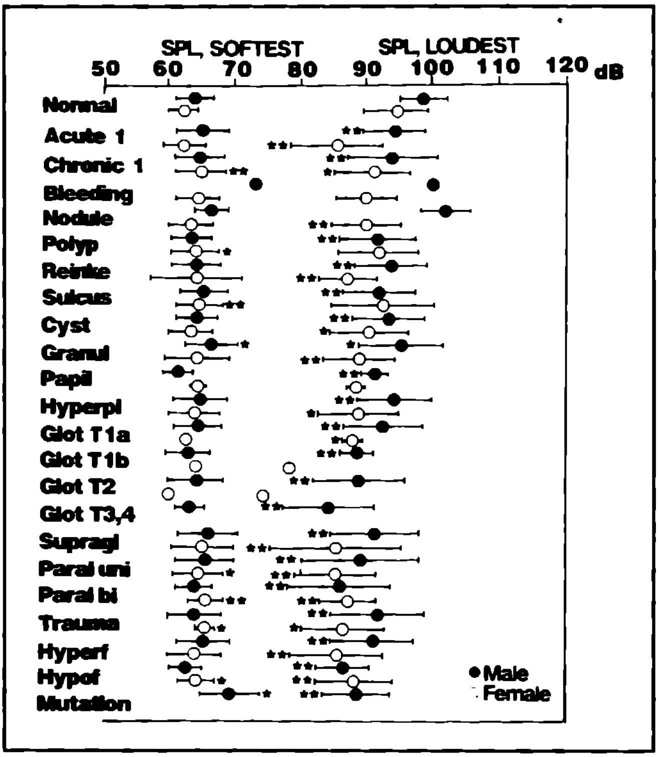

Figure 1-8. Sound pressure level (SPL) for the softest and the loudest tone for each group.

about which of these (or other) measures are most useful, either alone or in combination, is particularly glaring and strongly inhibits the application of any. (p. 96)

Bless and Baken (1992) go on to say that there are different disciplinary perspectives and different levels of training and experience in the use of available instruments; thus, testing procedures vary dramatically. In the next decade there will undoubtedly be wide discussion and hopefully some resolution of critical issues such as calibration requirements, testing environments, and examiner qualifications. At its triennial congress in 1986, the International Association for Logopedics and Phoniatrics (IALP) established an International Voice Committee to examine issues and make recom-

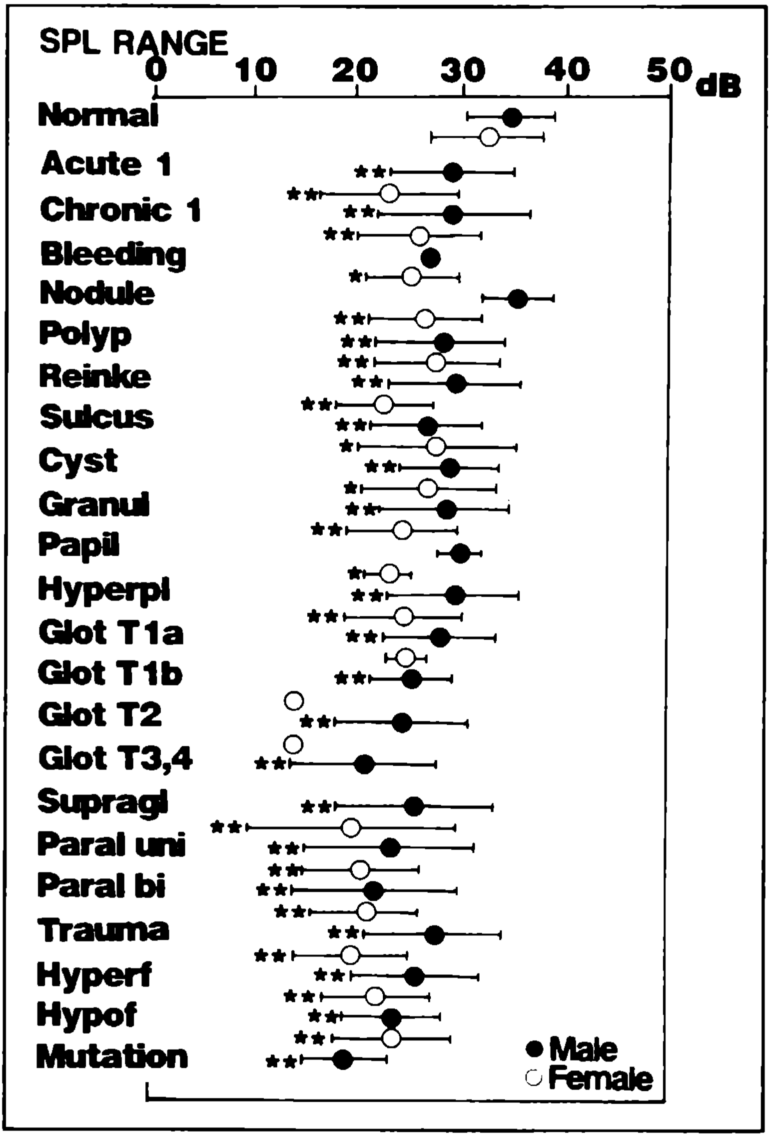

Figure 1-9. Sound pressure level (SPL) range of phonation for each group.

mendations concerning the standardization of voice evaluation procedures. The *Journal of Voice* (Vol. 6, No. 2, 1992) published the results of a survey conducted by the IALP, as well as a report of the issues, in the hope that serious professional dialogue in this area would be stimulated. This section reviews some of that material. The reader is strongly urged to consult the original papers published in the *Journal of Voice* for more comprehensive coverage.

a. Stroboscopy

Endoscopy (from the Greek word *scopios* meaning "to observe") is a technique used by physicians to view internal parts of the body. **Laryngoscopy** is the viewing of the laryngeal area. **Stroboscopy** (*strobos* means whirling) is a term used to indicate the use of a particular type of light during visualization. Because the unaided eye cannot see the rapidly vibrating vocal folds, stroboscopy provides a way of illuminating the larynx with brief flashes of light (Faure & Muller, 1992). Because the intermittent light occurs at a frequency just slightly less than the rate of actual fold vibration at any given time, the eye perceives a slow-motion view of the movement patterns. Faure and Muller (1992) suggest that the use of the vowels /i/ and /e/ at several frequencies produced in ascending and descending scales and at different intensities may allow observations relevant to the confirmation of vocal pathology.

(1) **Video recording (videostroboscopy)** allows the clinician to make a permanent record of the vocal fold patterns for post hoc analysis and/or comparison with subsequent evaluations (e.g., pre/post treatment). Video recordings may be made using either rigid endoscopes which are inserted orally or flexible endoscopes inserted transnasally. See Figure 1-10 showing a photograph of bilateral vocal fold nodules taken from a video printout.

(a) **Transnasal insertion** allows the vocal tract to be observed under more normal conditions (e.g., the rigid scope lies on the tongue and impedes articulation) and connected speech or singing may be observed.

Figure 1-10. Photography of bilateral vocal fold nodules obtained using a printer attached to the laryngostroboscopy unit. A photograph of this type becomes an important part of documentation of physiologic status prior to intervention and is placed in the patient's permanent file.

(b) However, the nasal insertion causes more discomfort, is invasive, and does not provide as large or distinct a picture as does the **rigid scope.** It is difficult to obtain absolute quantitative measures of laryngeal structures and movement patterns using either a rigid or a flexible scope because of positioning factors.

(2) The **major advantage** of stroboscopy is that it allows visual inspection of laryngeal structure and function. Thus, the development of trained visual perception is probably the most important clinical skill. Figure 1-11 shows some examples of glottic closure that may be seen on videostroboscopy.

(a) Adequacy of closure, mucosal waves, and vibratory amplitudes are the most **easily observed aspects of laryngeal function** according to Wendler (1992).

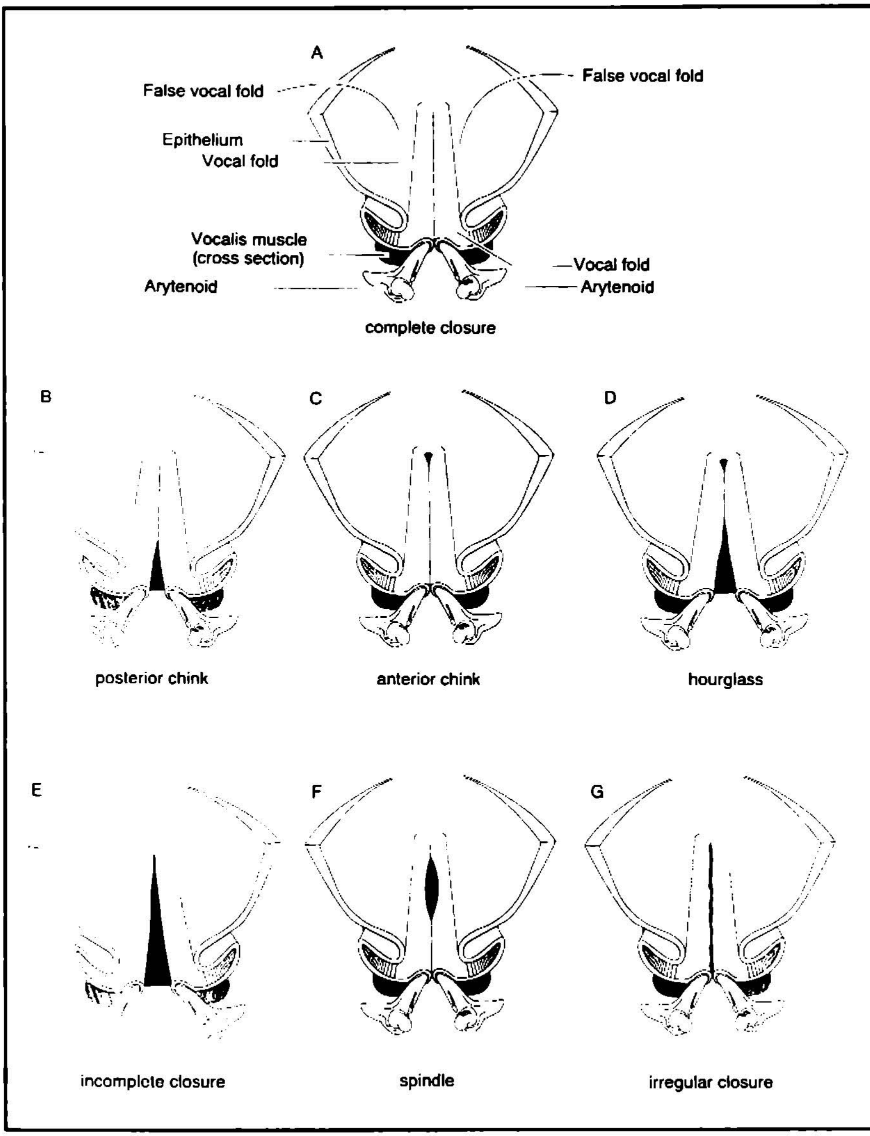

Figure 1-11. Schematic illustration of glottic closures that may be seen during videostroboscopy. (Adapted from Bless, D. [1987]. "Stroboscopic evaluation of the larynx" [Abstract]. Madison: University of Wisconsin.) (Jim Hull, Graphics Services, Indiana University)

(b) The **mucosal wave** (Hirano, 1981) yields information about the status of the tissue situated between the superficial mucosa (the cover) of the fold and the vocal muscle (the body).

(c) Observation of the **transverse movement of the muscle and the vertical wave motion of the cover** is clinically useful because lesions may restrict free movement. Abnormal stiffness of the wave may be complete or incomplete, unilateral or bilateral, and transient or permanent.

(d) Faure and Muller (1992) note that **specific aspects to be observed** during stroboscopy also include amplitude of the opening phase, amplitude of the closing phase, bilateral symmetry of these amplitudes, diminution of the opening phase, diminution of the closing phase, variability with phonatory frequency or intensity, and phase delay of wave activity when comparing the two folds. They list (p. 142) information relevant to the interpretation of stroboscopic findings. A thorough familiarity, on the part of the clinician, with normal laryngeal activity viewed stroboscopically is a prerequisite for clinical assessment of atypical laryngeal structure and function. See Appendix A for a chart of glottal configurations.

b. Electroglottography

Electroglottography is a technique that is noninvasive, inexpensive, and capable of providing information concerning some aspects of vocal fold function not obtainable by other means (Baken, 1992). It provides a valid means of representing the relative area of contact of the vocal folds during the glottal cycle. It does not provide information on the area of the glottal opening or the instant at which opening and closing occurs. Karnell, Li, and Panje (1991) synchronized electroglottography with videostroboscopy and suggested that pathology may be more easily identified during the closing or opening phases of the vibratory cycle rather than during the closed phase.

(1) **Description.** It is convenient to use and several instruments are commercially available (see Figures 1-12 and 1-13). A stable oscillator generates a high-frequency current that is coupled to the client's external neck surface via a set of small electrodes. During each glottal cycle, the electrical impedance across the larynx rises as the glottis opens and falls as the glottis closes and the folds come into increased degrees of contact. During the production of an isolated vowel, with the electrodes in place on the neck, the client receives a carrier signal of approximately 300 KHz with a low voltage across the neck (around 0.5 V). Changing impedances in the path of this current, presented externally to the neck, allow interpretation of glottic adduction via waveforms. The symbol Lx is used to denote a record of trans-neck impedance changes with the *glottal* changes amplified (other changes are filtered out) to make the significant details in the waveform more obvious.

(2) Baken (1992) described the **relationship between the gross features of the Lx waveform and the major**

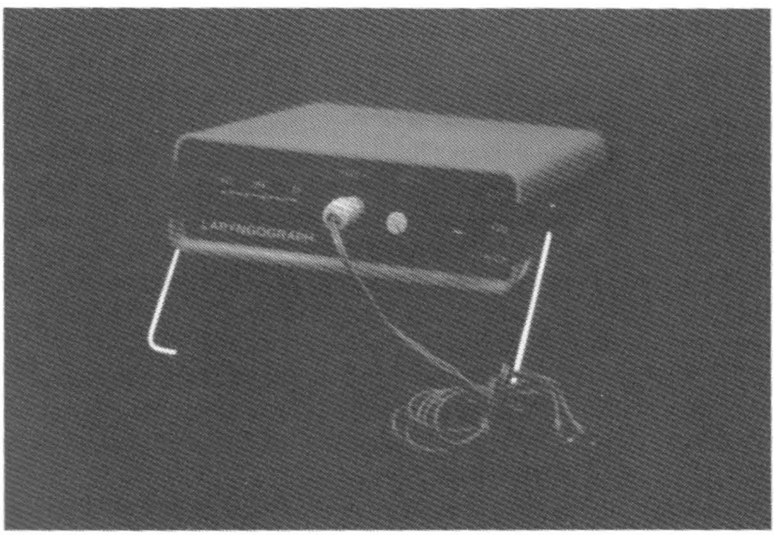

Figure 1-12. Photograph showing Kay Elemetrics Laryngograph equipment.

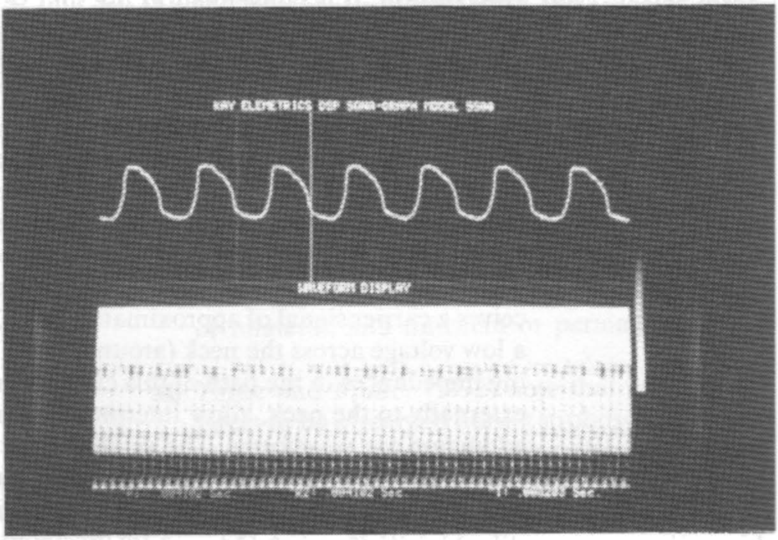

Figure 1–13. Photograph of the printout obtained from the Laryngograph, displayed next to a sonogram.

phases of **the glottal cycle** (p. 103). He says (p. 106) that the Lx wave is almost ideal as a raw signal from which vocal F_0 may be derived. He notes also that jitter measures are valid, but shimmer measures are not. However, Baken cautions that the Lx signal may contain significant noise and this may contaminate results. Baken suggests that electroglottography be used carefully and interpreted conservatively in conjunction with other means of laryngeal observation.

(3) He cites the **recommendations of the IALP**, some of which are listed below.

(a) Electroglottography is a **valid diagnostic technique** and may be used, where appropriate, **as part of a battery of routine vocal assessment procedures.**

(b) Manufacturers of electroglottographic instrumentation should clearly **specify the cut-off frequency** associated with the highpass filtered (Lx) outputs of their devices. Until standardization occurs, the cut-off frequency used should always be noted on the electroglottogram.

(c) Pending further research, **numerical measures** (e.g., open quotient [Oq]) that depends on open and closed times derived from electroglottograms **must be considered of questionable validity.** Their use is not recommended.

2. Stability of Measures

Higgins, Netsell, and Schulte (1994) quantified the normal intrasubject performance variability of four measures of phonatory function within and across sessions. Electroglottographic signals as well as aerodynamic measures were obtained from normal speakers on four different days. Relative intrasubject variability was compared across speaking task, gender, and vowel type. Average across-session intrasubject variability was 5% for the abduction quotient and compared favorably with variability of the other measures considered (5% for fundamental frequency, 8% for estimated subglottal air pressure, and 15% for mean phonatory air flow during syllable repetition). There was significantly greater intrasubject variability for abduction quotient (and mean phonatory air flow) for the sentence repetition task. There were no significant differences in intrasubject variability across gender and vowel type. The authors suggest that these normal data can be used for comparison when clinicians are assessing and monitoring the phonatory abilities of individuals with voice disorders. Abduction quotient was measured using procedures described by Higgins and Saxman (1991). Tables 1–4 and 1–5 allow inspection of Higgins, Netsell, and Schulte's data.

a. Inverse Filtering. Fritzell (1992) describes inverse filtering as a noninvasive acoustic method of producing a glottogram thought to reflect the vibrating motions of the vocal folds. The microphone signal of a sustained sound is passed through acoustic filters. These filters eliminate the formants and thus a graphic representation of voice source is available. It is depicted in the form of the glottal volume velocity waveform and is referred to as a flow glottogram. It provides information concerning the type of

Table 1-4. Intrasubject ranges (*R*) and coefficients of variation (*V*) of mean phonatory air flow (V_I), abduction quotient, (Q_a), fundamental frequency (F_0), and estimated subglottal air pressure (P_s) across 4 days for [pa] syllable repetition.

		V_I (cc/s)	Q_a	F_0 (Hz)	P_s (cm H_2O)
Males (*N* = 11)					
1	*R*	144-193	.42-.53	101-114	6.0-8.7
	V	13	10	5	16
2	*R*	97-175	.40-.50	93-102	6.2-6.4
	V	25	10	8	2
3	*R*	138-183	.38-.45	102-108	6.0-8.6
	V	14	7	3	7
4	*R*	211-261	.49-.54	97-104	6.4-7.3
	V	11	4	3	5
5	*R*	95-134	.43-.48	167-194	7.7-8.6
	V	14	6	7	5
6	*R*	157-213	.36-.46	98-108	6.9-10.6
	V	15	11	4	17
7	*R*	191-288	.49-.53	129-139	5.9-7.3
	V	17	3	3	9
8	*R*	159-237	.42-.45	125-137	6.6-9.4
	V	22	3	4	15
9	*R*	133-157	.41-.47	139-160	7.3-8.2
	V	8	5	6	5
10	*R*	127-180	.47-.52	104-122	4.6-5.9
	V	18	4	7	11
11	*R*	151-188	.49-.51	108-112	6.4-7.5
	V	10	2	1	7
Females (*N* = 10)					
1	*R*	91-148	.41-.50	175-192	7.9-8.5
	V	21	7	4	3
2	*R*	123-129	.51-.64	151-161	5.9-6.5
	V	2	10	3	5
3	*R*	208-223	.48-.52	200-208	5.2-5.9
	V	3	3	2	6
4	*R*	106-153	.55-.66	207-221	6.4-7.5
	V	16	8	3	7
5	*R*	84-144	.47-.51	190-192	6.2-7.0
	V	23	3	1	7

		V_I (cc/s)	Q_a	F_0 (Hz)	P_S (cm H_2O)
6	*R*	146–175	.44–.50	206–216	6.1–7.7
	V	8	5	2	12
7	*R*	87–138	.47–.51	190–192	6.2–7.0
	V	20	3	10	10
8	*R*	122–153	.42–.49	184–217	9.4–11.1
	V	11	7	7	8
9	*R*	84–133	.51–.58	209–237	6.3–7.8
	V	18	7	5	9
10	*R*	98–126	.51–.60	166–195	5.9–6.6
	V	11	7	7	5

Source: From Higgins et al. (1994). Aerodynamic and electroglottographic measures of normal voice production: Intrasubject variability within and across sessions. *Journal of Speech and Hearing Research, 37,* 38–45.

phonation, the sound pressure level, the regularity of vocal fold vibrations, and the presence or absence of vocal fold closure. Inverse filtering has been used mainly for research purposes (Higgins & Saxman, 1993) although it is becoming more popular as a clinical tool. It requires more complicated instruments and technical expertise than the electroglottograph, for example. Its present use is limited to sustained sounds in syllables such as /pe:/. Fritzell (1992) notes that the development of a normative data base and also the availability of computer programs for automatic inverse filtering and analysis would encourage more clinicians to use this type of glottogram.

b. Aerodynamic Measurements. Schutte (1992) emphasizes that the myoelastic-aerodynamic theory of phonation implies that aerodynamic factors are important in the evaluation of voice function. The vibratory pattern of the vocal folds is affected by subglottal pressure and airflow in concert with musculo-elastic laryngeal adjustments. If the subglottal pressure and the mean air flow rates can be meaningfully related to the magnitude of the power of the

Table 1-5. Group means (*M*), coefficients of variation (*V*), and ranges (*R*) for mean phonatory air flow (V_I), aduction quotient, (Q_a), fundamental frequency (F_0), and estimated subglottal air pressure (P_s).

		Syllables		*Sentences*	
		[pa]	[pi]	[pap]	[pip]
Males (*N* = 11)					
V_I	*M*	171	177	176	189
	V	21	18	18	23
	R	120-235	143-234	139-239	123-267
Q_a	*M*	.47	.48	.47	.49
	V	8	7	8	6
	R	.41-.52	.43-.53	.43-.53	.44-.54
F_0	*M*	120	125	121	126
	V	20	19	19	20
	R	100-177	101-181	95-181	97-192
P_s	*M*	7.1	7.2	6.8	7.0
	V	15	14	17	18
	R	5.3-8.8	5.5-8.8	4.1-8.2	4.4-8.7
Females (*N* = 10)					
V_I	*M*	135	132	124	126
	V	24	20	25	26
	R	110-216	101-183	96-200	91-195
Q_a	*M*	.51	.53	.51	.53
	V	10	9	9	8
	R	.46-.60	.45-.62	.44-.58	.47-.60
F_0	*M*	196	206	194	212
	V	10	10	11	11
	R	154-225	163-229	150-225	162-242
P_s	*M*	7.1	7.4	6.9	7.2
	V	18	20	20	19
	R	5.6-10.1	5.7-10.6	5.8-10.3	5.9-10.5

Note: V_I is expressed in cc/s, F_0 in Hz, and P_s in cm H_2O.

Source: From Higgins et al. (1994). Aerodynamic and electroglottographic measures of normal voice production: Intrasubject variability within and across sessions. *Journal of Speech and Hearing Research, 37,* 38-45.

sound that is produced, it may define vocal efficiency (Schutte, 1992).

Schutte (1992) reviewed the use of aerodynamic measures and their use in voice diagnosis. He noted that an intact larynx needs only a small amount of air to phonate, much less than is needed to support life which requires a tidal volume of 0.5l during quiet respiration. Schutte (1992) goes on to say that both the quantity of available air and the pressure of the air available for phonation, must be considered. Measures of vital capacity indicate the amount of available air for phonation. However, Schutte (1992) believes that even simpler clinical procedures also are effective. When a patient prolongs /s/ for as long as possible, useful information concerning the amount of available air, as well as control of the air, is obtained. To estimate the patient's ability to create sufficient air pressure, a patient could simply be asked to blow through a straw in a glass of water. Schutte (1992) emphasizes that if a patient is indeed too weak to phonate or does not have enough air to do so, he or she is not a candidate for voice treatment. Rather, such patients need treatment by a pulmonologist or a neurologist. The simple measures described above can be used to ascertain the need for such referrals.

(1) **Air flow rates** may be measured using methods such as pneumotachography and body plethysmography. Fine pressure differences which vary linearly with flow changes are measured using a pneumotachograph. The pressure differences are sensed by a pressure transducer. One disadvantage of this procedure is that, if a mouthpiece or mask is used, it affects the resonance characteristics of the vocal tract. Body plethysmography involves testing the patient in a closed chamber. The patient inhales and exhales through a connection to the outside air. The ventilatory volume is calculated by the way the thoracic and abdominal movements affect pressure changes within the chamber. The disadvantage of this method is that the equipment is expensive.

(2) **Subglottal pressure** may be obtained directly or indirectly. The direct method is invasive as a hollow needle

is placed in the subglottal space. This has obvious disadvantages for clinical use. The indirect measures available use either a balloon in the esophagus or a body plethysmograph with airflow interruption to determine alveolar pressure during voicing. Schutte (1992) provides specific information on these techniques and makes the following observations (p. 131).

(a) Subglottal pressure varies markedly with vocal intensity (2 cm H_2O to 100 cm HO).

(b) Depending on the laryngeal adjustments, the measured rate of airflow ranges between 50 ml/sec and 600 ml/sec, with a mean of about 100 ml/sec. Higher values also have been documented and variation probably is due to differences in experimental design.

(c) There seems to be no established relationship between airflow rate and sound pressure (or fundamental frequency).

(d) An increase in measures of vocal efficiency does not necessarily mean an increase in healthy phonation patterns.

(3) Schutte (1992) also discussed the use of **aerodynamic measures as part of the diagnostic process.** He believes that the value of the mean airflow has not proved to be useful or reliable. However, it may be useful in pre- and post-therapy testing to monitor the usefulness of both surgery and vocal training. Schutte (1992) cites studies in which decreased flow rates reflected improved glottal function following teflon injection into a paralyzed fold. Schutte (1992) compared data derived from 64 patients with different types of voice disorders with normative data. Some patients with vocal hyperfunction tend to have higher subglottal pressures than do normals whereas others (41%) had values that were indistinguishable from normals. Schutte (1992) also studied pre- and post-treatment differences with respect to aerodynamic measures. Before therapy for hyperfunctional dys-

phonia, patients demonstrated increased subglottic pressure but decreased airflow. Following therapy, he found decreased subglottic pressure but unaltered airflow values despite improved glottal efficiency. Schutte (1992) interpreted the findings as indicating an increase in the amplitude of vocal fold vibration due to the more relaxed patterns resulting from therapy.

(4) Tanaka and Gould (1985) listed the following results from a study **comparing voice disordered and normal subjects using plethysmographic measures.** Lower than normal vocal efficiency:

(a) **vocal fold paralysis** (high airflow/incomplete closure)

(b) **vocal fold tumor** (increased subglottic pressure and airflow)

(c) **infiltrative vocal fold growth** (increased stiffness with increased subglottic pressure)

Data on vocal tract aerodynamics during syllable productions have been reported by Netsell, Lotz, DuChane, and Barlow (1991). They used the method pioneered by Smitheran and Hixon (1981) obtaining recordings of intraoral air pressure (P_0) during the occlusion phase of voiceless stop consonants. Simultaneous recordings of pressure and mean volume velocity of laryngeal air flow (V) were obtained using a face mask. Netsell et al. developed speaking tasks and aerodynamic measures to reflect the laryngeal kinematics in valving the airstream during speech. They used the term laryngeal kinematics to include the articulatory function (abduction/adduction) for consonant production and the phonatory function for vowels. They varied the type of vowel as well as the rate of syllable production. Their finding that men and women use similar subglottal air pressure in speaking tasks agrees with the finding of Holmberg, Hillman, and Perkell (1988), who found that men and women maintain the same range of subglottal air pressure (4–8 cm H_2O). Their subjects were remarkably consistent with peak pressures varying no more than 0.5 cm H_2O from syllable to syllable. For all speaking tasks in Netsell et al.'s (1991) study, women generated significantly less mean volume velocity of laryngeal airflow than did men. Women also had higher laryngeal airway resistance than men and generated higher resistances on [pi] than on [pɑ]. Increased rate of syllable production appeared to result in only minor changes in the aerodynamic measures for both men and women.

Wilson and Leeper (1992) studied airway resistance in young adult adults and advocated use of separate norms for men and women. They also suggested that, when measures are made for clinical purposes, sound pressure levels or vocal loudness level should be specified. Their data, together with comparison data from other studies, can be seen in Table 1-6.

(5) Titze (1992) noted that **traditional methods of calculating glottal efficiency** were affected by dependence on fundamental frequency and intensity. He cited examples of how high-pitched, although strained, vocalizations generally will have better vocal efficiency values than low-pitched vocalizations. If F_0 and SPL levels are not specified and held constant in pre- and post-therapy testing, an improvement in glottal efficiency may simply reflect a different pitch and loudness. Titze (1922) also commented on the irony that a singer, for example, with a pressed voice, will have better glottal efficiency values (in aerodynamic terms) than if a slightly breathy, less injurious voice was used. He suggested that the traditional glottal efficiency calculation would be better if it allowed for an evaluation of contact stress and tissue trauma to provide a more realistic assessment. A global estimate of glottal efficiency would include levels of intrinsic and extrinsic muscle contraction, as well as a cost/benefit ratio for vocal health and longevity. The shape of the glottis, and its effect on aerodynamic measures, reflects changes in pitch and loudness more accurately than it reflects true glottal efficiency in terms of appropriate function (Titze, 1992).

Table 1-6. Descriptive data (mean, standard deviation) for R_{law} (cm H_2O/L/s), airflow (ml/s), and air pressure (cm H_2O) of normal subjects during syllable production. Results of the Wilson and Leeper study (1992) are shown together with results of previous investigations.

	R_{law}[a]		Airflow		Air Pressure	
Investigators	***Men M (SD)***	***Women M (SD)***	***Men M (SD)***	***Women M (SD)***	***Men M (SD)***	***Women M (SD)***
Smitheran and Hixon (1981)						
Normal pitch, normal loudness	35.7 (3.3)					
Shaughnessy et al. (1984)						
Normal pitch, normal loudness	34 (15)	44 (14)	209 (55)	140 (36)	7.1 (.83)	6.2 (.50)[b]
Leeper and Graves (1984)						
Normal pitch, normal loudness		38.3 (9.3)		200.4 (66)		6.4 (1.9)
Holmberg et al. (1988)						
Soft	23.6 (10.4)	29.5 (10.3)	250 (110)	170 (40)	5.1 (1.2)	4.6 (.8)
Normal	37.7 (16.7)	42.2 (8.1)	190 (70)	140 (30)	6.3 (1.4)	5.8 (.9)
Loud	48.6 (19.4)	60.9 (20.6)	200 (60)	150 (40)	9.0 (2.4)	8.2 (1.8)
Melcon et al. (1989)						
Normal pitch, normal loudness (25-yr. olds)	39.4 (6.4)					
Netsell et al. (1991)						
/pi/ (1.5 SPS[c])	31.7 (7.8)	42.6 (9.2)	192.9 (46.5)	127.1 (27.4)	5.9 (1.4)	5.3 (1.2)

(continued)

Table 1-6. *(continued)*

Investigators	R_{law}[a]		*Airflow*		*Air Pressure*	
	Men ***M* (SD)**	***Women*** ***M* (SD)**	***Men*** ***M* (SD)**	***Women*** ***M* (SD)**	***Men*** ***M* (SD)**	***Women*** ***M* (SD)**
Wilson and Leeper (1992)						
/pi/						
25% SPL	27.5 (21.6)	39.4 (18.3)	210.1 (96.2)	139.5 (60.1)	3.8 (1.1)	4.1 (1.5)
50% SPL	33.8 (19.3)	51.7 (31.1)	274.8 (92.9)	174.2 (47.4)	7.6 (2.8)	7.6 (2.9)
75% SPL	49.2 (26.8)	97.3 (69.5)	346.5 (130.3)	222.5 (108.8)	14.2 (5.4)	16.9 (6.6)
/bip/						
25% SPL	33.4 (17.6)	49.6 (20..9)	161.2 (67)	114.3 (31.9)	5.1 (1.8)	4.8 (1'.7)
50% SPL	37.3 (15.1)	83.4 (45.5)	236.2 (77.7)	148.1 (42.6)	7.8 (2.2)	10.2 (3.3)
75% SPL	51.9 (26.1)	114.4 (69.9)	381.3 (231.3)	214.6 (79.7)	14.9 (4.1)	19.8 (7.0)

[a] R_{law} = Laryngeal Airway Resistance (the ratio of air pressure to air flow). Wilson and Leeper suggest that separate R_{law} norms should be used for men and women. Specification of vocal loudness is also important if measures are used for pre- and post-therapy comparisons. The authors report the following values from a study by Holmberg, Hillman, and Perkell (1988): Men: soft *M* = 23.6 cm H_2O/L/S; normal *M* = 37.7 cm H_2O/L/S; loud *M* = 48.6 cm H_2O/L/S; Women: soft *M* = 29.5 cm H_2O/L/S; normal *M* = 42.2 cm H_2O/L/S; loud *M* = 60.9 cm H_2O/L/S.

[b] Estmated.

[c] SPS, syllables per second, SPL, sound pressure level.

Source: From Wilson, J. V., and Leeper, H. A. (1992). Laryngeal airway resistance in young adults. *Journal of Voice, 6*(3), 242.

c. Electromyography and Neurography

(1) **Electromyography (EMG)** is the study of electrical potentials generated in a skeletal muscle. Kotby et al. (1992) described laryngeal EMG and the theoretical basis for the technique. The electromyograph consists of an electrode system (either surface or needle electrodes may be used) which picks up the activity of laryngeal muscle fibers and feeds the electrical sign into a preamplifier and differential amplifier. The output is connected to a cathode ray oscilloscope, a loudspeaker, and a write out system. Modern computerized systems allow on-line monitoring as well as deferred analysis. Surface electrodes are used by voice clinicians for clinical purposes such as the recording of excessive muscle tension seen in hyperfunctional dysphonia. The surface electrodes cause no discomfort and are easily applied to the laryngeal surface area. However, they do not provide exact information about the action of the specific small muscles, but rather a signal of global activity in the laryngeal area. EMG can be used as a biofeedback technique during treatment.

(2) **Neurography (ENG)** is the study of the motor and sensory nerve conduction velocities and complements EMG (Kotby et al., 1992). For measurements of nerve conduction velocity, a supramaximal stimulus is applied to the nerve at two levels to provoke an evoked potential in the muscle. Such techniques can help localize the site and degree of peripheral nerve injury or detect neuromuscular disease affecting the larynx (see Appendix A). Research in the area of nerve reinnervation (Crumley, 1983) has employed EMG and ENG to measure results obtained.

3. Instrumental Analysis Profile

No one piece of equipment or computer program can make a diagnosis of a voice disorder. However, results gleaned from a variety of different measures of the vocal product provide patterns that allow inferences to be made concerning aerodynamic, vibratory, and vocal tract changes. The voice scientist or clinician obtains as much objective data as possible to ascertain physiologic and perceptual correlates. See Nittrouer, McGowan, Milenkovic, and Beehler (1990) for acoustic measures of male and female voices. A sample summary sheet used to record information appears in Figure 1-14. Also see Appendix A for additional forms and normative data.

4. Interpretation of Measures

Great advances have been made in methods of instrumental analysis in the last 25 years (Stempel, 1993). These advances in both technology and research methodology have resulted in many new insights concerning voice production. A summary of some of the most frequently used instrumental measures appears in Appendix A. However, the clinician who does not have the financial resources available to equip a laboratory or to buy pieces of expensive equipment need not feel at a disadvantage. It is important to remember that:

a. There is **no one instrumental measure that provides undisputed evidence of the nature of a voice disorder.**

b. **All measures have to be interpreted accurately,** and this continues to be a problem in relation to both instrumental and behavioral measures. Sufficient normative data are not always available.

c. **Standardization[3] of procedures** (and ready access to definitive normative data) is a problem which remains to be addressed.

d. All voice clinicians, even those with access to the most sophisticated laboratory equipment, must rely on **gathering many kinds of information from many different types of measures.** The clinician still has to integrate all findings and try to draw conclusions.

e. Instrumental measures may sometimes be **used to confirm what a clinician already hears in a voice.** However, there is always the risk that unnecessary measures will be made because the state of our knowledge about instru-

[3] For a detailed discussion of acoustic analysis procedures that could be standardized to enhance the assessment of laryngeal control, see Titze (1993).

Frequency characteristics within normal limits? Yes ___ No ___
Conversational F_0 = _____ Reading F_0 = _____ (males 100–150 Hz; females 180–250 Hz)
Total musical range[1] _____ Hz _____ semitones
Perturbation measures (see Baken, 1987) ___ normal range
___ too high ___ too low ___ vowel
Jitter _____ (See Nittrouer et al., 1990)
Circle unit used: PM Pitch analyzer; Visipitch; C-Speech;
Other ________________

Amplitude characteristics within normal limits? Yes ___ No ___
Conversational mean SPL = _____ dB (average conversational level = 75–80 dB [Baken, 1987])
Dynamic range (average maximum intensity minus minimum intensity = 65 dB) = _____ dB (produce /a/ at limits of range) minimum intensity = 50 dB; maximum = 115 dB (Coleman, 1977)
Perturbation measures suggest vocal fold instability? Yes ___ No ___
Shimmer = _____ (mean = .33 dB with .55 dB one S.D. above and .11 dB one S.D. below) (Also see Nittrouer et al. [1990])
* Data collected using consistent mouth to microphone distance of _______ inches
* Calibrated sound level meter (sustained vowel) Yes ___ No ___
* Circle unit used for analysis: Visipitch; C-Speech; Mirco Speech Lab; Other ________________

Spectral characteristics within normal limits? Yes ___ No ___
Vowel used? _____ It is important to use the same vowel for comparative purposes (a normal voice has identifiable harmonics and little or no identifiable high frequency noise)
Harmonic to noise ratio = _____
Interruptions in harmonic energy? Yes ___ No ___
Circle program used to make spectrogram: Kay Sonograph; Micro Speech Lab; Kay Elemetrics; RSL; DSPS Inc.; Mac Speech Lab; GW Instruments; Other ________________
Spectrogram attached? Yes ___ No ___

Movement patterns within normal limits? Yes ___ No ___
Inverse filtered acoustic waveform
AC flow = _____ (normal is 234 ml/sec.)
Min flow = _____ (normal is 101 ml/sec.)

(continued)

Figure 1-14. Instrumental Analysis Profile.

[1] Speakers typically use a range of about 2.5 ST around their average F_0 (Orlikoff & Baken, 1993). Many performers and some young persons have a total range of 3 octaves (Stemple, 1993). Also see Stone and Rainey (1991).

Electroglottogram[2] (EGG) indicates? ____________________
Unit used ____________
Comments ______________________________

Aerodynamic results within normal limits? Yes ___ No ___
Hyperfunction indicated? Yes ___ No ___
Hypofunction indicated? Yes ___ No ___
Airflow rates[3] for sustained /a/ = ____ mL/s (normal range for both adults and children = 80 to 220 mL/s; high air flows indicate inadequate vocal fold closure and low air flows may indicate obstructions minimizing glottal opening or excessive muscular tension during closure)
Glottal resistance (Subglottal pressure P_{sub}) divided by mean flow rate (MFR) = ________) (the higher the resistance the greater the closure)
Air pressure[4] (measured indirectly uing pa/pa/pa to estimate subglottal pressure) within normal limits? Yes ___ No ___ (4–8 cm H_2O for healthy young adults). (Also see Holmberg, Hillman, and Perkell [1988]; Smitheran and Hixon [1981]; and Netsell, Lotz, DuChane, and Barlow [1991]).

Figure 1-14. *(continued)*

mental analysis and what it contributes to the diagnostic process is still so incomplete.

f. **Referral and consultation** with colleagues remain important avenues for obtaining supplementary instrumental and behavioral analyses.

g. Appropriate **analysis and synthesis of diagnostic information** depends ultimately on *clinical,* rather than technological, knowledge and skill. For example, adequate knowledge about the physiologic processes underlying normal and disordered voice and the ability to marshall evidence are prere-

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[2] Petersen, Hoffman, Vandenmark, and Bankmeier (1993) reported that for /a/ and /i/, average EGG closed quotients were greatest for "pressed" voice. Although this was a preliminary study, high closed quotients in proportion to total cycle may correlate with hyperadduction (e.g., /a/ = −.61; /i/= 0.64).

[3] Normal ranges reported by Hirano (1989).

[4] See Baken (1987) pp. 300–301; Stathopoulos and Weismer (1985); Stathopoulos (1986); and Netsell, Lotz, DuChane, and Barlow (1991).

quisites for all clinical problem solving. Good diagnosticians know how to ask the correct questions and how to systematically find answers. No clinician should ever feel intimidated because he or she is unfamiliar with a particular piece of equipment.

h. **The clinician's job is to ask the right questions.** For example:

(1) What measures does it provide?

(2) What is the rationale for such measures?

(3) What can it tell me about this patient's voice?

(4) What are the norms for comparison purposes?

(5) What drawbacks do these measures (and the available normative data) have?

III. APPRAISAL

A. History, Background Information, and Observations

It is useful to have the patient (or the parent) complete a comprehensive history (see Appendix A) before the voice evaluation. Sometimes this form is mailed to the home prior to the interview. Alternatively, the patient is asked to complete the history questionnaire at the office prior to meeting with the speech pathologist. After a review of the history provided by the patient, the clinician is better prepared to explore areas that appear to be significantly related to an individual's specific problem. The interview itself is used to follow up on questions that emerge as a result of the written information already provided and to observe the patient's behavior, communicative skills, vocal strategies, and level of insight concerning the presenting problem.

1. **Ask leading questions** (see Table 1-7).

The clinician attempts to establish a comfortable, interpersonal environment (Rollin, 1987) so that the patient is as relaxed as possible in the interview situation. This provides

Table 1-7. Sample questions and prompts.

Tell me about your...
How does that make you feel...
Can you explain more about...
What does your spouse suggest...
Is that difficult for you...
Why do you think that...
What have you tried that helps...
Why do you believe that helps...
When did all this start...
When is your voice best...
Describe your typical day...
How would you describe your voice...
How would you like to sound...
What do your friends say...

an opportunity for the interviewer to observe the patient's overall communicative skill as well as specific vocal patterns. After a few minutes of general conversation, however, the clinician assumes a facilitative role so that the patient can do most of the talking. By avoiding questions that can be answered yes or no, and using followup questions, the clinician can elicit a more comprehensive picture of the patient's situation, feelings, and reactions.

2. **Use reflecting statements** (see Table 1–8).

When the patient describes his or her situation (or her child's situation), the clinician attempts to penetrate beyond the reporting of factual information to elicit feelings concerning the problem and others' reactions to it. All voice disorders affect interpersonal relationships to some extent, and interpersonal conflicts also may be diagnostically significant. Reflecting statements are used to mirror or echo the feelings that the patient seems to be expressing. No judgments are made, only simple paraphrases of the client's statements are offered in a warm, supportive manner.

Table 1-8. Sample of reflecting statements.

Your wife's comments were upsetting...
You seem to resent that...
It was a difficult period in your life...
You felt nobody wanted to help...
Your voice problem worries your mother...
It was hard on your family...
You think others pity you...
You don't feel comfortable talking to strangers...
The telephone frightens you...
Nobody seems to take you seriously...
You want to be more assertive...
You sound angry about that...
It is frustrating for you...
You lack confidence in yourself...
Depression is a problem...

3. **Observe nonverbal behavior** (see Table 1-9).

Visual clues provide important information concerning the patient's ability to function appropriately in social, family, and work contexts. The ease with which a person adapts to the interview situation and relates to the examiner is a barometer of self-esteem and social skills. Level of relaxation and general deportment provide clues about musculoskeletal tension and anxiety level. Head or hand tremors, breathing patterns, tightness of neck and jaw, facial expression, and gaze are also noteworthy signs of neurological involvement, tension, and depression.

4. **Listen to audible characteristics** (see Tables 1-10 and 1-11).

The patient's description of the disorder in his or her own words as well as the onset and development of the problem is especially helpful. Word choice and level of observational skill and insight can be noted. Additionally, the patient may be asked to demonstrate how his or her voice behaves when it

Table 1-9. Nonverbal behaviors/visual characteristics.

Inappropriate eye contact . . .
Mask-like face . . .
Tremors or rigidity . . .
Subvocalizations . . .
Postural deviations . . .
Excessive or repetitive movements . . .
Tics and mannerisms . . .
Hyperextension of jaw . . .
Strain in neck . . .
Minimal mouth opening . . .
Inappropriate facial expressions/emotions . . .
Mouth breathing . . .
Excessive saliva . . .
Physical signs of possible vocal abuse . . .
Dejection or lack of engagement . . .
Clumsy or poor coordination (fine and gross) . . .
Careless personal grooming . . .
Difficulty swallowing . . .

Table 1-10. Audible characteristics.

Vocabulary used to describe problem
Flow of words/pauses/rate/fillers
Emotionality in voice/tremors/breaks
Coughing/throat clearing/hard onsets
Repeated laughing/weeping/sighing
Jaw clicking/clenched teeth sound
Noisy breathing/stuffy nose
Sneezing/nose blowing/wheezing
Repetitive oral sounds (sucking, clicking)
Whining/complaining pattern
Excessive attempts to please/agree
Vagueness regarding details/memory lapses
Word-finding difficulties
Effortful/jerky/arrhythmic phrasing/spasms
Stridor (narrowed or intermittently blocked airway)

Table 1-11. Characteristics of onset and development of disorders.

Onset	***Characteristics***
Sudden	Trauma, infection, CVA, injurious inhalation, intubation, conversion reaction, severe allergic reaction
Slow	Degenerative neurologic disease, musculo-skeletal tension, vocal abuse and misuse, growths on folds, gastroesophageal reflux, chronic allergies

is particularly distressing. The patient should also be asked to rate his or her voice today. Is it better or worse than usual?

Other audible characteristics can provide clues concerning appropriateness of pitch, loudness, quality, vocal variability, and expressiveness. Signs of possible vocal abuse, neurological problems, emotional states, self-awareness, and dependency can also be noted.

5. **Note the consistency and variability of symptoms** (see Table 1-12).

The consistency and variability of symptoms are diagnostically significant. Frequently, patients with vocal misuse and abuse will report that their voices are worst after periods of intense use and/or at the end of the day. Similarly, patients with gastroesophageal reflux will report that their voices are worse first thing in the morning. When there is drainage and excessive pooling of secretions during the night, it may take some time for the voice to "clear" after the patient gets up in the morning. Seasonal hoarseness is usually related to allergic reactions which cause the folds to be swell (e.g., hoarseness during ragweed season). Some individuals who are particularly sensitive to cigarette smoke or recreational drugs may also report hoarseness after parties and visits to bars. "Weekend laryngitis" is common among college students who abuse their voices at games and spend time in bars celebrating afterwards. Alcohol dehydrates the system causing increased susceptibility to irritation. Premenstrual syndrome may cause cyclical edema of the laryngeal and nasal mucosa in some women. Fatigue and emotional stress also may increase the severity of voice symptoms and demonstrate a

Table 1-12. Consistency of symptoms.

Symptoms worsen when system fatigues
degenerative neurologic disease
vocal misuse
vocal fold polyp
Inconsistent symptoms in the early stage
vocal misuse and abuse
gastroesophageal reflux
musculo-skeletal tension
psychogenic dysphonia
Consistent symptoms following onset
recurrent laryngeal nerve paralysis
hemorrhagic polyp

fluctuating pattern. Periodic fluctuations in severity may also be reported by patients with chronic progressive development of musculoskeletal tension or psychogenic dysphonia. In such cases, the clinician can ascertain the contexts and conditions under which episodic remissions occurred during the development of the disorder. Degenerative neurologic diseases and large lesions that increase the mass of the vocal folds usually cause progressive deterioration of vocal function with more consistent symptoms across time.

B. Selection of Diagnostic Strategies

There is no gold standard for testing used in the diagnosis of voice disorders. Although there is considerable interest in the profession in developing standards for voice testing, this is still in the future. The current approach of choice that is adopted in differential diagnosis is perceptual evaluation confirmed by instrumental test results and consultation. The instrumental tests that are ordered depend on the availability of laboratory facilities and equipment; clinician training, experience, and preference; and the type of presenting problem. An otolaryngologic examination and, where possible, physiologic evaluation (e.g., videolaryngoscopy) are routinely obtained so that the laryngeal structures can be viewed.

1. Testing diagnostic hypotheses developed during the interview

As a result of the history and interview, the clinician usually develops some diagnostic hypotheses concerning the possible etiology of the voice problem. The risk factors that may contribute to the problem are noted, and a brief statement summarizing clinical impressions is developed. Consider the case information summarized in Table 1-13.

2. **Confirmation of clinical impressions: An example**

   By a process of elimination and hypothesis testing, the clinician is able to zero in on the signs and symptoms that support a final diagnosis.

   a. The first step in the voice evaluation involves a **check of how the voice is currently being used.**

   b. The next step will be to **see how stimulable the child is** (e.g., what changes can be made under various conditions).

   c. For **example,** William is severely hoarse and has periods of aphonia, so the clinician will first obtain a voice sample. Because William likes sports and video games, he

Table 1-13. Sample clinical impressions and summary.

William Boggs, age 8, is the youngest child of Mary and Henry Boggs. He has four older siblings and experiences severe hoarseness with periods of aphonia. His father is a cigar smoker and has a moderate bilateral hearing loss. Mrs. Boggs describes her son as "boisterous, loud, and aggressive." He enjoys sports, Cub Scouts, and video games. The medical report notes allergic rhinitis and vocal fold edema.

Etiologic Aspects	*Risk Factors*
Increased effort-swollen folds	allergies? cigars?
Excessive loudness levels	Father's hearing loss?
	noise level at home?
Psychosocial factors	"aggressive"
Hearing	family history; allergic rhinitis

Hypotheses

Vocal misuse/abuse — excessive tension
Mouth breathing/inadequate respiratory support
Inappropriate interpersonal skills
Inappropriate compensations secondary to chronic allergy
Reduced resonance

may be asked to tell the examiner about an exciting play or how to play a favorite game. A topic that elicits a representative sample of the child's voice use is best. Judicious prompts such as "and what happened then?" encourage spontaneity of expression. Audio recording of the voice examination (and video recording if possible) is essential for post-hoc analysis. The clinician will note signs that may be evidence to support or refute hypotheses. A listing of signs noted during the voice sample can be seen in Table 1-14.

3. Manipulation of key variables

a. William tried to vary his voice, primarily by increasing effort and loudness. **To observe** his **loudness range,** the clinician asked William to read from a chart. On the chart were the numbers from 1 through 10 with the size of the numerals denoting gradual changes in loudness. This task allows acoustic analysis of sound pressure level if a sound level meter is available and mouth-to-microphone distance is controlled. A simple response sheet (Table 1-15) with the numbers printed on it can be used to record perceptual impressions. Notations can be made concerning voice breaks, aphonic episodes, quality changes in relation to loudness levels, location of breaths taken, and level of tension.

b. To see whether William was stimulable in terms of contrastive loudness levels, the clinician presented him with

Table 1-14. Signs noted during voice sample.

Hard onsets	Rapid rate
Jerky phrasing	Minimal mouth opening
Few replenishing breaths	Noisy inhalations
Hyperextension of jaw	Aphonia on unstressed syllables
Visible tension in neck	Aphonia at ends of utterances
Throat clearing	
Strained laughter	
Minimal variability (except getting louder)	

Table 1-15. Loudness variation task.

1	2	3	4	5	6	7	8	9
							hard onset	
9	8	7	6	5	4	3	2	1
	hard onset							

number of breaths taken = 1

Aphonic on second syllable of "seven" and on "one two three."

Minimal loudness variation. Quality best when loud which is consistent with excessive laryngeal effort as a compensatory technique.

Date: November 26, 1993 Name: William Boggs

some evocative sample pairs (Table 1-16). Attempts to maintain continuity of air flow and evenness of vibration are noted on prolongations of /s/ and /z/. Maintenance of voicing on monosyllabic versus bisyllabic words is also observed. If the child's voice "cuts out" on unstressed syllables, it is further evidence of his need to adduct forcefully to accomplish voicing. This is characteristic of individuals with size/mass changes (e.g., nodules). Unfortunately, this strategy also exacerbates the laryngeal irritation.

c. William appeared to **understand the concept** of loudness variation as he attempted the contrastive pairs, but he used neck tension and increased laryngeal effort as his primary strategy. The clinician decided to experiment with humming and prolongation of voiced continuant consonants in order to shift his attention to a facial "buzz." She used the sensation of vibration of the lips to elicit the humming sound. This distracted William's attention away from his neck and proved helpful. She asked William to sustain the humming sound while she counted to five. With some coaching (a model and feeling the vibrations on his hand), William could sustain a hum for approximately 5 seconds without neck tension. The clinician next worked on prolongation of /z/ and used the cue

Table 1-16. Sample pairs used to evoke loudness contrasts.

whimper	YELL
insect	HIPPO
ant hole	CANYON
shush	BANG
sss	SSS
zzz	ZZZ

"rattle your teeth." Subsequently, prolongation of /v/ and /ð/ were achieved with appropriate facial "buzz."

d. William appeared to **continue speaking past the point when he needed to replenish his breath.** His inhalation was shallow, and tension was noted in the upper chest, shoulders, and neck. When he was asked to "take a deep breath," the tension was increased, and no movement of the lower chest occurred. As a result of his shallow inspiration, he was unable to prolong the expiratory phase of speech breathing. The clinician asked him to pull his chair up to the table so that his lower chest was touching the table edge. Then they practiced breathing in and out with lower chest expansion. The pressure of the table edge provided feedback which helped William concentrate on lower chest movement. The clinician showed William how to relax his neck and shoulders by watching himself in a mirror. William's responsiveness indicated that he was capable of modifying his respiratory patterns during voice production. A complete respiratory evaluation was not necessary in William's case. If he had suffered from a neuromuscular problem (e.g., cerebral palsy) or chronic asthma, referral for further respiratory evaluation would be indicated. Adults with chronic pulmonary disease (e.g., emphysema), degenerative neurologic disease (e.g., Parkinsonism) or who demonstrate severe shortness of breath or struggle behavior related to air intake should always receive a comprehensive respiratory assessment. Noisy breathing (stridor) always signals the need for medical consultation. Table 1-17 shows a summary of respiratory behaviors.

Table 1-17. Checklist of respiratory behaviors.

Patient Name: ______________________

Date: ______________________

Clinician: ______________________

History of pulmonary disease? Yes ☐ No ☐

Check items listed below if applicable:

- ☐ nasal blockage
- ☐ mouth breathing
- ☐ voice fades at ends of utterances
- ☐ insufficient replenishing breaths
- ☐ shallow inspiration
- ☐ short exhalation phase
- ☐ clavicular breathing
- ☐ observable tension in neck
- ☐ wheezing
- ☐ noisy inhalation
- ☐ snores at night
- ☐ tension at ends of utterances
- ☐ arrhythmic breathing
- ☐ exhales air before talking

Breaths per minute: ______________________

Additional Comments: ______________________

Referral for: ______________________

e. **Maximum phonation time (MPT)** is obtained as a measure of phonation during one exhalation phase of speech breathing[4]. At least three trials are given and timed with a stopwatch. The patient's MPT in seconds is compared with normative values (approximately 15-20 secs for adults; 10 secs for children). See the chart in Appendix A for specific values. This task usually involves prolongation of a single vowel /a/ in one breath. The task is also useful for

[1] The aim is to obtain as long a prolongation as possible and to make inferences concerning he closure and function of the folds during continuous vibration.

listening for continuity of vibration (note voice breaks, diplophonia, tremor). The degree of glottal efficiency demonstrated on this task can also be inferred. For example, conditions that impair glottal closure (lesions, paralysis or paresis) will result in breathy quality, rapid expenditure of available air, and reduction of duration of a sustained vowel.

(1) The **s/z ratio** (Eckel & Boone, 1981) is also used as a measure of respiratory and phonatory efficiency. Because /s/ is voiceless, the duration of this phoneme indicates the duration of the exhalation phase. When the /z/ is prolonged, it can be noted whether the vocal folds can sustain the vibratory pattern for approximately the same amount of time as the exhalation lasted for /s/. If /z/ is sustained a significantly shorter time, it is inferred that the problem is related to poor laryngeal control or lesions that increase mass.

(2) Decisions about a patient's glottal efficiency during continuous vibration are usually best made by **considering performance on MPT and the s/z ratio together.** This allows a more accurate behavioral assessment of the interaction between respiratory and laryngeal function. Stone (1983) discussed the drawbacks of MPT with respect to number of trials and the influence of the pitch used. However, MPT is used by most clinicians primarily as a vehicle to listen to the smoothness of continuous vibration, rather than only a maximum production measure. When this task is used in association with the s/z ratio, it provides additional useful information. It is also used as a stimulation activity to assess the patient's ability to modify behavior. Such was the case with William. If the prolonged vowel is used for acoustic analyses (i.e., jitter and shimmer), then vocal intensity must be controlled or accounted for in some way (Orlikoff & Kahane, 1991).

(3) As an **example,** William initially was able to sustain sounds for 5 seconds, but his responsiveness to suggestions for improved lower chest expansion increased the depth of his inhalation. Subsequently,

this deeper inspiratory pattern resulted in a longer MPT. A summary of William's speech breathing behaviors is provided in Table 1-18.

f. A **hearing screening** is an essential aspect of any voice evaluation (Table 1-19). This was particularly important for William because of the family history of hearing loss and the overloud voice levels he used, as well as the nasal congestion that was present. In William's case, however, the screening revealed hearing sensitivity within normal limits, bilaterally. This allowed the clinician to eliminate hearing loss as a possible etiologic concern.

g. **Evaluation of the pitch characteristics** of the patient's voice involves exploration of range, level, and stimulability.

Table 1-18. Speech breathing data.

Name: Wiliams Boggs **Date:** November 26, 1993

Type of inhalation: clavicular

Length of exhalation: 5 sec (3 trials)

MPT /a/ vowel: 5 sec (3 trials)

s/z ratio: 1.0 (3 trials)

Understands concept of lower chest expansion after training?
☐ Yes ☐ No

Improved length of exhalation phase after training?
☐ Yes ☐ No

Reduced observable tension after training?? ☐ Yes ☐ No

Number of replenishing breaths while counting = 1
(counted 1-10)

Comments: Mouth breathing — some nasal congestion but both nostrils clear and nasal resonance on hum when cued.

Recommendations:

1. Increase number of replenishing breaths during spontaneous speech.
2. Increase appropriateness of location of replenishing breaths during spontaneous speech.
3. Improve type and depth of inhalation during speech breathing.
4. Increase length of exhalation phase during speech breathing.
5. Reduce tension during speech breathing.

Table 1-19. Steps in diagnosis.

1.	Develop diagnostic hypotheses (using background information)
2.	Test hypotheses systematically to rule out sensory or physiological constraints (e.g., hearing test, visualization of larynx, medical examination, etc.)
3.	Evaluate voice function perceptually
4.	Explore possible modifications by shaping key behaviors
5.	Select instrumental analyses to confirm perceptual judgments (compare normative values)
6.	Schedule additional consultations and evaluations as needed

(1) For professional voice users, a phonetogram or **frequency *and* intensity profile** (see Appendix A) might be considered. However, this was not necessary, or practical, with a child such as William.

(2) William's evaluation included only the **pitch stimulation activities.** Because William was stimulable in all areas pertinent to his symptom reduction, it was recommended that he be enrolled in therapy to reduce abusive vocal behaviors. His treatment program included teaching him to use his vocal mechanism more appropriately and to use less injurious strategies to get and hold attention. Consultation with his physician resulted in medication to reduce allergic edema. Psychosocial changes were accomplished through family counselling (Rollin, 1987). A review of some popular evaluation strategies related to pitch is shown in Table 1-20.

h. Pitch and loudness are, of course, related. Measures of the average intensity during speech, in addition to intensity range should be obtained.

(1) **Acoustic analysis** using computer software or a dB meter may be employed to obtain measures of loudness in both conversation and during speech stimulation activities.

Table 1-20. Perceptual evaluation tasks versus instrumental measures.

Perceptual Evaluation Task	***Instrumental Measures***
1. *Total phonational frequency range:* ascending and descending pitch slides to establish lowest and highest pitch levels; scales played on an electronic keyboard; eliciting vocal fry and moving into the first musical note above it to determine basal pitch; producing a high squeak on the vowel (i) and modifying it into the highest musical note possible, including falsetto.	1. *Phonational frequency range* using computer software packages such as CSpeech.® Patient is asked to begin in midrange and sing up and down his or her available musical range during three trials. Matching highest and lowest note to a stimulus* note may be used by clinicians to cue nonsingers.
2. *Habitual pitch level:* Patient says the sentence "I live in Alabama__a__a" prolonging the final vowel. This pitch is matched with a note on the electronic keyboard. The patient is asked to say the days of the week and the stressed syllables are matched to notes. Tape record a spontaneous speech sample and stop the tape frequently and match pitch with notes on electronic keyboard or pitch pipe. Begin the matching process with a note that is near the expected level for the patient's age and sex (see Appendix A).	2. *Mean fundamental frequency* (F_0) obtained through standard acoustic analysis during reading and spontaneous speech samples. A low F_0 level (as compared to norms in Appendix A) may be related to the effect of vocal fold bowing, aging in females, Reinke's edema, or laryngeal granuloma (contact ulcer of the posterior cartilaginous portion of the folds). It is believed that habituation of an inappropriately low pitch level may cause the development of this type of lesion.
3. *Conversational range:* The patient is asked to describe the furniture in the examining room. From the taped sample, the clinician later matches the highest and lowest pitches used or makes perceptual judgments concerning variability.	3. *Frequency range during conversation speech* sample is obtained through acoustic analysis.
4. *Pitch fluctuations* during sustained vowels: Patient prolongs vowels (/a/ and /i/) for 10 secs, and pitch breaks are noted. Diplophonia (the perception of two pitches	4. *Pitch perturbation measures* are obtained during acoustic analysis of sustained vowels over three trials. Percent jitter and jitter ratios may be obtained to ascertain

(continued)

Table 1-20. *(continued)*

Perceptual Evaluation Task	*Instrumental Measures*
produced simultaneously) may occur if the false (ventricular) vocal folds are also vibrating or if vocal fold irregularities or mass changes are present. Hyperfunction and unilateral vocal fold paralysis may also cause diplophonia.	fluctuations or cycle-to-cycle variations in fundamental frequency.
5. *Pitch stimulability:* The patient is asked to maximize the contrast between the pitch levels of two contrasting words. The clinician observes the amount of variation. If the patient does not produce appreciable variation, the clinician provides a model and cues in an effort to note stimulability.	5. *Frequency differences* produced on contrastive word pairs are obtained by acoustic analysis of fundamental frequency levels for each word. A mean difference score is computed in Hz.
Sample contrastive pairs (randomize order) thud/squeak up/down high/low huge/teeny flute/drum	
6. *Pitch inflection:* The patient reads sentences reflecting pitch variation suggested by meaning. The clinician cues the patient before each item.	6. *Frequency contours* are obtained by acoustic analyses of sample utterances.
Sample items to elicit pitch variation	
cue: You are not sure (questioning)	1. It is a dinosaur?
cue: You are certain it is (statement of fact)	2. It is a dinosaur.
cue: Make your voice flutter	3. The bird's wings fluttered.
cue: Make your voice leap and fall	4. He leapt up and then fell down.
cue: Make a *very* cheerful "Hi"	5. She smiled cheerfully and said "Hi!"

* Stimulus tones may be given by using an electronic keyboard, pitch pipe, or digital metronome. A pocket-sized metronome (chromatic scale) is available from Seiko (DM-40) which also displays the frequency of the tone in Hz.

(2) The **relationship between pitch and loudness variation** is occasionally revealing (see Table 1-21). For example, low intensity associated with laryngeal inefficiency due to lesions may be more apparent at low frequencies than at high frequencies.

(3) It is important to control **recording conditions** carefully. For example, mouth-to-microphone distance, the testing environment, the type of voice sample, and the use of calibration tones when making recordings. Normative values for intensity (Bless, 1991) are noted on page 62.

Table 1-21. Diagnostic significance of limited voice variation.

Inappropriate or limited vocal variety (e.g., pitch and loudness changes) may be due to a number of etiologic factors.

deafness or hearing impairment
increased mass/stiffness of folds (e.g., lesion or scar tissue)
swollen vocal folds
neurologic disease or paralysis
depression/low self-esteem
tremors/spasms
excessive tension/elevated larynx

The ability to vary the voice only in certain ways is also diagnostically significant.

CAN make voice louder but not softer	Nodules, other lesions, or vocal fold irregularity that must be compensated for by forceful adduction
CAN produce high pitches but only occasional lower pitches	Hyperfunctional pattern — musculo-skeletal tension and elevated larynx; may also be seen in post-pubertal males with mutational falsetto
CAN produce only a soft, weak voice	Inefficient glottic closure; may be due to unilateral paralysis, neurogenic weakness, large mass lesions, bowed vocal folds, extreme scarring, psychogenic disorder or pulmonary disease

Intensity	**dB**	**SD**
Conversational speech	75–80 (+2 dB for children and males)	5.4
Maximum level	110	
Minimum level	50	
Available intensity range	60 or greater	

i. **Voice quality deviations** can occur because of noise or aperiodicity affecting the distribution of acoustic energy generated at or near the vocal folds. These are quality variations related to phonation. Resonance disorders, which are quality deviations due to supraglottal activity, will be discussed later.

(1) **Phonatory quality disorders are difficult to describe** because the terms used to describe them mean different things to different listeners.

(a) It is frequently suggested that **five- or seven-point rating scales** be used to judge the severity of quality disorders, although many clinicians prefer the simple three-point continuum denoted by mild, moderate, and severe levels of quality deviation. Aperiodicity of vibration, or noise in the signal, varies in distribution across the spectrum. Sometimes it is confined to specific frequency bands, and sometimes it is randomly distributed across the entire range.

(b) **Acoustic representations of spectral characteristics,** such as spectrograms, enable the clinician to identify the presence of noise in the spectrum. Signal-to-noise or harmonics-to-noise ratios are computed to ascertain the level of noise that is present in a given prolonged vowel.

(c) Another acoustic measure that is often used to estimate regularity of vocal fold vibration is **amplitude perturbation or shimmer.** Exact correlations between type of pathology and acoustic measures have not been established. Rather, the acoustic data are used primarily to confirm degree of disruption in the signal.

(2) **Judgments of the perceived quality of a voice sample will be affected by many variables** (Krieman et al., 1993). These include speaker characteristics; specification of standards; listener characteristics, including experience and training; the phonetic content of the material spoken or read; and the pitch, loudness, and rate. Pitch and loudness should be controlled during production of vowels during evaluation. With prolonged vowels, the choice of vowel (usually /a/, /i/, and /u/) also will affect the perception of quality. When samples of prolonged vowels are to be rated or analyzed post hoc, it is customary to use a segment in the middle of each of the sustained vowels that is digitized or dubbed from each successive trial.

j. Definitions of terms used to describe quality deviations

(1) **Breathiness** is the perceptual impression of excessive leakage of air during phonation. This implies that the folds are not completely adducted during the closed phase of the vibratory cycle. The degree of breathiness that is perceived will be related to the degree of closure. Bowing of the folds; irregularities of vocal fold margins; additive lesions (nodules, polyps, cysts, papilloma); asynchronous adduction of the folds (see Table 1-22); asymmetry in the vocal folds' vibratory patterns; anterior or posterior glottal chinks; unilateral paralysis of a fold in the abducted position; dislocation of an arytenoid cartilage; granuloma; edematous folds; and vocal fold weakness, such as that occurring in patients with degenerative neurologic disease, can be associated with a breathy phonatory pattern (see Tables 1-23 and 1-24). Severe breathiness or aphonia, is characterized by complete absence of sound.

(2) **Hoarseness** is perceived in a voice when there is leakage of air as well as aperiodicity of vibration (noise)

Table 1-22. Characteristics of voice tremor.

Laryngoscopic Evaluation During Vowel Prolongation

Folds may rhythmically adduct and abduct with pitch rising during adduction and falling during abduction.

In severe cases, when folds adduct completely along the midline, voice arrest occurs.

Disorders Associated with Tremor

Organic essential tremor occurs only during volitional acts. It is an intention tremor. Alcohol may reduce it. May affect pharyngeal and laryngeal areas completely or be confined to the folds.

Parkinsonism tremor occurs at rest. It is a nonintentional tremor.

Psychogenic tremor can be precipitated or aggravated by stress in the same way as neurologic tremor can be.

Tremor associated with spasmodic dysphonia occurs intermittently (4-5 Hz) during abduction (SDAB) or adduction (SDAD).

Severity

Mild: Tremor occurs intermittently on vowels in every few sentences.

Moderate: Intermittent occurance of tremor during every sentence. Occasional effects on intelligibility.

Severe: Consistent occurance of tremor on nearly every word with decreased intelligibility.

present in the signal. When the adduction of the vocal folds during the closed phase of the vibratory cycle is incomplete and the mass of the folds is increased in a way that results in an irregular vibratory pattern, hoarseness is heard.

(a) **Hoarseness is the most common voice symptom** and occurs in conjunction with a great many etiologies. It may be permanent or transitory, depending on the nature of the laryngeal changes. Some laypersons use the term "laryngitis" when they mean hoarseness that occurs as a result of an upper-respiratory tract infection. The suffix "itis" merely refers to an infection or inflammation of

Table 1-23. Pathologies associated with incomplete glottic adduction.

Neurogenic Lesions	Neurologic with Intermittent Vocal Fold Hyperabduction
Unilateral Xth cranial nerve lesion	Essential tremor
Bilateral Xth cranial nerve lesion	Abductor spasmodic dysphonia
Neurologic Diseases	**Psychogenic Etiology**
Parkinsonism	Psychogenic dysphonia
Myasthenia gravis	Conversion aphonia
Frontal lobe disease	Globus hystericus
Apraxia of phonation	Mutational falsetto
Mass Lesions	**Other Causes**
Nodule	Bowing of folds (heavy use/age)
Polyp	Sulcus vocalis
Cyst	Laryngeal web
Carcinoma	Dislocated arytenoid
Hematoma	

Note: 1. Lesions that cause glottic incompetence will also result in increased air flow rates measured objectively. Mean flow rates for children and adults average 89-141 ml/sec with a range of 72-200 ml/sec (Hirano, 1981a).

2. Verdolini (1994) reported that laryngeal diadochokinetic rates for glottal plosives provide a gross measure of neurological laryngeal function. Patients with paralyses exhibit weak and/or slow repetitions. Patients with non-neurological phonatory disorders exhibit normal rate, strength and consistency on the L-DDK task.

3. Older patients with impaired motor or sensory function may present with a pattern that is characterized by both glottic inefficiency and dysphagia.

4. Tanaka, Hirano, and Terasawa (1991) discuss the usefulness of various measures of airflow.

Source: Adapted from S. Tanaka, M. Hirano, and R. Terasawa, 1991. Examination of air usage during phonation: Correlations among test parameters. *Journal of Voice, 5,* 106-112.

Table 1-24. Pathologies associated with hoarseness.

Conditions Causing Hoarseness	
Nodules	Reinke's edema
Polyps	Nonspecific laryngitis
Cysts	Keratosis
Papilloma	Leukoplakia

Hoarseness with Pitch Change

Pitch Decreases	Pitch Increases
Large mass lesions	Pathologies and anomalies
Polypoid degeneration	Laryngeal web
Nodules	Sulcus vocalis
Carcinoma of fold	Glottic and supraglottic carcinoma
Endocrine conditions	Endocrine conditions
Hypothyroidism	Immature larynx
Virilization	
Acromegaly	
Trauma/irritation	Surgical procedures
Hyperplasia	Vocal cord modulation (surgery to adapt the vocal folds of male to female transsexuals)
Contact ulcer/granuloma	
Reinke's edema	
Acute laryngitis	
Psychogenic factors	Psychogenic factors
Chronic stress/anxiety	Conversion dysphonia
Vocal image/inappropriately low level	Mutational falsetto
	Immature voice image

Sex Influences

Hirano, Tanaka, Fujita, and Terasawa (1991) summarized the effect of pathology on habitual frequency and indicated differences related to sex. For example, habitual F_0 was significantly high in his sample only for males with sulcus, glottic, and supraglottic carcinoma and mutational falsetto. No disease groups affected F_0 in females. F_0 was significantly low for acute laryngitis and Reinke's edema in males and for acute and chronic laryngitis, nodule, polyp, Reinke's edema, sulcus, cyst granuloma, carcinoma, paralysis, and hyper- and hypofunctional dysphonia in female patients.

the larynx and does not suggest causation. When the cause of hoarseness is unknown, or there is generalized erythema (redness) and swelling of laryngeal structures, the term "nonspecific laryngitis" is sometimes applied. Hoarseness is sometimes related to the presence of excessive or thick secretions in the vocal tract, and the term "wet hoarseness" may be used to suggest this. The aperiodicity of vibration appears to be related to thick mucus on the folds or stranding between them. Coughing and throat clearing exacerbate the irritation of the laryngeal mucosa in such cases. Severe hoarseness is usually accompanied by voice breaks or aphonic episodes during connected speech.

(b) Bastian, Keidar, and Verdolin-Marston (1990) reported on the use of softly sung staccato, legato, and trilled phrases at high pitches in falsetto register (males) as a **method of detecting vocal fold swelling.** This "high-quiet" singing (e.g., opening phrase of "Happy Birthday") resulted in delayed phonatory onset, discontinuous voicing and difficulty producing a quiet voice if patients had increased vocal fold mass. The subjects' productions were rated on an ordinal scale with 1 = extreme symptoms and 10 = normal vocal behavior. All subjects who received scores of 1 through 4 were found to have some impairment of the membranous folds.

(c) Woo, Colton, Casper, and Brewer (1991) described the **usefulness of laryngostroboscopy** in the examination of hoarse patients. However, they noted that a patient must have a relatively periodic acoustic source to pace the stroboscopic light. Thus, patients with severe aperiodicity are poor candidates for stroboscopy.

(3) Harshness is perceived in a voice when there is excessive effort, tension, and constriction in the vocal tract (see Table 1-25). Aperiodicity of vibratory pattern is diffused across the spectrum. Hard onsets, visible ten-

Table 1-25. Conditions associated wtih strained, effortful, vocal fold hyperadduction.

Aronson (1990) notes that strained effortful voice can result from hyperadduction of the true and false folds.

Neurologic etiologies

organic (essential tremor)
orofacial dyskinesia or dystonia*
adductor spastic dysphonia

These extrapyramidal diseases can occur singly or together and spastic dysphonia (adductor type) may be the first sign, but other signs will appear as the disease progresses.

Psychogenic etiologies

conversion reaction
musculo-skeletal tension
adductor spastic dysphonia

Onset: Between 40 and 50; slow appearance of symptoms; frequently, stress is associated with the onset of both the neurogenic and psychogenic types.

* Adductor spastic dysphonia is used to describe dystonia that occurs only in the larynx. When contractions occur in other speech muscles as well, it may be referred to as hyperkinetic dysarthria (Mayo Clinic classification system; see Aronson, 1990).

sion, overadduction of the folds (which is heard as a tight or pressed sound), and a grating or unpleasant "edge" in the voice may be noted. Staccato or jerky phrasing also may be present. Harsh vocal quality is frequently the result of inappropriate learned behaviors or compensatory strategies. It may be associated with vocal abuse, misuse, structural alterations in the larynx, and compensations for neurologic deficits. Some clinicians believe that personality attributes and conflicts also contribute to constriction of the acoustic tube and result in harsh quality.

(4) **Vocal fry or pulse register** is a relaxed syncopated vibratory mode that is produced below the lowest note of the musical pitch range (basal pitch). A subharmonic frequency, below about 70 Hz, is perceptually dominant. Vocal fry often is likened to the sound of popcorn popping or a door creaking. Occa-

sionally, all speakers drift off into fry at the ends of sentences, especially when they are tired. When a speaker uses an habitual pitch that is too close to basal pitch, many downward inflections may dip into the fry register. This is not harmful, but it does destroy the perception of smoothness and musicality in the voice. The frequency with which fry occurs and the location (end of breath group or sentence) is noted during evaluation (see Tables 1-26 and 1-27).

Table 1-26. Materials for evaluations of vocal quality (vowels and voiceless consonants).

Words	***Sentences***
Pepsi	Patty eats potato chips
shifty	Put Sasha's two fat cats out.
shoot	See Hettie's tic-tac-toe set.
tasty	She shouts out at ships.
tissue	Tape up Pete's tepee tip.
petite	Cats eat thick icy fish sticks.
fate	Pick up Pat's hat.
kiss	
fifth	
sheets	
shut	
chops	
push	
pity	
cheat	
shush	
pipe	
pace	
teeth	

Note: The words and sentences in this table are composed of vowels and voiceless consonants. When a person with a breathy voice quality reads these lists, the perception of breathiness will be more marked. Additionally, these materials can be used as facilitating words and sentences for patients needing to reduce adduction of the vocal folds. Cue speakers to breathe out on the words to reduce laryngeal constriction if you are seeking to modify tense production during diagnostic stimulability activities. Ask the patient to hold his or her hand in front of the face to feel the air flow.

Table 1-27. Materials for evaluation of quality (vowels and voiced consonants).

Words	***Sentences***
Zionsville	Vivian lives in Evansville now.
Merrillville	The lions were lying in the zoo.
lovely	Maizie mows the lawn in the morning.
evening	Rosie was born in Manila.
morning	Naomi is Joan's mom.
running	Wayne is as wise as an owl.
neon	Lemon jam is oozing all over the jar.
longing	Ron, move my lawn mower.
realize	Lillian is always whining.
lazily	Your new winery is lovely.
normally	
reasoning	
rising	
zulus	
Maui	
Miami	
usually	
New Orleans	
aluminum	
minimum	
ringing	

Note: The words and sentences in this table are composed of all voiced sounds and lend themselves to chanting, smoothness, and increased duration. These are useful materials to observe if a patient can keep the voicing going continuously across words and sentences. Listen for devoicing of phonemes, and cue the patient to blend the words together to avoid hard onsets on words that begin with vowels. Emphasize the "facial buzz" to shift effort and tension from the larynx if you are trying to encourage the patient to reduce laryngeal effort. To decrease a perception of breathiness or hoarseness, suggest that the speaker linger on the sonorous consonants.

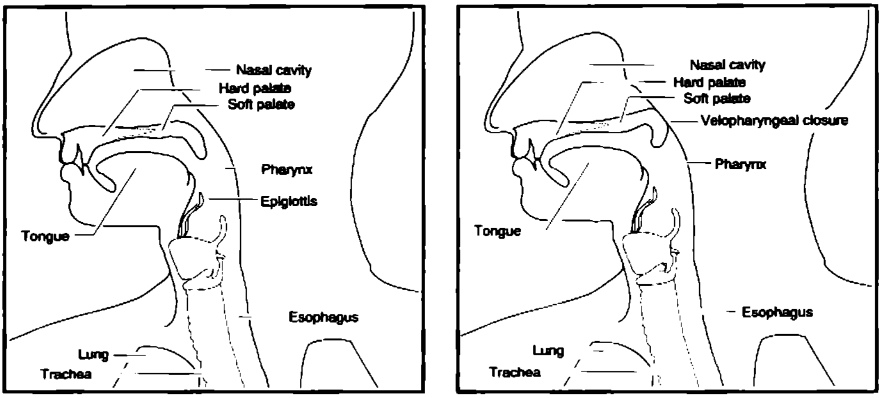
(5) **Hypernasality** is the term used to describe the deviation in quality that is perceived when there is inappropriate or incomplete velopharyngeal closure and excessive nasal resonance. Inadequate velopharyngeal closure affects the ability to maintain the appropriate oral breath pressure necessary to produce plosives and fricatives. Thus, nasal emission of airflow

on non-nasal sounds and weak or absent pressure-dependent phonemes are articulatory signs that, in association with hypernasal voice quality, usually indicate velopharyngeal inadequacy. Clefts of the palate, submucous clefts, inadequate velopharyngeal sphincter structure or function, and neurological deficits that impair cranial nerves IX, X, and XI may be etiologically significant.

(a) **Velopharyngeal closure** is a sphincteric action which occurs when the velum is raised by the movement of the paired levator and tensor palatini muscles. The velum makes contact with the posterior pharyngeal wall which sometimes can be seen to bulge inward. This bulge is known as Passavaunt's pad. As well as inward movement of the pharyngeal wall, there is also lateral movement of the wall as the pharyngeal constrictor muscles assist in closing the velopharyngeal port. There appears to be more active movement of the velopharyngeal sphincter during non-nasal consonant production than for vowel production. On vowels, there are various degrees of closure, with a greater degree necessary for the production of high vowels, /i/ and /u/, than for low vowels. See Figure 1-15 for a diagram of structures. When the velum is too short and/or immobile, it fails to make effective contact with the posterior and lateral walls of the pharynx, and air and sound escape into the nasal cavities. This is described as velopharyngeal inadequacy.

(b) **Velopharyngeal incompetency** describes partial or total paralysis of the muscles of the velum (levator and tensor palatini) and the pharyngeal wall (pharyngeal constrictors). The structures may appear to be adequate, but they do not function appropriately to achieve closure because of neurologic factors.

(c) **Velopharyngeal insufficiency** describes structural deficits frequently caused by inadequate development or post-surgical tightness. There is insufficient tissue, or the distance between structures



A B

Figure 1-15. Drawings illustrating an open (**A**) and closed (**B**) velopharyngeal port. (Jim Hull, Graphic Services, Indiana University)

is too wide (e.g., velum and pharynx), for functional closure to be accomplished. Compensatory movements, for example, pharyngeal wall activity, or the in-bulging of Passavaunt's pad, are noted as positive prognostic signs. These signs suggest that if a secondary surgical procedure (e.g., a pharyngeal flap) or a prosthetic device could be provided, the patient may be able to use it effectively to achieve closure. Examples of structural defects causing velopharyngeal insufficiency include the sequelae of cancer surgery or traumatic injury, post-surgical limitations resulting from primary repair of a cleft palate or secondary revision procedures such as pharyngeal flap or from an adenoidectomy, and unrepaired congenital clefts of the palate (overt, submucous, or occult).

(6) **Inadequate velopharyngeal function** can be inferred when the speaker's voice quality is hypernasal and articulation is affected in specific ways.

(a) **Vowels** are hypernasal, and the perception of nasality is greater on high vowels, such as /i/ or /u/, because they require a greater degree of closure.

The nasalization of vowels does not, however, affect recognition of the vowel. Increased mouth opening also may reduce the severity of the perceived nasality of vowel sounds. See Table 1-28 for ways to elicit vowel samples.

(b) Consonants present problems because they require more intra-oral air pressure. Generally speaking, the following signs will be noticed when a phonemic analysis is made.

(i) Fricatives and affricatives will be absent or weak with /s/ being particularly difficult and most vulnerable to distortion.

(ii) Plosives are next difficult in terms of reliance on oral breath pressure and substitution errors occur frequently on stop plosives. Breathed plosives are more difficult than their voiced cognates. For example, /b/

Table 1-28. Materials to elicit samples of vowels.

Sound	*Words*	*Sentences*
(ɑ)	Ollie	Harry, roll away.
(u)	Lulu	Val, lie here.
(eɪ)	ray	Hoe early Lulu.
(a)	hah	Heave ho, Ray!
(i)	hee	
(ou)	hoe	
(aɪ)	lie	
(au)	vow	
(ɜ̂)	her	
(æ)	Val	
(ɪ)	hill	
(e)	hell	

Note: The vowels are presented in conjunction with oral, low pressure consonants. By asking the patient to open the mouth and prolong the vowel sounds, the clinician can make perceptual judgments concerning the nasal quality of vowels in facilitating oral contexts.

may be produced with more ease and less nasal emission than /p/.

(iii) More **errors and substitutions will occur when high-pressure consonants occur in blends** than in isolated sounds and CVCs.

(iv) Patients with **borderline velopharyngeal inadequacy** may produce all high-pressure sounds correctly in isolation and in single words but have difficulty with high-pressure consonants during connected speech. This is a subtle, but nevertheless, diagnostically significant, sign that warrants patient referral for in-depth physiological testing (e.g., nasoendoscopy).

(c) **Additional errors** that may be demonstrated by individuals with velopharyngeal inadequacy are diagnostically significant. They reflect the speaker's attempts to compensate for inadequate closure. When these signs (see Table 1-29) are noted, the clinician should always arrange for further testing so that the adequacy/inadequacy of closure can be documented physiologically. Often this can be arranged by referral to experts on a medical center cleft palate team. Special training and the availability of equipment should be considered when referrals and consultations are sought.

Table 1-29. Additional signs of velopharyngeal inadequacy.

Nasal emission of air	Nasal snort (posterior nasal friction)
Nasal grimace	Palatalization/lateralization of sibilants
Wrinkling or movement of nares	Glottal stops (plosive produced at vocal fold level)
Substitution of a nasal for a high pressure phoneme	Pharyngeal stops (compensation for /k/and /g/
Mid-dorsum palatal stop as substitution for /t/, /d/, /k/, or /g/ made in the same location as the /j/ glide	Pharyngeal fricative (friction produced in the pharynx)

(i) **Videofluoroscopy** and **fiberoptic nasopharyngoscopy** confirm trained auditory perception by providing a visual image of structures, size and shape of the velopharyngeal port, movement, timing, activity of pharyngeal wall, and extent of closure.

(ii) A number of **noninvasive aerodynamic protocols** (AEROS) and accelerometric devices, such as the Honc and Nasal Vibration Analysis (NVA), are used for testing velopharyngeal adequacy.

(d) **Sample materials** for the behavioral evaluation of velopharyngeal inadequacy are provided in Table 1-30.

Table 1-30. Sample materials for behavioral evaluation of velopharyngeal inadequacy.

Sound	***Words***		***Sentences***
/tʃ/	choke	peach	A pitcher of chopped ice chips.
	chop	ditch	We see three geese.
	cheese	beach	Charley eats potato chips.
	butcher	teacher	The dishwasher washes dishes.
/ʃ/	shut	push	Biscuits are served at breakfast.
	shoe	bush	The gidget cars zigzag by.
	sheet	fish	Gophers dig up the seed beds.
	dishes	washer	Please fish for five catfish.
/s/	sea	face	Cook eggs for Dottie's kids.
	saw	rice	Bobby buys a baseball cap.
	sit	horse	
	passes	seesaw	
/z/	zoo	pays	
	zip	bathes	
	zit	pigs	
	laser	razor	

Note: The words and sentences listed here allow the clinician to select examples of high pressure consonants in combination with various high and low vowels. All of the sounds are oral, since no nasal consonants are included. Gently occlude first both nostrils and then alternate nostrils to listen for changes in perceived nasality and intelligibility. If there is a marked positive change in the production when both nostrils are occluded, it is a sign of velopharyngeal inadequacy, and the patient should be referred for specialized medical evaluation.

(7) A "blocked" voice quality, "stuffy nose," or denasal voice quality is described as **hyponasality.** The direct (/m/, /n/, and /ŋ/) nasal resonance as well as the indirect nasal resonance that occurs in a normally balanced resonance pattern is lessened or absent depending on the severity. An effective vocal quality depends on a pleasing balance between oral, direct nasal resonance on the three nasal consonants, and indirect nasal resonance due to reverberation of the sound in the bony cavities of the head (e.g., sinuses). Hyponasality may occur because of faulty learning (e.g., in conjunction with hearing impairment); however, the majority of cases require medical intervention in addition to hearing evaluations.

(a) When the nasopharynx and/or nasal passages are obstructed, the timing of velopharyngeal closure is affected (e.g., the port may be partially or completely closed) and restricts the transmission of the vibrating column of air. The **most common reasons for persistent hyponasality** include:

(i) Excessive and/or thick secretions due to chronic allergies or infections.

(ii) Swollen membranes lining the nasal passages and cavities that block free passage of air.

(iii) Congenital or acquired (e.g., broken nose) structural deviations of the nasopharynx, nasal septum, or sinus cavities.

(iv) Growths such as nasal polyps.

(v) Enlarged adenoids that impinge on the opening to the eustachian tube (middle ear infections may result) and impede mobility of the velum.

(b) **Diagnostically significant signs of nasal obstruction** include:

(i) Inability to sustain a humming sound or a weak humming sound that fluctuates.

(ii) Articulatory substitutions such as b/m, d/n, and g/ŋn.

(iii) No variation in the perceived quality of the voice during production of the sentence "No one knows Norman's name" when nostrils are compressed and released.

(iv) Observable signs that indicate severely enlarged adenoids. The facial signs are sometimes seen in a cluster that is labeled "adenoidal facies" in children.

swollen bridge of nose

mouth breathing

pallor and fatigue

dark circles under eyes

changes in hearing thresholds

diminished concentration

inward movement of nostrils during attempts to inhale through nose

nasal discharge

slow eating habits (can't breathe through nose while eating)

frequent school absences

(c) **Sample materials** for behavioral evaluation of obstructed nasal resonance are provided in Table 1-31.

(8) **Other terms** are sometimes **used to describe the quality of the voice related to the resonance characteristics** that are perceived. Usual descriptors are:

(a) **Mixed resonance pattern.** Occasionally, a listener will be puzzled, because a speaker seems to

Table 1-31. Sample materials for behavioral evaluation of obstructed nasal resonance.

Words	*Sentences*
mini	My name is Mervyn Millman.
nylon	Gongs ring "bong, bong, bong."
murmuring	No one knows Nanny's Mom.
kneeling	Melanie's home is in Alabama.
Armenian	Newell Moran is a naval man.
	Molly's animals are mainly mammals.
	Manuel was mesmerizing Maureen.

Ask client to:

Breathe in with mouth closed

Hum "Happy Birthday" as loudly as possible

Chant (stretch out) the words on the list

Read each sentence twice, holding the nose the second time

Note: These materials are loaded with nasal consonants and sounds that facilitate chanting and maintenance of continuous vibration. As the clinician attempts to shape the patient's responses, it will be helpful to ask her to place her hands on her face in order to observe whether tactile cues can be used to elicit increased nasal resonance.

demonstrate signs of both hypernasality and hyponasality. This can occur as the result of a temporary change, such as nasal congestion, in an individual with velopharyngeal inadequacy (e.g., cleft palate). It also may occur following removal of the tonsils and adenoids (T&A) for about 6 weeks while a child readjusts to changes in the mechanism. If a submucous cleft is unmasked following tonsillectomy and adenoidectomy, nasal escape, difficulty with pressure consonants, and other signs of velopharyngeal inadequacy may occur simultaneously with some previously learned habits that suggest obstructed speech. It is crucial to make sure that children who are scheduled for T&A receive a careful examination prior to surgery. A swollen adenoidal mass may be used as a necessary part of the velopharyngeal closure mechanism and cause a submucous cleft to be undetected. After surgery, it may be unmasked if a prior examination is not performed.

(b) **Assimilated nasality** occurs on vowels because of the influence of adjacent nasal phonemes. This inconsistent quality variation is commonly heard in many regional speech patterns. It is not considered to be a disorder and is not usually addressed in treatment unless a speaker or singer has professional voice goals that preclude it. For example, a classical singer or actor may wish to eliminate assimilated nasality, whereas a country and western singer may choose to emphasize it. (See Table 1-32 for sample materials for evaluation of assimilated nasality.)

(c) **Cul-de-sac resonance** is sometimes described as muffled or hollow oral resonance. The voice seems to echo in the back of the mouth cavity. The soft tissues in the oropharynx do not "brighten" the voice in the same way as the teeth and hard palate do when the sound hits structures in the front of the mouth. Some of the reasons that have been suggested to explain this pattern include:

(i) Excessive tension in the muscles of the pharynx.

Table 1-32. Sample materials for evaluation of assimilated nasality.

Isolated Vowel	*No Nasal*	*Nasal Before*	*Nasal After*	*Two Nasals*
u	spook	noose	spoon	moon
i	leaf	knees	lean	mean
au	foul	now	gown	noun
ɔ	horse	nor	horn	Norm
eɪ	ate	mate	aim	main
ɪ	fish	mitt	fin	min
ou	dole	mole	groan	moan
æ	cat	mat	can	Nan
aɪ	I'll	my	I'm	nine
e	pet	net	ten	men

Note: To listen to the vowel quality and note the influence of context, the clinician may select words from this chart for a patient to say. To cue for increased orality, the clinician should suggest dropping the jaw and separating nasals from vowels.

(ii) Tension and retraction of the tongue.

(iii) Failure to project the vibratory column of air forward to the front of the mouth.

(iv) Inadequate mouth opening and lip and tongue tip movement.

(v) Sensory deficits, particularly hearing loss.

(vi) Nasal polyps.

(vii) Deviated septum.

(viii) Craniofacial anomalies.

(d) **Asthenic voice** with a weak "thin" resonance pattern may be described as a quality disorder in some individuals who seek assistance in developing a more authoritative voice pattern. Associated characteristics may include:

(i) An elevated habitual pitch level and limited inflectional patterns in the lower portion of the range.

(ii) Exaggerated or stereotypical inflectional patterns in the upper portion of the range.

(iii) Forward carriage of the tongue that interferes with vowel resonance.

(iv) An imbalance of oral and nasal resonance.

(v) Atypical duration characteristics (e.g., vowel length).

(e) **Inconsistent voice quality variations** are noteworthy when a change in the voice is correlated with fatigue. If normal voice and speech patterns are demonstrated when the mechanism is rested, but deterioration of function occurs after relatively short periods of stressful sustained use (prolonged rapid reading or counting), it may signal a neurogenic disorder (e.g., myasthenia gravis).

(i) **Signs that indicate progressive muscular weakness** are indicative of neurologic disease such as Parkinsonism or myasthenia gravis:

Reduced loudness (this can also occur in conjunction with other causative factors);

Voice tremor during vowel prolongation (see Table 1-22);

Changes in diadochokinetic rates for /pʌ/, /tʌ/, /kʌ/;

Loss of pitch and loudness variability;

Hypernasality;

Articulatory imprecision;

Weak cough.

(ii) Limited vocal endurance or deterioration in laryngeal quality as a function of use or fatigue also may occur in conjunction with:

Vocal misuse and abuse;

Laryngeal elevation with excessive tension in extrinsic and intrinsic laryngeal musculature;

Weak adductory action of the membranous folds (older men);

Insufficient sleep and rest;

Dehydration and alcoholism;

Systemic disease (see Appendix A).

IV. SUMMARY

In this chapter many of the approaches used to assess and diagnose voice disorders were reviewed. To date there is no gold standard for instrumental testing for the presence of a voice disorder, but an array of measures is used to supplement clinicians' trained, perceptual judgments. However, a clear understanding of the physiology of voice production is mandatory to make inferences concerning deviant production. The voice clinician uses data obtained from the case history, visualization of structures, and behavioral and instrumental measures to test etiologic hypotheses. Information from a variety of sources must be sifted through to obtain the evidence necessary to document clinical judgments. Accurate assessment, diagnosis, and documentation is a painstaking process. There are no shortcuts or easy answers, and a myriad of analytical questions must be asked along the way.

CHAPTER

2

Principles of Intervention

I. KEY PERSONNEL

A. The Physician's Role

Frequently a physician is the professional who refers the patient for assessment and treatment.

1. Developing Professional Relationships

Physicians vary in their knowledge concerning voice treatment; and therefore, in some settings, the clinician has to take an active role in developing close professional ties with physicians in the area. This can be accomplished in a number of ways.

a. Letters, workshops, grand rounds, presentations to hospital staff, invitations to physicians to lecture to speech-language pathology groups, and other contacts that **demonstrate the resources** that speech-language pathologists provide.

b. **Prompt and appropriate documentation and follow-up calls and reports** when patients are referred.

c. The quality of the service, range of services and skills provided, and the initiative in dealing with complicated cases and in making referrals.

Physicians can usually be expected to use strategies similar to those described in the examples that follow when dealing with a patient with a voice disorder.

2. **Order tests and consult to ascertain associated or underlying etiologic factors**

   a. An otolaryngologist may refer a patient, for example, with a tentative diagnosis of **neurologic disease** (e.g., myasthenia gravis) to both speech-language pathology and neurology. The neurologist will complete an evaluation and may discuss the findings with the speech-language pathologist and the otolaryngologist. If it seems unclear whether the patient's symptoms are neurogenic or psychogenic, a test involving the administration of Tensilon® may be agreed upon. This can be approached in two different ways. Either Tensilon® or sterile water may be injected into the patient's arm after the voice has demonstrated fatigue to ascertain whether the voice improves following the injection. If the placebo (sterile water) affects voice function positively, it may be inferred that the deterioration in vocal quality could be psychogenic in origin.

   b. A patient with **persistent pulmonary symptoms** may be referred to radiology so that infectious or neoplastic disease may be evaluated. If mass lesions are identified, further tests such as tomography, histology, or a nuclear lung scan may be ordered. Arterial blood gas analysis and sputum analysis may also be used. Symptoms such as dyspnea (disordered breathing) may be related to cardiac disease which would necessitate an electrocardiogram. Blood work might also be ordered. Endoscopy is an important diagnostic tool for visualizing the entire respiratory tract, and provides essential information. For example, paradoxical vocal fold motion could be mistaken for asthma in the absence of visualization of the tract.

c. **Allergy testing** is frequently needed in cases where there is chronic, thick mucus and irritation of the laryngeal structures related to throat clearing and coughing. Skin testing to identify allergens is the most common approach; however, intradermal injection of antigens is also used. A blood test is also available for antigen-specific immunoglobulin E to both inhaled and ingested antigens. Nasopharyngoscopy may be used to diagnose pharyngeal or laryngeal obstruction. Radiography and tomography may also be ordered for patients with nasal obstruction and sino-nasal symptoms.

(1) **Treatment of allergies** involves avoidance of specific allergens and desensitization therapy.

(2) **Symptoms** include:

(a) **Allergic rhinitis** sneezing, itching, clear rhinorrhea, nasal obstruction, allergic conjunctivitis.

(b) **Sinusitis:** nasal obstruction, mucopurulent rhinorrhea, postnasal drip, facial pressure, retro-orbital pain, fever.

See Figure 2-1 for the location of the sinus cavities. **A** shows the frontal view of the paired cavities and **B** illustrates the side view. It is important to remember that swell ing of the mucous membrane lining these cavities inhibits drainage through the narrow openings. Infected sinuses result in pressure, pain, and hyponasal voice.

d. In cases of **pharyngeal obstruction**, lateral neck x-rays may be ordered or endoscopy performed to show the source of the obstruction (e.g., adenoid and tonsil hypertrophy).

(1) Some obstruction may be related to swelling due to **acute infection** (e.g., mononucleosis).

(2) **Asthma** is a common obstructive respiratory disease and pulmonary function testing, bronchoprovocation with methacholine, chest x-ray, and bronchoscopy may be suggested by the consulting physicians. Patients with chronic asthma frequently have used steroid inhalants

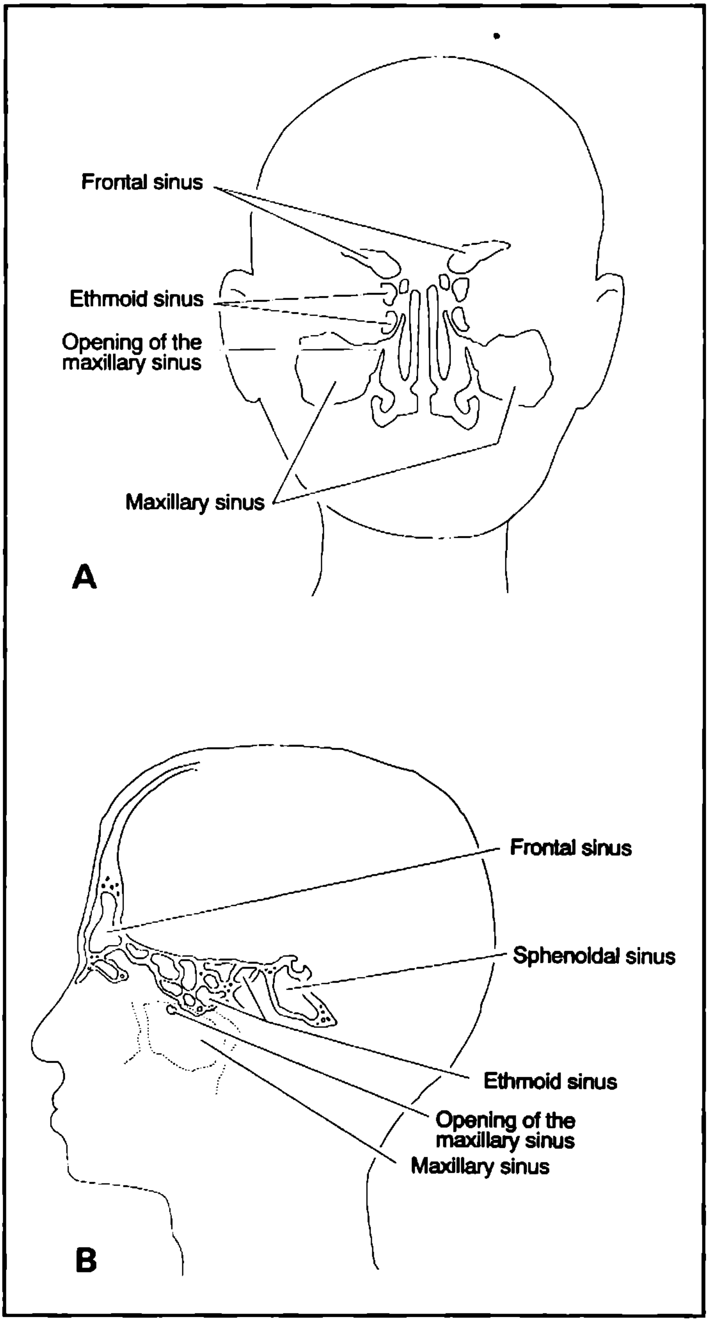


Figure 2-1. The sinus cavities: **A.** Frontal view. **B.** Lateral view.

for long periods of time. Dysphonia may result from reactions to the freon propellants, the steroids themselves, or from the growth of candida in the larynx.

(3) When obstructive pulmonary disease is not reversible, it is deemed to be chronic as in the case of **bronchitis** and **emphysema**.

(4) The term **chronic obstructive pulmonary disease** (COPD) is used when there is permanent obstruction of airflow out of the lungs. Causes of COPD include cigarette smoking, occupational exposures, air pollution, repeated lung infections, or an inherited enzyme deficiency in a small percentage of patients. When patients have decreased lung volume with proportionately normal flow rates, they are described as having restrictive respiratory impairment. Restrictive lung disease may be the result of weakness of the musculoskeletal support for respiration; be neurologic in origin; or caused by lesions, pulmonary conditions, and systemic disease.

e. **Biopsy**, where a tissue sample is taken by the physician, is performed to **confirm the presence or absence of malignancy**. Treatment decisions are based on laboratory analysis of tissue samples and imaging techniques to ascertain size and depth of tumor.

f. Hoarseness, coughing, increased airway reactivity, or frequent episodes of pneumonia may suggest gastroesophageal reflux. **Radiologic testing and visualization** of the larynx (to observe inflammation of structures) are strategies used to diagnose this condition. Consultation with a gastroenterologist is appropriate if the patient has a history of gastroenterologic problems such as Crohn's disease. Antidiarrheal medications that contain atropine may dehydrate the laryngeal mucosa and cause relaxation of the esophageal sphincter.

g. Physicians may **prescribe medications** for patients with voice disorders, depending on the type of complaint. They also should be alert to the effects of nonprescription drugs and their possible relationship to the patient's voice probem. The use of medications will depend on the patient's general health problems as well as the specific voice disorder.

(1) Professional voice users may request rapid resolution of edema, vocal fold inflammation, or other conditions affecting their voices if important performances are scheduled. In such instances, corticosteroids may be used because of the special circumstances. These are not suitable for more than occasional use, as they are powerful drugs.

(2) A summary of some descriptions of various types of **drugs that affect** voice follows.

(a) **Alcohol** results in dehydration of laryngeal mucosa and reduces inhibitions concerning vocally abusive behaviors.

(b) **Analgesics**, such as aspirin, are sometimes used by individuals to treat pain. However, aspirin can increase susceptibility to vocal fold hemorrhage. Ibuprofen may also interfere with blood clotting. It is usually not wise to use pain killers for throat pain, as the speaker or singer needs this feedback to avoid overexertion. If throat pain is present, the individual should not self-medicate but see a physician.

(c) **Antibiotics** are usually administered in a course of 7 to 10 days. This family of drugs is used to treat bacterial not viral infections. The entire course must be taken to avoid future bacterial resistance. Antibiotics frequently prescribed for respiratory tract infections include ampicillin, erythromycin, and tetracycline.

(d) **Antihistamines** cause dryness of the entire respiratory tract and frequently cause drowsiness. They frequently are used to treat allergic reactions but should not be taken before prolonged speaking or singing, because irritation of dry tissues could result. Decongestants and mucolytic agents are frequently used in combination with antihistamines.

Seldane® is an example of a more recently developed antihistamine that is not as drying as some of its predecessors. It does not cause drowsiness, but it may have affects on the heart that are currently under investigation.

(e) **Beta blockers** are sometimes prescribed to reduce performance anxiety. Their effect is usually considered to inhibit rather than improve a user's ability to monitor voice production on stage.

(f) **Cocaine** can irritate the nasal mucosa and cause constriction of blood vessels. Cocaine use may be a relevant factor in relation to the voice problems of some popular singers as well as others.

(g) **Corticosteroids** are strong anti-inflammatory drugs that are used to treat serious laryngeal inflammation for short periods of time. Caution is advisable in the use of these drugs, and antibiotics are usually given in conjunction with them if the inflammation could be due to infection.

(h) **Diuretics** are sometimes used by women who self-medicate in an attempt to reduce vocal fold edema related to the premenstrual period of the cycle. Diuretics are not effective in this regard, and the associated problems of decreased and/or thickened secretions are not advantageous for professional voice users or those with voice problems.

(i) **Hormones**, such as birth-control pills and estrogen replacement therapy, may affect vocal fold function, although variable effects are reported by different women. The effect of androgens is to lower the fundamental frequency of the voice. (See Sataloff, Lawrence, Hawkshaw, and Rosen [1994] for a discussion of these medications.)

(j) **Inhalers** involve a propellant, and many people develop sensitivities to them. Asthmatics who use steroid inhalers for long periods of time may become sensitive to the freon propellant, may react to the steroid itself in aerosol form, may develop candida of the larynx, and/or atrophy of the vocalis muscle.

(k) **Marijuana** causes irritation of the laryngeal and nasal mucosa in some individuals.

(l) **Mucolytic agents**, such as Organidin®, help liquify thick mucus and increase the production of thin lubricants in the respiratory tract. Entex®, Guaifenesin®, and Humibid® are prescribed frequently to reduce thick secretions and postnasal drip that result in coughing and excessive throat clearing.

(m) **Tobacco smoke** causes irritation and edema of the laryngeal mechanism as well as respiratory disease.

(n) **Topical vasoconstrictors** are frequently used to combat nasal congestion. Nasal sprays, such as Afrin®, are especially useful for air travellers to help ear problems related to blockage of the eustachian tube. Occasional use is recommended to avoid a rebound effect.

(o) **Vaporizers** are often used to moisturize with water, saline, or steam and provide hydration benefits. Equipment must be cleaned regularly as bacteria and fungi may invade the system. The physician usually also suggests that patients increase hydration levels by drinking more water. Mists delivered to the larynx with vasoconstrictors that include analgesics should be used cautiously, if at all, because sensations cannot be monitored.

h. **Surgery** is sometimes necessary to treat a voice disorder if pathology affects vocal fold function. The term "phonosurgery" is used when a microscope and specialized surgical instruments are used. Informed physicians are likely to explore medical treatments and voice therapy before scheduling surgery and suggest voice therapy prior to and after surgery. They also make fewer recommendations for complete voice rest (Koufman & Blalock, 1989) than previously was the norm. The importance of voice use to the patient is a pertinent factor when decisions concerning surgery are made.

The primary concern is always to maintain the integrity of the vibrating margin of the folds (Gould & Lawrence, 1984). Alterations in the mucosa[1], such as scar tissue, inhibit the mucosal wave. Hirano (1981) noted ways pathology may interfere with vibratory function. He said that the location of a pathology affects how the voice is perceived. Pathological states may cause glottal incompetence, changes in symmetry between the folds, lack of uniformity within a fold, and changes in the layer structure of the folds and in the mass and stiffness of individual layers. See Figure 2-2 which provides a schematic representation of the layer structure of the folds. A complete understanding of the histology of the human vocal fold may be gained by also referring to Hirano's (1981) research findings. He describes how the mucous membrane, or mucosa, covering the vocal fold muscle consists of the epithelium and lamina propria. The lamina propria is divided into three layers: superficial, intermediate, and deep. Hirano describes these layers in the following way: The superficial layer appears loose and pliant, and it is here that edema often develops. The intermediate layers is made up primarily of elastic fibers. The deep layer is dense with mostly collagenous fibers. The intermediate and deep layers of the lamina propria make up what is known as the vocal ligament. The epithelium, together with the superficial layer of the lamina propria, is known as the cover. Except for carcinoma, the majority of lesions seem to invade only the cover, for example, nodules and polyps. Any pathology causing hyperplastic thickening of the epithelium also increases the mass and stiffness of the cover, as does papilloma. Papilloma, a benign neoplasm originating in the squamous cell epithelium usually enters the superficial layer, but may, on occasion, also involve the intermediate and deep layer of the lamina propria. Hirano noted that papilloma may sometimes even invade the vocalis muscle. Listed below are some examples of conditions that may involve surgical treatment.

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[1] Procedures that avoid surgical trauma to the mucosa have become known as *laryngeal framework* techniques. There are a number of these techniques, such as thyroplasty, that alter vocal fold position using strategies that are external (Isshiki, 1974, 1991).

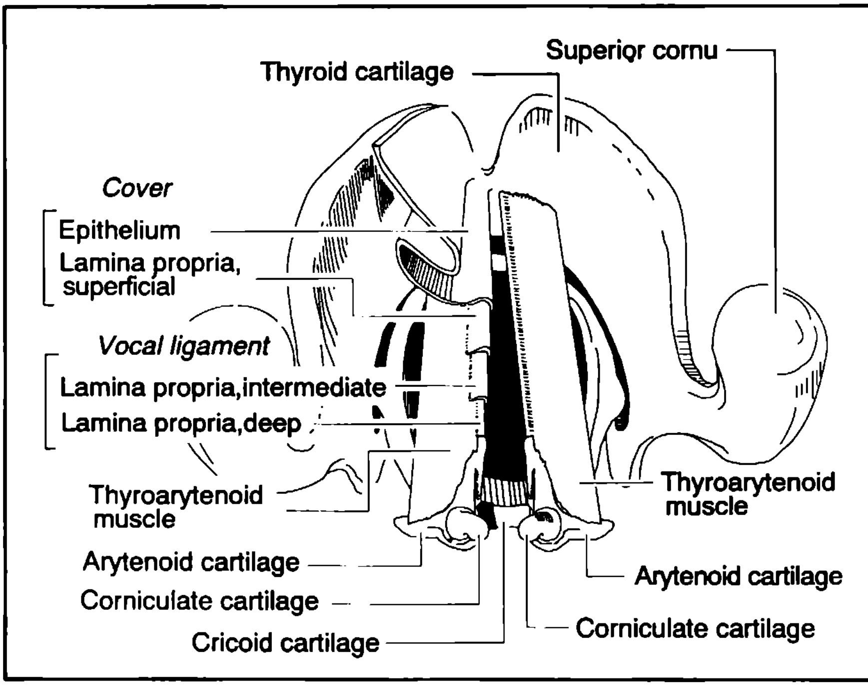

Figure 2-2. The layers of the vocal fold, as described by Hirano (1981), depicted schematically. (Jim Hull, Graphics Services, Indiana University)

(1) **Cancer of the larynx** will usually necessitate surgical removal of the malignancy. This is discussed in Chapter 5.

(2) **Vocal nodules**, unilateral or bilateral, at the junction of the anterior and middle thirds of the vocal folds are sometimes removed surgically. Figure 2-3 shows the structure of the vocal fold prior to the development of the nodule shown in Figure 2-4. Figure 2-5 shows the irregular vocal fold margin in the presence of a mature, large nodule. Bilateral nodules also clearly inhibit the even approximation of the folds as seen in Figure 2-6. Sataloff (1991) suggests surgery should be avoided, if possible, and appropriate voice therapy, with patient compliance, should always be tried first. Mature fibrotic nodules may eventually re-

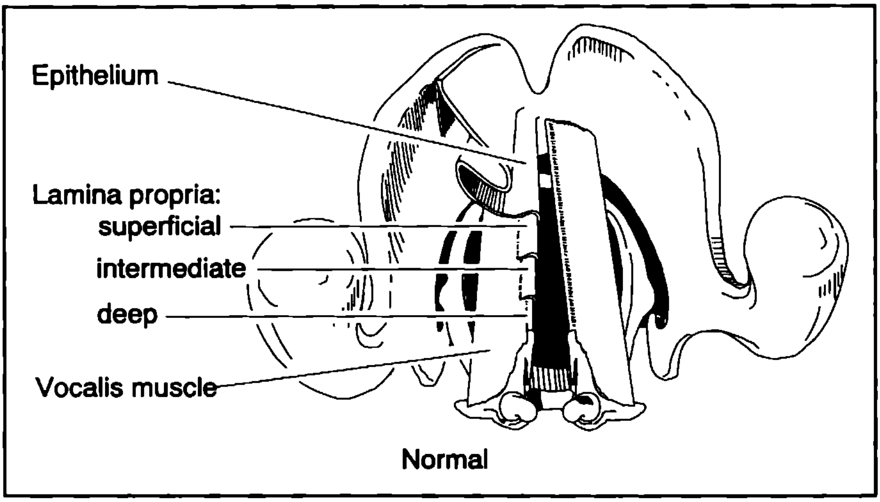

Figure 2-3. Normal vocal folds cut away to show layer structure. (Jim Hull, Graphics Services, Indiana University)

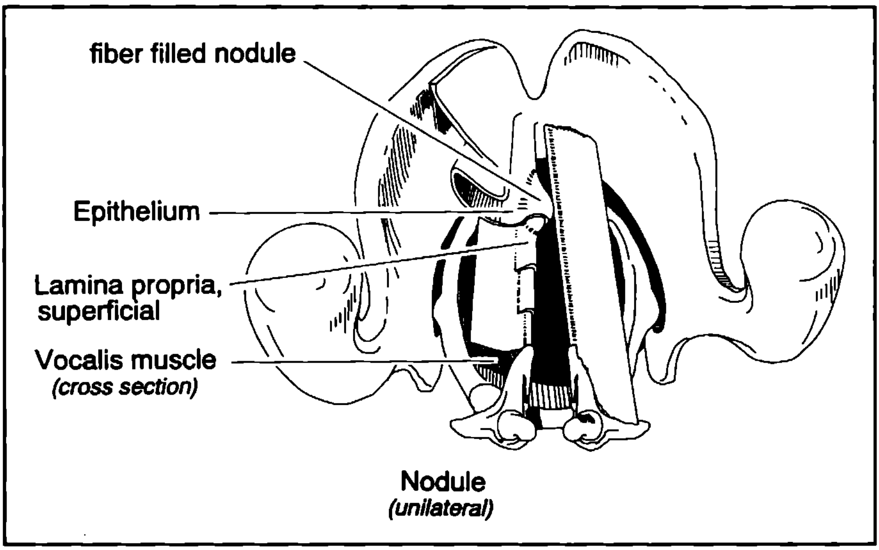

Figure 2-4. A vocal nodule shown in relation to the layers. (Jim Hull, Graphics Services, Indiana University)

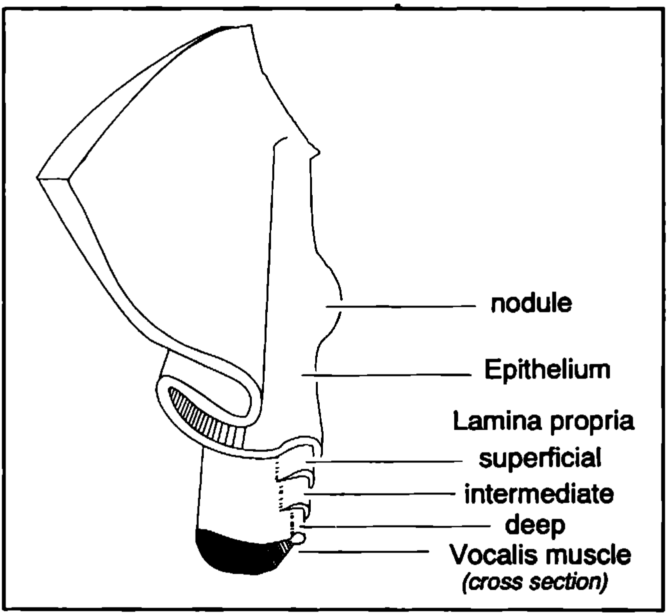

Figure 2-5. A large nodule causing an irregular vocal fold margin. (Jim Hull, Graphics Services, Indiana University)

quire surgical excision, but voice therapy is also necessary to prevent recurrence.

(a) **Differential diagnosis** is sometimes challenging without histologic analysis as small cysts or polyps may be mistaken for nodules. Sataloff (1991) and Kleinsasser (1991) note also that cysts and polyps on one fold may create contact reactions on the opposite fold. This mimics bilateral nodules.

(i) **True vocal fold nodules** are seen most frequently in postpubertal females and in prepubertal males. These benign lesions may be bilateral and when they are small they look like soft, flat, translucent mucosal swellings. As they increase in size they protrude more into the glottic space and approximate during vocal fold closure. They then cause

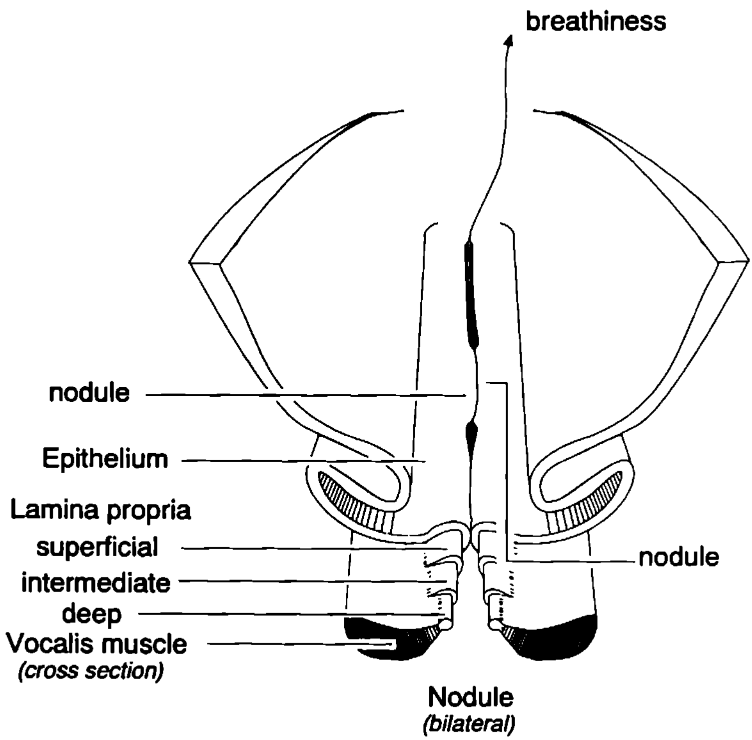

Figure 2-6. The effect of bilateral nodules on vocal fold closure. (Jim Hull, Graphics Services, Indiana University)

irregular or incomplete vocal fold closure and leakage of air which is perceived as breathiness. Refer to Figure 2-6 which also illustrates the leakage of air occurring during the closed phase of the vibratory cycle. Because they are additive lesions, as they increase in size they add to the vocal fold mass and also create aperiodicity during vocal fold vibration. Size and mass increases also may affect the production of higher pitches and hoarse vocal quality is perceived.

(ii) Mature, hard nodules may not look symmetrical, and may present a crater or dome shape, occasionally with keratinization on the dome-like protuberance. Larger nodules are usually long-term lesions with dense fibrosis under the basal membrane, and they may appear hard and white during stroboscopic examination.

(b) When nodules are removed surgically, the **aim is to leave the smallest possible defect in the epithelium of the vocal fold**. Surgery is usually followed by a short period of voice rest during healing, after which voice therapy is initiated. For a discussion of voice rest following surgery see Koufman and Blalock (1989).

(3) **Cysts** are fluid-filled lesions that result from trauma. Sataloff (1991) indicates these can be misdiagnosed as nodules and can occur contralaterally to a unilateral nodule. Strobovideolaryngoscopy and microscopic examination aids differential diagnosis.

(a) Vocal fold cysts are **usually unilateral**; however, bilateral and even multiple cysts are not unknown.

(b) Patients with cysts are **usually adult males and females**, although cysts are sometimes seen in younger individuals.

(c) **Description.** Cysts may be congenital or acquired and are lined with epithelium. Usually cysts develop in Reinke's space just below the squamous epithelium. The fluid in a cyst may be watery and clear or yellowish mucous material. The coloration of the fluid is determined by the type of lining. Large cysts may look yellow because their contents contain keratin. They may also cause trauma to the opposing vocal fold and mass and stiffness changes in the vocal fold cover. Vestibular fold cysts project from the ventricle or they may, on occasion, cause swelling on the margin of the vocal fold.

(d) **Treatment.** Trial voice therapy may be recommended prior to surgical removal, but usually surgery is the most common treatment. The aim is to remove the sac completely without tearing the thin wall. Surgeons may, for example, make an incision that preserves as much mucosa as possible and then remove the entire sac of the cyst while minimizing scar formation. (See the discussion of endoscopic microsurgery provided by Sataloff & Spiegel [1993]) In Figure 2-7, A shows the vocal folds prior to the emergence of the cyst depicted in B. Note the distortion of the margin of the fold in C and the effect this has on vocal fold closure in D.

(4) **Polyps** are usually unilateral, and most of them require surgical removal.

(a) Cigarette smoking, vocal abuse or trauma, and vocal fold hemorrhage seem to be significant in the **pathogenesis** of polyps, but the exact cause is not known.

(b) **Polyps occur mainly in middle-aged individuals** and most occur **unilaterally**, although they may occasionally be seen bilaterally or in multiples.

(c) **Description.** Dilated submucosal capillaries may occur in association with polyps. In some cases there will be evidence of previous bleeding around the vascular clustering from which the polyp arises. Sometimes, small polyps are mistaken for cysts or nodules, but the defining characteristic is the nucleus of capillaries nourishing the polyp. Some polyps are gelatinous and secrete fibrin. The thin squamous epithelium covering these lesions glistens and appears translucent. Polyps may be sessile or pedunculated. Pedunculated polyps have a foot or stem which allows the polyp to move, sometimes hanging below the fold or obstructing the glottis if the polyp is large. This results in

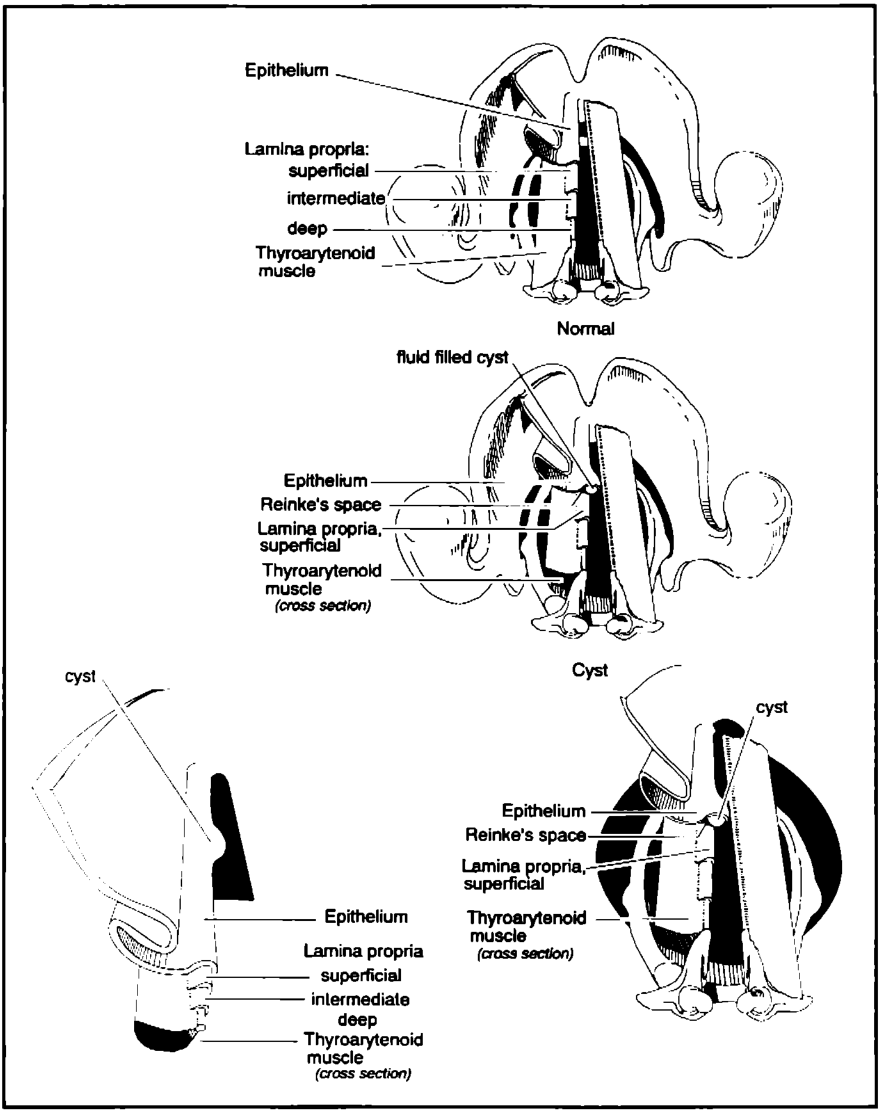

Figure 2-7. An illustration of the location of a cyst in relation to the vocal fold layers. It can be seen that, while the cyst does not invade the muscle, it does affect both the characteristics of the mucosal wave and the evenness of closure. **A** shows a normal set of folds. **B** depicts the folds after the emergence of a cyst. **C** shows the distortion of the margin of the fold, and **D** shows its effect on vocal fold closure. (Jim Hull, Graphics Services, Indiana University)

inconsistent or variable voice symptoms and, in extreme cases, occasional airway obstruction. Large polyps on one side of the glottis may also cause damage to the fold on the opposite side resulting in contact lesions. See Figure 2-8 and note the evenness of the margin of the normal folds seen in A contrasted with the glottal configuration that occurs in the presence of a hemorrhagic polyp. Note the feeder vessels nourishing the polyp.

(d) **Treatment.** The aim during removal of polyps is to avoid an incision that is too deep as this can result in scarring. A polyp is usually removed with scissors to reduce the amount of mucosal damage and a short period of voice rest is recommended during healing.

While the use of lasers in vocal-fold surgery is still controversial, the CO_2 laser may be used for cauterizing isolated blood vessels often found at the base of a hemorrhagic polyp (Sataloff, 1991). Voice therapy is usually recommended in conjunction with surgery to avoid the continued use of traumatic vocal behaviors. It should be noted that physicians may sometimes refer to polyps as hemangiomas, fibromas, or myxomas. Figure 2-9 depicts an enlarged section of a fold that is normal (A), in contrast to one that has a cyst (B), a nodule (C), and a polyp (D).

(5) **Vascular lesions** in the larynx involve dilation of a blood vessel described as a varix (plural is varices), vasculitis (inflammation of blood vessels), hemangioma (a benign tumor consisting of blood vessels), hematoma (a localized mass of blood outside of the blood vessels usually found in a partly clotted state), and hemorrhage or bleeding. During visual inspection of the larynx, physicians may note a reddened network of blood vessels and describe it in the report as hyperemia or injection (congestion or forcing of blood through the tissues).

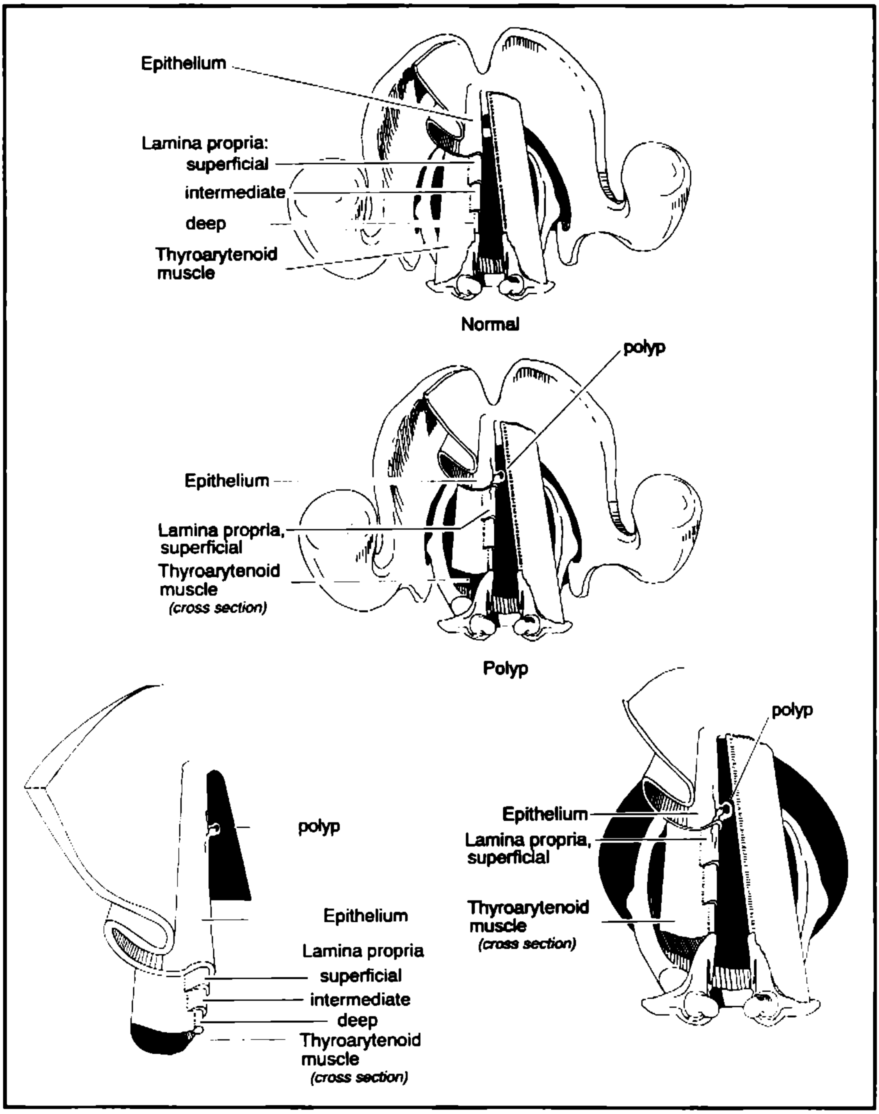

Figure 2-8. Polyps may be firmly attached to a fold or to a stem. A pedunculated polyp (with a stem) is mobile and therefore the vocal effects are more variable and less consistent. In this figure it can be seen that a feeder vessel supplies a polyp. **A** shows a normal set of folds. **B** depicts the folds after the emergence of a polyp. **C** shows the distortion of the margin of the fold, and **D** shows its effect on vocal fold closure. (Jim Hull, Graphics Services, Indiana University)

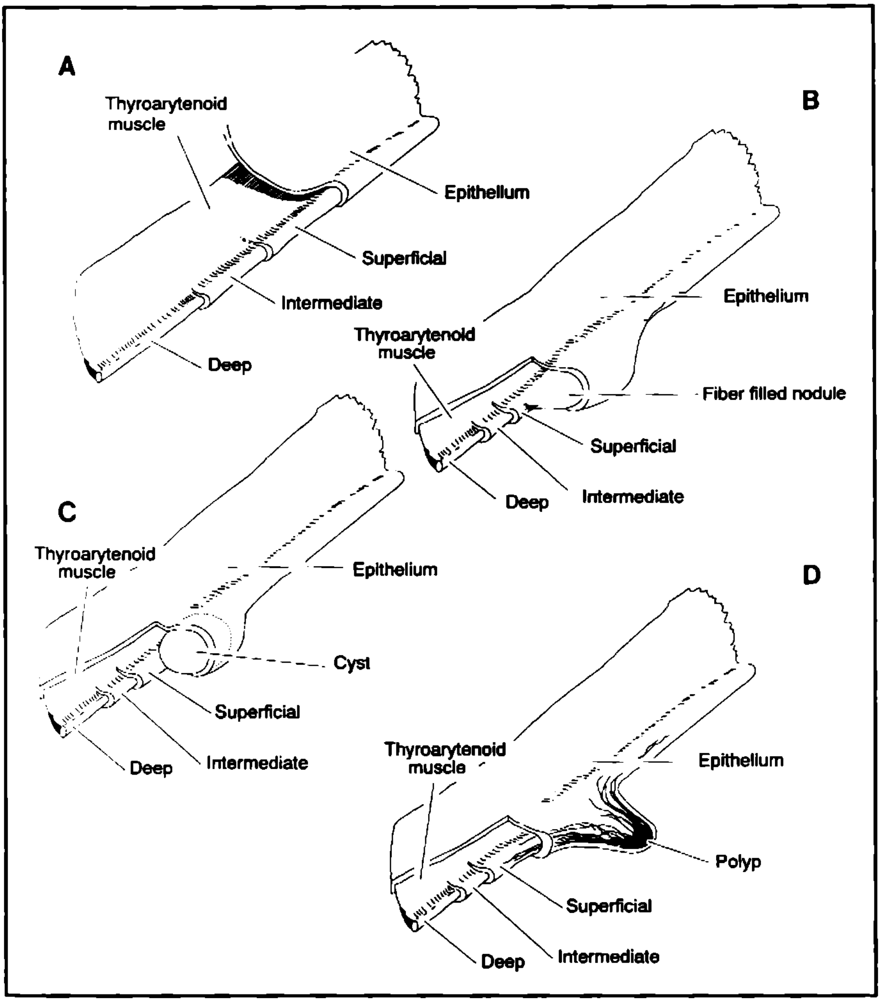

Figure 2-9. Site of lesions: **A.** Normal fold. **B.** and **C.** Lesions situated under the epithelium. **D.** Epithelial encasement of a polyp. (Jim Hull, Graphics Services, Indiana University)

(a) **Vascular disorders** in the larynx, most frequently treated with medication, rest, and caution, may, in some instances, be treated surgically if spontaneous resolution does not occur. Patients with recurrent vocal fold hemorrhage in the same location may be treated by laser vaporization of the offending blood vessel.

(b) **Consultation with an endocrinologist** and hormonal therapy may be indicated if the vocal hemorrhage is associated with the menstrual cycle. Hemorrhage also may be related to the use of prescription medications such as anticoagulants and nonprescription drugs such as aspirin. Disorders such as hemophilia and vocal abuse and trauma have also been noted as predisposing factors.

(c) Depending on the extent and location of the hemorrhage and the swelling of the submucosal layer of the folds, there will be **various degrees of disruption of the vibratory pattern**. Onset is sudden, coughing and choking may occur, and the throat may ache and feel dry. Voice symptoms include hoarseness, loss of range, and fatigue. Voice rest is usually strongly recommended until resorption is completed. If a varix or prominent varicose dilation remains visible following resorption of a hemorrhage, it is usually on the free edge of a fold or on the superior surface. The varix can stiffen the mucous membrane and alter or inhibit the vibratory pattern. Quality, range, and vocal endurance may be affected; and these symptoms will not ameliorate without surgical intervention. Large varices are excised after the acute phase of the hemorrhage is completed and blood has been resorbed. At this stage the capillary ectasia is visible. It should be noted that this is a relatively rare problem that occurs primarily in women, but can occur in men, particularly singers. It may affect only one fold or occur on both folds. Voice therapy is recommended, particularly in cases where patients are professional voice users, to protect against further strain and trauma.

(d) **Acute laryngeal trauma** may result in hematoma which may be mild enough to be treated with medication such as steroids or severe enough to cause generalized edema that requires tracheostomy to maintain the airway. Hematoma is suspected if there is sudden dysphonia or aphonia and/or symptoms of respiratory distress following trauma or injury.

(6) **Papillomas** are multiple wart-like growths caused by a virus. Juvenile papillomatosis is documented frequently in the literature and usually requires numerous surgeries. However, papillomas are also seen in adult larynges. When they are seen in adults, they occur singly and are keratinized.

(a) **Papillomas may be life-threatening** if they obstruct the airway.

(b) **Removal with a laser is common practice**, but it is necessary to ensure that viral particles are not transmitted through the laser smoke. This is a risk for surgical staff as well as for the patient, because laryngeal papillomas may spread to other parts of the respiratory tract. Kleinsasser (1991) recommends use of the suction coagulator to remove the papillomas along with endoscopic removal of any associated scars or webs.

(c) The **aims of surgery for juvenile papillomatosis** are as complete a removal as is possible, minimization of scar tissue formation, maintenance of the airway, and improvement of voice.

(d) In young children, the **papillomas often recur** despite excellent surgical care, and multiple surgeries may be necessary. In Figure 2–10, A shows normal vocal fold structure for comparison with B where the presence of multiple papilloma can be seen. If the papilloma continue to proliferate the entire airway may become compromised. The growths may begin on the vocal folds and sometimes spread upward and downward through the respiratory tract. In recurring papillomatosis (the name of the condition characterized by multiple papilloma), it is usually advantageous for the voice

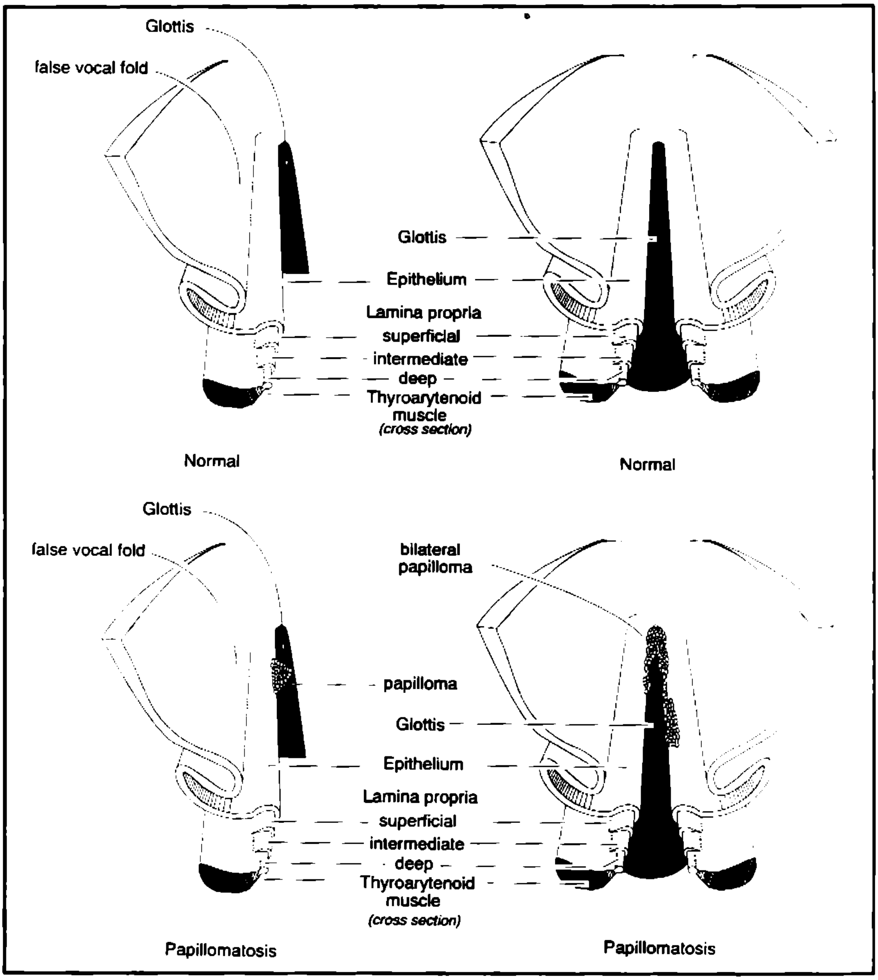

Figure 2-10. A. Normal vocal fold. **B.** Papillomatosis. Papilloma may spread to any site throughout the respiratory tract. In these illustrations they are shown on the vocal fold surface. Located there, they would impede the vibratory characteristics during voice production. (Jim Hull, Graphics Services, Indiana University)

clinician to be involved in the ongoing care of the child to provide information, support, and help in the avoidance of inappropriate compensatory behaviors. A child who has to adjust to changes in the mechanism needs assistance in making appropriate behavioral adjustments, even though the primary treatment of the condition is surgical.

(7) **Spasmodic dysphonia** occurs when adductor or abductor interruptions occur involuntarily resulting in loss of control during speech.

(a) **Adductor spastic dysphonia** occurs when the folds are hyperadducted. Voicing is constricted, strained and strangled-sounding, and great effort occurs during speech. The unpredictable interruptions, pitch breaks, and squeezed bursts of sound result in the perception of arrhythmic, staccato speech patterns. The interruptions may occur intermittently on vowels every two or three sentences, or in severe cases the glottal constriction may seem to be always present. Constriction and spasms of the true folds may be accompanied by adduction of the false folds and pharyngeal constriction. Facial spasms, spastic torticollis[2], and extrapyramidal dystonia[3] may be associated with this hyperadductive voicing pattern. The overall quality of the voice may be perceived as strained breathiness or hoarseness; and struggle behaviors and anxiety about talking often are noted. There may also be a voice tremor during prolonged vowels. Occasionally the patient reports swallowing and/or breathing problems. Onset is usually in midlife, and symptoms may be first noticed after an upper-respiratory problem or a stressful event. The first two years after onset are characterized by deterioration of function.

(b) **Abductor spasmodic dysphonia** is similar except that the interruptions are breathy rather than squeezed, and breaks occur most frequently on or following unvoiced consonants. The voiceless consonants may be prolonged because the vocal folds fail to close again.

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[2] Spasmodic contraction of the muscles of one side of the neck, causing the head to be drawn and usually rotated to that side.

[3] Abnormal tonicity of the musculature.

Both types of spasmodic dysphonia suggest the possibility of neurologic dysfunction, and both are affected adversely by stress. Adductor spasmodic dysphonia has been treated by recurrent laryngeal nerve section (Dedo, 1976) and botulinum toxin injection (Blitzer, Brin, Fahn, & Lovelace, 1988). Presurgical protocols usually involve careful differential diagnosis of the type of spasms that occur and injection of lidocaine (Xylocaine) into one of the recurrent laryngeal nerves to simulate unilateral vocal fold paralysis. Anesthesia of the nerve prior to permanent resection allows for evaluation of the result presurgically. In recent years, botulinum toxin injections have become the treatment of choice. However, most patients appear to need reinjection every 3 months or so.

(8) **Unilateral adductor vocal fold paralysis** usually results from injury to the recurrent laryngeal nerve. It may be due to trauma, neurologic disorders, intubation, neck or thoracic surgery, or be idiopathic. The paralyzed fold rests in the paramedian[4] position, which is in between the adducted and abducted positions, because the intact cricothyroid muscle is innervated by the superior laryngeal nerve. Both the cricothyroid and the interarytenoid muscles may appear to medialize the fold slightly.

(a) **Voice symptoms** are breathiness; hoarseness; and weak vegetative functions, such as coughing and diplophonia, when the paralyzed fold cannot tense for pitch changes. More frequent replenishing breaths also may be needed. Usually the normal fold gradually compensates by increased activity during closure.

(b) **Treatment.** After observation and voice therapy for an extended period of time — Sataloff (1991) recommends 1 year — injection of substances that

[4] Fold position may be described as being at the midline (normal phonation), paramedian, intermediate (at rest), or full abduction (maximally open as in gasping) (see Tucker and Lavertu, 1992).

push the paralyzed fold toward the midline may be used. Presurgical protocols often involve the use of Gelfoam® paste which is absorbed after a few weeks. If injection of the Gelfoam paste is effective, injections of permanent substances such as Teflon®, collagen, or autologous fat may be employed. Thyroplasty (Isshiki, Okamara, & Iskikawa, 1975) is a procedure that may also be used in cases of unilateral paralysis. A rectangle of thyroid cartilage is removed on the side of the paralyzed fold, and the cartilage is depressed inward and held in place with a wedge of silicone. This moves the affected vocal fold further toward the mid-line. Arytenoid adduction may be necessary if the superior laryngeal nerve is affected or if the position of an arytenoid is involved. In such cases, a surgical procedure known as arytenoid adduction or rotation may be performed.

(c) **Movement disorders** affect the ability to either open or close the glottis and affect individuals in various ways, depending on the position of the folds, general health, and the compensatory adaptations that are possible. Sometimes there may be air hunger with exercise, or a danger of aspiration. Arytenoid ankylosis with a lateralized fold is rare, but may be mistaken for a paralyzed fold. Unilateral abductor paralysis is often asymptomatic in terms of voice. Free movement of the other fold enables closure to occur during phonation. The respiratory needs of the individual are also met by the lateralization of the unaffected fold, although the size of the glottal opening is reduced.

(d) **Bilateral adductor paralysis**, usually due to injury to the recurrent laryngeal nerve, also may occur in association with neurologic disorders. In such cases the voice is severely affected and the danger of airway compromise and aspiration is exacerbated. Bilateral abductor paralysis was once seen frequently as a result of thyroid surgery. This now occurs much less frequently. While serious breathing problems can result from an inability to abduct the folds, some patients manage with a restricted airway and are mistakenly thought to have chronic asthma. Combined paralysis of both the recurrent and superior laryngeal nerves is usually central in origin or due to injuries near the base of the skull. It is rare, but life threatening because of airway obstruction. It occurs as a result of blunt and penetrating trauma sustained, for example, during automobile and other accidents that involve extensive cervical damage. Other possible causes are metabolic diseases such as diabetes, carotid endarterectomy[5], neurotropic[6], viruses, and intracranial trauma. Sometimes the folds may not abduct because of cricoarytenoid joint fixation which results from arthritis. Mild cases of bilateral fold immobility may present dyspnea[7] only in the presence of physical exertion. Paralysis of both folds at the midline, due to bilateral laryngeal nerve paralysis, necessitates immediate tracheotomy. Subsequent surgical procedures are then considered to improve the airway with as little compromise of phonation as is possible. Procedures include surgical lateralization and nerve-muscle pedicle reinnervation. Patients with combined superior and recurrent paralysis and loss of sensation in the hypopharynx also must be treated for aspiration difficulties.

(9) **Reinke's edema** results from irritation such as that caused by cigarette smoking and possible voice abuse. It is sometimes referred to as polypoid degeneration, but is not related to vocal fold polyps. Edema occurs on the ventral surface of both vocal folds; ideally, however, only one fold should be surgically treated at a time. One surgical procedure involves an incision along the superior surface of the fold and suction of the edematous material. Another involves removal of the excess epithelium. The presurgical protocol should include voice therapy.

(10) **Contact ulcers[8] and granulomas[9]** of the vocal processes may be due to reflux, intubation, trauma, and vocal abuse. Figure 2-11A shows normal laryngeal structures prior to the

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[5] Surgical removal of atheroma (degenerative cholesterol-containing plaque) within the lining of an artery.

[6] Having an affinity for nervous tissue.

[7] Difficult or labored breathing.

[8] Depressed lesions on the mucous membranes of the vocal processes of the arytenoid cartilages caused by traumatic contact during vocal fold adduction.

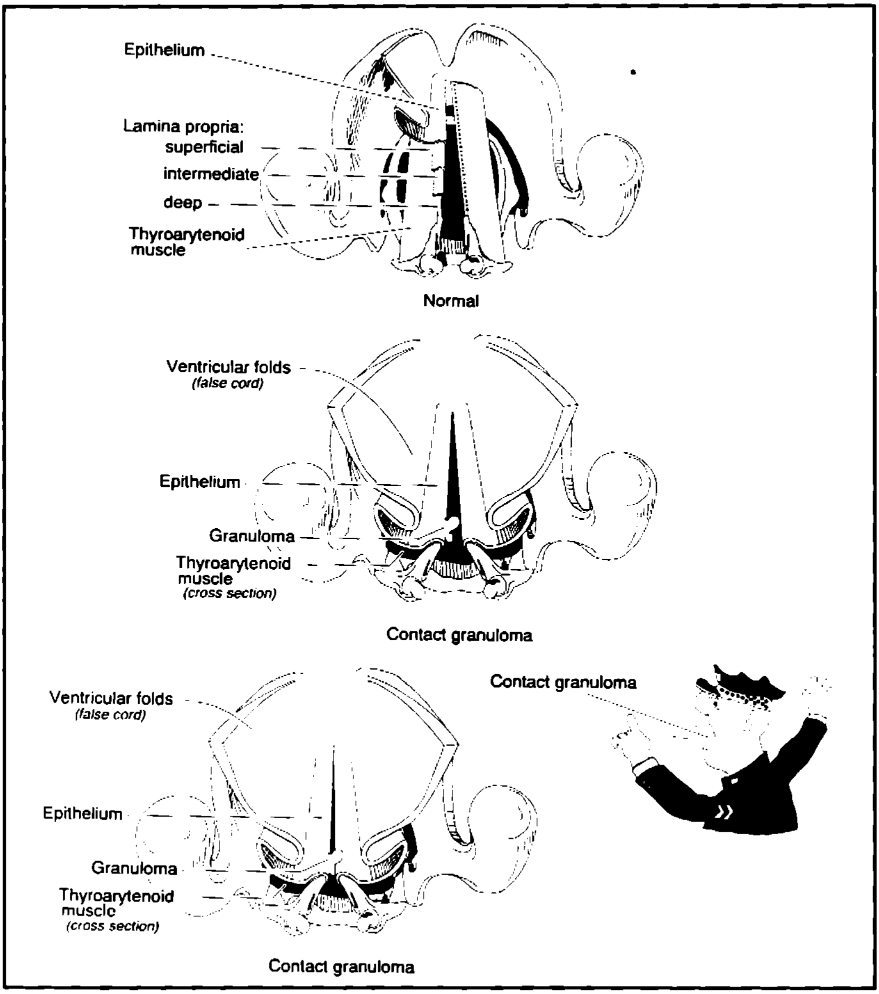


Figure 2-11. Contact ulcers and granulomas occur on the posterior cartilaginous portion of the folds. The initial lesion, with subsequent formation of granulation tissue, is the result of vocal fold trauma. This trauma results from excessively low pitch level and forceful adduction patterns. **A** shows a normal set of folds. **B** and **C** depict the folds after the emergence of a contact granuloma. **B** shows the distortion of the margin of the fold, and **C** shows the effect on vocal fold closure. (Jim Hull, Graphics Services, Indiana University)

[9] Tumors composed of granulation tissue overlaying the mucosa in response to trauma. Multiple (benign) granulomas are described as granulomatosis.

development of contact ulcers and/or granulomas. Figure 2-11B shows the formation of a small granuloma. Granular tissue may overlay a contact ulcer and is a response to prolonged vocal fold trauma. Granulomas may occur singly (Figure 2-11C) or in multiples and obstruct vocal fold closure. Symptoms include discomfort and sensations of throat obstruction. When asked to identify the site of the discomfort, the client usually puts a thumb and forefinger on either side of the larynx, near the arytenoids. Granulomas are frequently removed and biopsied and may recur especially if reflux is not treated (Sataloff, 1991). Voice therapy is helpful because habituated use of an excessively low pitch seems to be etiologic.

(11) **Arytenoid dislocation** may be mistaken for vocal fold paralysis. It should be considered as a possible cause of persistent post-operative hoarseness, because it can result from intubation and extubation as well as other types of neck trauma. Repositioning of the arytenoid cartilage to realign the vocal process and improve fold approximation is usually possible if the problem is identified and dealt with promptly. Additionally, Teflon®, collagen, or fat injections may be required to restore vocal fold closure function. Pre-surgical protocols involve stroboscopic examination to observe differences in the height of the vocal processes, CT scan to image the arytenoid dislocation, and electromyography to differentiate immobility of the arytenoid joint from paralysis of the vocal fold (Sataloff, 1991).

(12) **Laryngeal webs** may be congenital or acquired. Extensive laryngeal webs are usually congenital and are surgically removed during infancy or immediately after birth if the airway is compromised. A technique that may be used is laser excision of the web with endoscopic placement of a keel to avoid reattachment of the folds during the healing process. Some disruption of the mucosal wave results from surgery, and its extent determines the amount of voice quality deviation that may persist. Webs that occur later in life are usually found near the ante-

rior commissure as a result of trauma. Some small anterior glottic webs do not affect the sound of the voice or significantly reduce the airway and do not require surgery. Web-like adhesions occasionally occur as a result of intubation. They are usually seen on the middle and posterior parts of the folds and rarely occur anteriorally. Vocal fold synechiae, or attachment, is treated surgically.

(13) Pontes and Behlau (1993) describe **sulcus vocalis** as a relatively rare laryngeal condition characterized by a furrow in the mucosa. It can occur unilaterally or bilaterally and vary in length and depth as it runs parallel to the free margin of the fold. In conditions where the depression is extremely deep, it may give the impression of a divided or double vocal fold.

- **(a)** It is **easiest to identify** sulcus **during inspiration** rather than during phonation. It was first identified in 1892, and its etiology has been linked to both congenital and acquired (e.g., trauma or infection) factors.

- **(b)** **Sulcus may inhibit the vibratory motion of the fold and distort or abort the mucosal wave.** Glottic closure may also be affected (e.g., a spindle-shaped configuration is seen).

- **(c)** **Dysphonia** may be **characterized by** variable components of breathiness, harshness, and diplophonia. An increased pitch level, reduced loudness, limited range, limited endurance, and reduced MPT may be heard.

- **(d)** **Secondary lesions** may occur as a result of internal and external muscle compensations.

- **(e)** **Treatments** have included voice therapy (beneficial for the secondary compensations but not the primary problem), injection of various materials, and surgery. In 1980, Pontes described the "slicing mucosa technique." This technique is described as interrupting the fibrotic and tension lines of the sulcus to yield a free mucosal vibrationi. Pontes and Behlan (1993) report comparative data pre- and post-treatment and describe the surgical and voice treatment techniques in detail. However, surgical treatment of sulcus remains controversial.

i. The physician, because of his or her role and professional status is often effective in **counselling** a patient **concerning life-style modifications** that may affect a voice problem. However, many physicians prefer to delegate this aspect of patient care to the voice clinician.

(1) **Increased fluid intake and humidification** may be recommended in order to improve hydration of laryngeal tissues.

(2) **Habitual coughing** may be reduced by response to suggestions and/or medications such as cough suppressants.

(3) The **management of reflux** may be accomplished by raising the head of the bed, not eating within 3 hours of retiring, and the use of nonprescription medications.

(4) **Nutritional counselling** may be helpful in improving resistance to infection, managing allergies, and premenstrual syndrome (Davis & Davis, 1993).

(5) **Stress management** techniques may be used to reduce overall anxiety levels and specific anxieties about voice.

(6) Suggestions about the general **amount of voice use** and the need for compliance concerning the speech pathologist's recommendations are frequently given.

(7) Counselling is provided for **caregivers and family members.**

(8) **Regular check-ups** may be scheduled subsequent to the acute phase of the voice problem to ensure long-term vocal health.

B. The Speech Pathologist's Role

The speech pathologist's role is multifaceted, and during the intervention process, various aspects may be emphasized at different stages. Initially, after assessment of the patient, the speech pathologist provides information to the referring physician (usually an otolaryngologist) in the form of written and oral reports. These reports should be succinct, provide and interpret results of testing, summarize clinical impressions, and make specific recommendations. Examples of reports may be found in Appendix B. If the speech pathologist plays an ongoing role in the treatment program, he or she will include some of the other aspects noted below.

1. **Selection and implementation of a voice therapy program.** Depending on the age of the patient and the type and severity of the disorder, the speech pathologist may provide direct and/or indirect services for varying amounts of time. The average number of voice therapy treatment sessions is approximately 15 for the majority of adult patients.

2. **Development of an appropriate therapeutic relationship with the patient, his or her family and significant others.** An integral part of satisfying therapeutic relationships is clear and appropriate communication of realistic goals, individual responsibilities, documentation, and dismissal criteria. Appropriate and regular communication with the patient, family, and other professionals also plays an important role in ensuring a comprehensive treatment program.

3. **Provision of technological assistance as warranted.** The speech pathologist is usually the professional who is best equipped to make assessments concerning the need for communication aids and assistive devices. Elderly patients with limited intensity may need amplifiers on their telephones, lecturers may need instruction in the development of multimedia techniques to reduce the amount of talking necessary in large lecture halls, laryngectomees and ventilator-dependent patients need special devices. The speech pathologist identifies the options available for each individual's communicative needs.

4. **Identification of appropriate** reading **materials,** video tapes, catalogues, self-help materials, and support groups to enhance the patient's understanding of the disorder and provide information relevant to total rehabilitation.

5. **Involvement** of family members, school personnel, social workers, vocal coaches, drama teachers, orthodontists, and other supportive associates in the treatment program to enrich and coordinate contributions to the patient's recovery.

6. **Development of improved vocal self-perception skills** (Haskell, 1988) through perceptual training, self-monitoring exercises, technological feedback, group experiences, and counselling.

7. **Sensitive referrals** for additional specialized counselling with psychiatrists or psychologists when psychosocial symptoms indicate severe depression or personality disorder.

8. **Analysis of life-style and environmental factors** pertinent to vocal behavior. The speech pathologist serves as a facilitator in this process, guiding the patient toward problem solving and acceptance of responsibility for making changes in life-style and communication patterns. For example, the patient may decide to increase the amount of time spent listening rather than talking by asking more questions during conversational exchanges.

9. Presentation of **hierarchies and strategies to reduce** and eliminate abusive or **hyperfunctional behaviors.**

10. **Explanation and modeling of facilitative techniques** (Boone, 1971) to shape target behaviors during symptom modification.

11. Attention to **patient's needs for improved self-esteem, realistic vocal image, and satisfying social interactions.** This may be accomplished through the design of activities to enhance the development of both insight and skills and through effective use of reinforcement.

12. **Use of materials and strategies that mesh with patient's developmental level, interests, and aspirations.** Honest and open discussion of various motivations to change behavior, expected benefits, and responsibilities of both patient and clinicians is provided.

13. **Consistent data collection and documentation of progress in therapy.** A variety of approaches, including perceptual and objective data, is advantageous. The acquisition of knowledge and insight about the problem also may be documented (e.g., pre/post-treatment quiz items).

II. TYPES OF THERAPY

A. Approaches

A number of factors influence the design of treatment programs. The age of the patient, the type and severity of the disorder, the personality of the patient and his or her understanding of the problem, and possible factors that precipitate and/or maintain the problem, as well as the patient's commitment to change, should be considered. A kaleidoscope of factors assemble in a unique pattern for each case. There are variables associated with the patient as well as variables related to the clinician. Clinician variables include training, previous experience, interest in voice disorders, confidence level, and personality. The interaction between patient and clinician variables creates a unique chemistry in the therapeutic partnership. Although the importance of the therapeutic relationship is frequently mentioned in discussions of treatment, it has received little attention from researchers. We do not know, for example, if extremely reticent patients are motivated and encouraged by extroverted, exuberant clinicians or overwhelmed by them. To an extroverted observer, the pace of a voice therapy session between an introverted clinician and an introverted patient may seem extremely slow. However, there is some preliminary evidence (Schmidt & Andrews, 1993) that pace varies significantly in therapy sessions and that this may be related to personality factors. A slower pace sometimes allows opportunities for reflection and self-determination that may be advantageous in some instances.

The amount of time the clinician and patient each talk during the therapy sessions has been noted by supervisors and observers of the therapeutic interaction. A ratio of clinician versus patient talking time is a gauge of overt participation, although it is, of course, influenced by the severity of the patient's problem, the structure of the session, and the control exerted by the clinician. The amount of active participation and the type of patient participation also are influenced by the client's personality and the general approach to treatment adopted by the clinician. The emphases may shift from session to session, but certain characteristics of therapeutic approaches to treatment are identifiable across a program.

1. **Symptomatic voice therapy** involves direct modification of overt behavioral characteristics of the voice disorder. Boone

(1971) describes this approach and provides a series of facilitating techniques to elicit desired behavioral patterns.

a. The first step is to **identify behaviors** that need to be eliminated or modified.

b. The second step is to **stimulate the desired target behavior by using a facilitating technique.** Boone's (1971) list of facilitating techniques includes:

(1) Altering tongue position

(2) Changing loudness

(3) Ear training

(4) Eliminating abuses

(5) Eliminating hard glottal attack

(6) Establishing a new pitch

(7) Explaining the problem

(8) Providing feedback

(9) Voice rest

(10) Yawn-sigh

(11) Chewing

(12) Digital manipulation

(13) Analyzing the hierarchy of behaviors

(14) Negative practice of behaviors

(15) Opening the mouth

(16) Inflecting pitch

(17) Pushing exercises

(18) Relaxing

(19) Respiration training

(20) Selecting target voice models

c. Once the desired behavior has been elicited, it is then **shaped, stabilized, and habituated** using practice hierarchies of increasing difficulty. Symptomatic voice therapy utilizes traditional behavior modification strategies to address each symptom needing attention. Typically, each target behavior is first addressed in isolation, and the process is hierarchial as the length and complexity of target utterances is gradually increased.

2. **Physiologic voice therapy** (Colton & Casper, 1990; Stemple, 1993b) is defined by Stemple as utilizing objective data regarding the patient's laryngeal function to modify the function of the laryngeal musculature and the respiratory support of voice production. The approach involves "direct modification of the inappropriate physiologic activity through direct exercise and manipulation" (Stemple, 1993b, p. 4). For example, vocal function exercises that focus on both airflow and laryngeal muscle strength and tone may be used.

   a. Stemple (1993b, p. 8) has described some **vocal function exercises.**

      (1) **Warm up.** Sustain the musical note F (above middle C for a woman or child; F below middle C for a man) for as long as possible on the vowel "E." The goal = _____ seconds. The amount of time depends on the patient's airflow volume, which is calculated as follows: Flow volume, mL H_2O/100 mL H_2O = _____ seconds.

      (2) **Stretching.** Glide from the patient's lowest note to his or her highest note on the vowel "O." The goal is to perform the exercise without voice breaks. (Continue the exercise even if the voice does break. The vocal folds will continue to lengthen in the absence of phonation.)

(3) **Contraction.** Glide from the patient's highest note to his or her lowest note on the vowel "O," again without voice breaks. (Do not permit the voice to fry or growl on the lower end.)

(4) **Adductory Power Exercises.** Sustain the musical notes middle C-D-E-F-G (for a woman or child; one octave lower for a man) for as long as possible on the vowel "O." The goal is the same as **(1)**, above.

(5) Each exercise should be done twice in a row, two times per day (preferably in the morning and evening). All exercises are to be done as softly as possible, increasing the muscular and respiratory effort and control to maintain phonation. The patient is taught to utilize extreme frontal focus and easy onsets of the "E" and "O" vowels, thus decreasing laryngeal muscle tension and impact. Progress may be plotted by keeping track of phonation times. Adjustments are made in the musical notes used (up or down) as dictated by the pathologic voice range (Stemple, 1993b).

b. **Principles** identified through research in the area **of exercise physiology** may also be relevant to vocal retraining (Saxton, 1993). The importance of both "warm-up" and "cool-down" activities; the number, duration, and intensity of training sessions; and the importance of considering the role of antagonistic muscles are pertinent to vocal exercise regimens. For example, Saxton (1993) noted that maximum intensity of training is usually 1:3 with 10 seconds of activity followed by 30 seconds of rest. The harder the work, the longer the rest periods should be. He also suggested saving the most strenuous vocal tasks until the end of a session and scheduling at least three sessions per week. Cool-down activities, such as humming or light vocalizations following strenuous voice use, allow for more rapid dissipation of built-up lactic acid. Warm-up activities, such as speaking or humming lightly in the middle of the range, allow blood flow to be established prior to strenuous activity. He emphasized that decisions concerning voice rest should be made on the basis of mucosal alterations not muscle state. It is generally believed that moderate use maintains muscle viability and that inactivity may result in deterioration.

3. Another voice therapy approach is **life-style and environmental modification.** This approach is frequently used to supplement other approaches or may constitute the primary intervention mode.

   a. It involves **analysis of precipitating and/or maintaining factors** or conditions inherent in the life-style and environment of the patient.

   b. The patient and the clinician and/or family work together to find acceptable **modifications** which are then implemented, and progress is monitored.

   c. Some **examples of goals related to life-style** and environmental modification are shown in Table 2-1. These were devised by a 39-year-old college professor who suffered from allergies and reflux.

Table 2-1. Life-style modifications that are frequently helpful for adult clients who need to reduce laryngeal irritation and enhance vocal efficiency in the workplace.

Drink 8 glasses of water per day
Use amplification during lectures
Use more visual aids during lectures
Decrease intake of caffeine
Raise the head of the bed 6-12 inches
Do not eat or drink within 3 hours of retiring
Remove plants from office (mold)
Banish dog from bedroom (dander)
Ask students not to smoke in class
Review medications with physician and do not take drying agents just before lecturing
Wait for students to quiet down before beginning class
Eliminate throat clearing and nonproductive coughing
Ask more questions during social conversations when allergies are bad
Ask teaching assistant to lead class discussions
Provide specific instructions concerning assignments on written handouts in class

4. **Psychodynamic voice therapy** is an approach that addresses the psychosocial aspects of voice use. Aronson (1973) said that "the larynx is exquisitely sensitive to emotional states." Voice disturbances frequently arise because of problems with self-esteem and interpersonal relationships. Even voice problems that are not psychogenic usually disrupt the patient's emotional equilibrium to some extent, because communicative interactions are impaired. In one sense then, all voice therapy is psychodynamic, because the relationship between clinician and patient creates a unique microclimate in which new behaviors are tested. The patient's self-esteem and interpersonal behaviors will always be affected in some way. In successful therapeutic partnerships, the patient's self-esteem is enhanced and empowerment occurs. The patient who, for whatever reason, does not make progress or drops out of therapy may demonstrate denial, resentment, frustration, or other feelings that erode the self-concept. Although all voice therapy is interactional in nature and has inherent psychodynamic effects, some treatment programs specifically describe psychosocial goals and use emotional or cognitive retraining as a way of changing voice use.

Consider the example of a 35-year-old business woman referred for bilateral vocal nodules. When this patient was counseled concerning abusive vocal practices she said, "But, I can't talk more quietly. My voice is my weapon." This patient was not a candidate for symptomatic voice therapy. She believed that her assertive (some might say aggressive) vocal style gave her a critical competitive edge in her hard-driving business milieu. She felt vulnerable and at a great disadvantage when she experimented with easy onsets and a reduced loudness level. The laryngeal tension gave an edge to her voice that she equated with power. The sample goals in Table 2-2 illustrate how a clinician specified the goals when the treatment plan directly addressed the psychosocial aspects underlying maladaptive vocal behaviors.

The psychodynamic approach to the business woman's tense, abusive vocal behaviors in the context of her competitive work environment involved providing her with information and the opportunity to analyze various vocal options. She analyzed how it felt to speak as she did and then compared it with how she reacted as the tape was replayed. Note that the

Table 2-2. Sample goals for a businesswoman with a voice disorder.

Identify authoritative voices (male and female)
Discuss impact of various speaking styles
Read literature concerning male and female communication strategies
Videotape business interactions and presentations
Analyze effect of techniques observed on videotaped interactions/ role playing
Retape using various alternative strategies
Compare feelings and reactions both as speaker and listener

analysis of her feelings was specific to her business communication style. If the clinician had observed signs of severe emotional disturbance, a referral for specialized counseling would have been made. Psychodynamic voice therapy does not mean general psychological counseling. It refers to problem solving and counseling concerning vocal behavior in specific contexts.

5. **Holistic voice therapy** draws on all of the approaches described above. There are always psychosocial issues to be addressed, symptoms to be eliminated or shaped, psychological adjustments or compensations to be considered, and lifestyle and environmental factors to be modified. The clinician's training and clinical assessment of the patient's most compelling needs will determine the priorities that are set. Sometimes, different approaches will be implemented sequentially. At other times, the clinician may implement approaches concurrently, organizing each session to include activities representing various approaches. Although each clinician develops a personal style over time, clinicians are, by training, versatile and adaptive. Most experienced voice clinicians become adept at fashioning eclectic programs that are truly holistic.

B. Sample Goals and Strategies

Development of specific goals and strategies is based on assessment data and the clinician's and client's analysis of priorities for treatment. General principles are illustrated in the following section, but it is essential that treatment goals and strategies are always individualized with respect to each client's needs. The following list of facilitating techniques used to achieve common goal behaviors may, however, be used as a general guide.

1. **When the vocal folds do not adduct evenly during the closed phase of the vibratory cycle,** and the physician and speech pathologist agree that it is appropriate to increase adduction, the following facilitating techniques may be implemented:

   a. Laryngeal closure reflexes (e.g., pushing, pulling, pressing down, coughing).

   b. Hard onset on repetitions of vowels (e.g., "i-i-i").

   c. Throat clearing prolonged into a vowel sound.

   d. Postural maneuvers to stimulate adduction (e.g., head turning, chin tilting).

   e. Visual images of tightness and constriction during isolated vocalizations.

   The danger posed by the use of these facilitating techniques is that effortful production will result and be habituated. For this reason, the clinician must be mindful of the need to use the facilitating techniques judiciously only as a way of stimulating adduction. Once adduction has been achieved, it is important that the clinician does not allow an overlay of hyperfunctional behaviors to exist in addition to the original problem. Unless an individual is severely impaired and a goal of easy, natural voicing is unattainable, the phonatory pattern must be shaped during subsequent sessions so that any effortful characteristics are extinguished.

2. **When the vocal folds adduct too tightly or with too much effort and vocal tract constriction,** the following facilitating techniques may be implemented:

   a. **Increasing the amount of air the client emits during vocalization.** This may be cued by feeling the air on the hand as the words are produced. The advice that "air is free, so use as much as you need to" is sometimes useful.

b. Use of facilitating materials such as **words and phrases loaded with breathed sounds,** especially voiceless continuants (e.g., "Shine Seth's shoes.").

c. **Increasing the number of replenishing breaths** and suggesting that breathing be tidal (e.g., "You take it in, and then let it come back out on the next few words, and then breathe more in." 1 2 3 || 4 5 6 || 7 8 9 || 10 11 12 ||).

d. **Yawn/sigh** to trigger an open, relaxed vocal tract.

e. **Froeschels' chewing method** (Froeschels, 1952) to relax the musculature during "chewed speech." It is essential that the chewing is relaxed "like a cow chewing a cud" with downward, relaxed jaw movements. This relaxes the suprahyoid muscles and reduces laryngeal elevation and tension.

f. **Images** of "openness" and "width" of the vocal tract or of the tract as a wide hose that the voice flows through.

g. General and specific **relaxation techniques** to reduce muscle tension and create a sensory awareness of a relaxed musculature.

h. Pleasant **mental images tied to appropriate phrases** (e.g., "I am lying on a beach, feeling the warmth of the sun on my face and neck.").

i. **Repetitions of breathed sounds followed by prolongation of a vowel** (e.g., "h h h h ha", "s s s s sa").

j. **Prolongation of cognate pairs** with a slow, smooth transition from airflow to voicing and no audible or visible tension (e.g., Prolong the breathed sounds for 3 seconds before adding voicing. Concentrate on the "facial buzz" as voicing is added — "ssssszzzzzzzz"; "θθθθθθðððððð"; "ffffffvvvvvvv".).

k. **Shifting clients' attention from laryngeal effort to facial buzz.** Practice of "front of the face" voiced continuants with attention to prolonged resonant sound and the feeling of vibration of facial structures (e.g., "m, z, ʒ, v").

3. **When a client uses hard onsets** (hard glottal attacks), it is necessary to address the timing of expiratory flow in relation to initiation of phonation. Sometimes a breathy onset will be used as an overcompensation initially, and then the breathy onset will be gradually shaped to maintain the easy initiation but eliminate excess waste of air. This and other facilitating techniques are listed below.

   a. Use **minimal pairs** to produce the word first with an /h/ before the vowel. Then, "think" the /h/ in order to adopt a relaxed preparatory set when the second word of the pair is produced.

whose	ooze (most facilitating vowel because of lip protrusion)
hill	ill
hair	air
hale	ale
heel	eel

   b. **Blend words together in phrases** using the final consonant on the first word to help smooth the initial vowel on the second.

   I'll_eat

   he's_anxious

   dive_under

   Bill's_exit

   c. **Blend words** when two vowels occur together by **using a linking sound** such as a /j/ or /w/.

   try /j/ it

   go /w/ on

   fry /j/ eggs

   see /j/ Ann

   d. Elongate the vowel sounds and linger on the voiced continuant consonants in the word (e.g., *el*egant, *eas*y, *an*imal, *as*ian).

e. In words where "hard" sounds such as /k/ follow the initial vowel (e.g., "exercise, aching"), **breathe out both the elongated vowel and the following consonant.**

f. **Practice identifying hard versus easy onsets** in words, phrases, and sentences produced by the clinician. Suggest strategies that would work best when saying those individual words.

g. Use **negative practice** to contrast successive productions of vowels (e.g., "a a a; i i i"). Alternate hard and easy onsets describing differences in preparatory set, visual, auditory, and kinesthetic characteristics.

h. Practice **rapid repetitions** of the following:

no no no   oh oh oh

no oh no oh no oh no

ha ha ha   ah ah ah

ha ah ha ah ha ah ha

4. When a client needs to **improve the carrying power of the voice,** without increasing tension in the laryngeal musculature, it is helpful to employ the following facilitating techniques.

a. **Humming** so that the lips and bones of the face "tickle" and vibrate.

b. **Prolongation of /z/** so that the teeth feel as if they are vibrating.

c. The **use of voiced continuant consonants and vowels** in syllables, words, phrases, and sentences to maintain continuity of voicing and maximize sensory awareness during chanting.

d. Use of a hum or a prolonged oral consonant to **focus the tone and attention on the front** of the face prior to chanting and finally saying a key word. For example:

mm	zz	Maisie (chanted)	Maisie (spoken)
mm	vv	Mauve (chanted)	Mauve (spoken)

mm	ll	Millie (chanted)	Millie (spoken)
ll	θ	leather (chanted)	leather (spoken)
zz	ll	zeal (chanted)	zeal (spoken)
vv	ll	veal (chanted)	veal (spoken)
nn	zz	nosy (chanted)	nosy (spoken)
ll	zz	lazy (chanted)	lazy (spoken)

e. **Practice maintaining the image and sensation of the facial and nasal buzz.** Use a "forward tone" placement during progressive variation in vowel sounds by focusing attention on the consonants (e.g., mim, mem, mam, morm, mum, moom).

f. **Use of the final /l/ sound** (prolonged to maintain a forward tone focus as vowels are systematically varied) (e.g., mill, meal, mel, mal, mall, mull, moll, mole).

g. **Mouth opening and "flicking" the voice forward by using precise lip movements.** (May think of speaking like a B.B.C. announcer or as a person who is emphatic or angry.)

Blood brothers were brave warriors.

One wonders whether wars are really won.

Vera's verbal vows were very valuable.

No one vendor's volume is ever really low.

MaryLou loves living in Zionsville.

h. **Practice "throwing" the voice towards a far wall across a room.** Use the Australian bush call "Coo-ee" or call the hogs using "soo-ee."

i. **Practice "projected speech"** by calling out using the "head voice" rather than pushing from the throat.

Come over here.	Hey there.
Now go away.	A home run.
Help me, help me.	Oh man!
Please be quiet now.	All out of the building.

5. **When prosodic patterns need to be modified,** it is usually helpful to link the speech "tune" and rate to the meaning, feeling, intent, function, or intelligibility of the utterance.

   a. **Visual cues** such as hand movements, contours on a computer screen, hand-drawn patterns, and instrumental feedback provide support.

   b. **Audible cues** that may be facilitating include large motor patterning (e.g., walking, clapping, stamping, tiptoeing); use of musical instruments (e.g., keyboard, noise makers, rhythm instruments, metronome); and vocal modelling, including singing of a target pattern.

   c. **Role-playing,** the use of characters that personify certain vocal characteristics, and the use of props (e.g., "talk calmly to soothe this frightened kitten") can be useful strategies.

   d. **Cognitive restructuring** is sometimes necessary in order for clients to understand the underlying reasons for some habituated prosodic patterns. The use of printed materials and reading passages, such as the one shown in Table 2-3, may be facilitating in such cases.

Table 2-3. Sample reading passage used to focus the client's attention on some ways of defining interactional styles.

Reading Passage
Rosabeth Moss Kantner is a professor at Harvard University. She has written about management styles in business. She identifies some characteristic styles that some women adopt. For example, she describes the cheerleader, seductress, earth mother, and iron maiden types of communication during interactions in the work place. It may be that individuals use some or all of these patterns at various times depending on the situation, their age, and their motivations. It is also possible that as women advance in a hierarchy and have to project power and authority, they relinquish strategies aimed at winning approval as an amusing, winsome, or nurturing person and adopt more of the behaviors associated with decisiveness, strength of purpose, and professional respect. Because this is incongruent with society's view of a woman's role (e.g., supportive, non-threatening), it may evoke resentment and unflattering, personal comments.

(continued)

Table 2-3. *(continued)*

Additional Activity Based on the Reading
Role-play a situation in which a woman supervisor presents sales information for the past three months and urges supervisees (four male sales representatives) to improve performance by 50% by increasing the number of contacts with clients in the next three months. Role-play the interaction four times, demonstrating four different presentational styles. Replay recordings of the presentations and discuss perceived effectiveness and level of comfort exhibited by both supervisor and the supervisee spokesperson (played by the clinician). Videotaping allows for additional analyses of nonverbal and postural aspects.

C. Sample Treatment Report and Progress Notes

Appropriate record keeping is an essential part of the treatment process. However, the style used by clinicians to report and document progress varies. For example, the type of clinical environment, as well as the clinician's experience and personal preferences, exerts an influence. In a training program, for example, longer reports are often required to provide students with experience in clinical writing. Samples of two different reporting styles are shown in Figures 2-12 and 2-13.

III. ISSUES IN DESIGNING PROGRAMS

A. Therapeutic Models

Therapeutic models may involve direct or indirect service. More and more clinicians are using a variety of service delivery models. Some of these are described below.

1. The **consultation model** lends itself well to the treatment of voice problems. For highly motivated adults, a consultation and the provision of appropriate reading materials may be sufficient to address a mild vocal problem. It is also helpful if the consultation is tape recorded so that the patient has access to a tape to play at home to refresh his or her memory.

2. **Clinician surrogates** may be provided with information and activity sheets. Parents, teachers, debate coaches, and singing and drama teachers frequently are willing and able to imple-

Name: Mary Conrad

Age: 73 years

Birthdate: Sept. 23, 1920

Diagnosis: Dysphonia (essential tremor)

Clinic file number: 7800564

Treatment period: 9/10/92–12/14/92

Clinician: Jodi Pathologist

Number of sessions: 13

Frequency and Type of Treatment

Mrs. Conrad was seen for 1 hour of individual voice therapy weekly during the fall semester. Primarily, the treatment focus was maintenance of communication and discussion and evaluation of strategies to minimize communicative disruptions.

Status at Initiation of Therapy

History

Mrs. Conrad has recently moved to a retirement community in this area in order to be closer to her daughter. She reported that she is the widow of a minister, is very outgoing, and feels frustrated by her voice problem because it inhibits her interactions with others. She said she has had voice problems for over 10 years and saw a speech pathologist in Boston, Massachusetts where she previously lived. She described her general health as "good" and is under the care of a general practitioner in the city. She regularly takes Antivert, as needed, to control dizziness, and Inderal (120–160 mg) to slow her heart rate, as well as Valium to reduce tremor of body and voice. An otolaryngology report indicated that both vocal folds moved, although the motion was dysrhythmic and tremulous. The vocal fold dysfunction was more pronounced on the left than the right. The diagnosis was essential tremor, and no additional medical or surgical treatment was recommended by her neurologist or otolaryngologist.

Mrs. Conrad has a sensorineural hearing loss with satisfactory speech frequency thresholds and a 60–75 dB loss at 8000 Hz.

Diagnostic Therapy

A. Quality: Mrs. Conrad's voice was characterized by regular vocal tremors. Spectrographic analysis of speech samples was obtained. The frequency of the tremors was fairly stable at 4 Hz (i.e., there were four vibrato cycles per second). Frequency of tremors varied significantly only in loud speech, where the repetition of the vibrato swing became too irregular to be calculated. There was no strained harsh or hoarse quality, laugh and cough appeared to be normal, and there was appropriate oral-nasal resonance balance.

(continued)

Figure 2-12. Sample report from a university training program clinic.

Figure 2-12. *(continued)*

B. ***Pitch:*** At conversational loudness level, the fundamental frequency varied between 230 and 200 Hz. During loud sustained vowels, however, there was dramatic variation in fundamental frequency. She had difficulty sustaining a pitch level that was higher than her habitual level, although a slightly higher level seemed to result in decreased frequency of tremor.

C. ***Loudness and Rate:*** Mrs. Condrad's loudness level and rate were within normal limits. However, increased rate reduced the perception of tremor, and slowing of rate increased the perception of tremor.

D. ***Breathing:*** Mrs. Conrad exhibited appropriate breathing patterns at rest, however, her speech breathing was accompanied by tension, and she could only sustain /a/ for 5 seconds on repeated trials. She prolonged /s/for 13 seconds and /z/ for 6 seconds. She became flustered when she tried to concentrate on breathing, and this increased laryngeal tension and vocal fold tremors.

Summary of Findings

Mrs. Conrad exhibited head tremors, hand tremors, and occasional tremors of the upper torso. She had minor difficulty with actions requiring fine eye-hand coordination such as opening her purse, folding paper, and writing. No oscillation of the larynx was noted during phonation, and the oral-motor examination was normal. She exhibited a normal gag reflex and no swallowing difficulties. Conversational loudness level and slight increases in pitch level and rate seemed to decrease the perception of tremor. Attempts to control her breathing or increase her loudness level seemed to exacerbate the tremor.

Therapy Program

Mrs. Conrad was anxious to talk abut and role-play some situations that caused her to have problems talking to people. She felt that her family and close friends understood her speech but she was frustrated by the difficulties she experienced using the telephone and in talking to people who were not used to her voice and couldn't understand her.

Goals for Therapy:

Mrs. Conrad will:

1. Use a slightly higher pitch level during reading and spontaneous speech.
2. Use more rapid rate during short phrases to maximize intelligibility.
3. Use shorter phrases, more pauses, and strategies to maximize

intelligibility through word choice, visual and auditory cues, and improved articulation.

4. Use an amplifier on the telephone to avoid the tendency to get louder when people can't understand her.

5. Plan telephone conversations in advance to use short easy recognizable utterances.

6. Role-play, discuss, and evaluate interactions that are troubling.

7. Discuss her feelings and coping strategies related to her communication problems with the clinician and with family and friends.

Evaluation of Progress

Mrs. Conrad learned to elevate her pitch and use 2–4 word phrases with minimum disruptions. When she reduced long utterances into small units, her intelligibility increased. She used this strategy effectively on the telephone and less consistently in role-playing conversations. She felt an increased sense of control as a result of practicing frequently used utterances such as her name, address, telephone number, and social exchanges and using them successfully. She had been a speech and drama major in college and enjoyed describing her new speech pattern as "talking like the Queen Mother" when she used a higher pitch. The "Queen Mother" image helped her speak in a smoother, rhythmic manner when using shorter phrases and proved to be a facilitating image. As Mrs. Conrad took more initiative in explaining her voice problem to people in her retirement community, she soon felt more comfortable and more accepted. She enjoyed reporting on how she managed difficult situations, and her confidence and sense of empowerment increased when she was reinforced for her positive attitude, sense of humor, and problem-solving skills.

Recommendations:

Mrs. Conrad should:

Continue therapy once a month during the next semester to maintain her current voice function.

Keep notes on behaviors and situations she would like to work on during her monthly visits to the clinic.

Reduce the frequency of the therapy sessions to periodic checks as soon as she feels comfortable doing so.

Midwest Medical Center
Speech Therapy Progress Notes

Patient's Name: Bryan Eton, 43 years

Medical Record Number: 674821

Code: 478.5

Date	Notes
2/24/93	Pt was referred by Dr. O.K. Physician who diagnosed bilateral, small vocal nodules. Pt is a salesman with a local manufacturing company. Assessment revealed inefficient speech breathing patterns, hoarse quality, hard onsets, laryngeal tension, and strain and abusive practices. Discussed evaluation with pt and identified abusive habits (e.g., throat clearing, neck tension, hard onsets). Provided pt with handout re nodules and vocal hygiene.
3/3/93	Symptomatic therapy using yawn/sigh, improved breathing and easy onsets. Pt was compliant. Will practice at home with a tape recorder.
3/10/93	Pt using easy, breathing phonation in therapy session. Hard onsets reduced 60% on practice sentences. Has increased hydration and decreased loudness levels during work hours.
3/17/93	Pt provided materials related to his sales presentations and these were practiced during session. Recorded and evaluated. Pt is identifying inappropriate vocal practices with 80% accuracy. Is using "blending" to reduce hard onsets in connected speech 90% of the time during therapy.
3/24/93	Pt made a 3-minute presentation concerning sales figures and evaluated tape and discussed strategies. Marked improvement during revised presentation.
3/31/93	Discussed strategies to improve delivery in projected speech. Practiced using pitch and rate changes to maintain listeners' attention without laryngeal effort. Has eliminated throat clearing and most (95%) hard onsets.
4/6/93	Reviewed work sheet on vocal variety. Self-evaluated tape from home assignment.

Figure 2-13. Progress notes from a hospital outpatient file.

Date	Notes
4/13/93	Patient cancelled session due to illness.
4/20/93	Prepared for a big presentation he will make next week. Discussed, taped, self-evaluted, retaped.
4/27/93	Pt pleased with his progress — presentation went well — vocal endurance improved — hoarseness markedly decreased. Will be seen again in a month following recheck with physician.

ment materials related to voice hygiene and prevention of vocal abuse.

3. **Inservice programs** for teachers, cheerleader advisors, music teachers, and others are economical ways for the clinician to educate colleagues and disseminate information concerning the prevention of voice disorders.

4. **Group workshops and mini-seminars for specialized groups who are at risk for or suffer from voice disorders** can be provided through university school and hospital community service programs. Target populations include cheerleaders, aerobic instructors, auctioneers, clergy, stock traders, and salespersons.

5. **Demonstration lessons in school classrooms and lectures in university courses,** by voice clinicians, are useful ways to disseminate information on voice hygiene. These strategies are being used more as the inclusion model for the delivery of service becomes popular.

B. Documentation of Progress in Therapy

Documentation of progress in therapy can take many forms but is always an essential part of voice therapy.

1. **Tape recordings of the pre- and post-therapy voice** are necessary parts of the record.

2. **Videotapes of the vocal folds pre- and post-therapy** also are extremely important especially when pathology is present.

3. **Instrumental measures** (e.g., aerodynamic, acoustic) are extremely useful and should be obtained when equipment is available.

4. Because voice changes are ephemeral, the **patient needs concrete evidence of progress** across treatment to sustain motivation. Examples include graphs, rating scales, quizzes, and logs (see Figure 2-14).

5. Clinicians need careful documentation for insurance reimbursement, **quality assurance,** and as evidence in cases involving **potential litigation.**

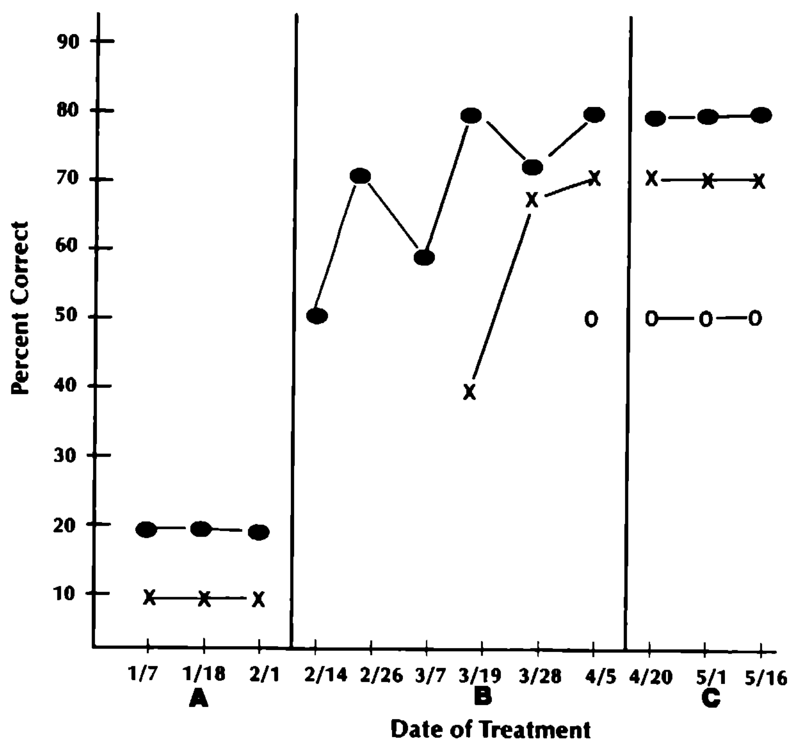


Figure 2-14. Graph documenting changes in frequency of hard onsets across treatment. **A.** Pretreatment. **B.** Treatment. **C.** Withdrawal. (•—• = words, x—x = phrases, o—o = sentences)

C. Dismissal Criteria

Dismissal criteria may be one of the least well-specified parts of therapy programs.

1. **Communication with patient.** Whereas the clinician has an idea concerning how the patient should sound when therapy is over, this is not always communicated to the patient. It is helpful to ask a patient how he or she would like to sound. Some clinicians ask their patients to name prominent people to illustrate how they would like to sound. This question has the advantage of eliciting information relevant to voice preferences. Sometimes clinicians list typical dismissal criteria and ask patients to circle the ones they would consider demonstrated success for them.

2. **Sample Dismissal Criteria**

   a. Voice doesn't sound tense

   b. People don't ask if I have a cold

   c. Voice doesn't tire quickly

   d. Voice carries well

   e. People don't ask me to speak up

   f. My voice sounds lively

   g. I understand how to protect my voice

   h. Voice is clear

   i. Voice is expressive

   j. I sound confident

   k. People can hear me

   l. My throat isn't tight

   m. Reduction of hard attacks by 80%

   n. Elimination of throat clearing

o. Reduction of abusive fillers (e.g., "um")

p. Normal looking vocal folds

q. Resolution of vocal nodules

r. Clearance from my otolaryngologist

s. My family says my voice is fine

t. Replenishing breaths used 90% of time

u. I can project my voice

v. I'm not asked to repeat

D. Motivation to Change Vocal Behaviors

Motivation to change vocal behaviors is based on different realities for different individuals. Teenagers may be motivated by the need to blend into their peer group. Geriatric patients may wish to be understood on the telephone, and professional voice users may be highly motivated to regain superior voice skills, because their livelihood is at stake.

1. The issue of **vocal image** (Cooper, 1973) is highly relevant to the issue of motivation. Yet, it is frequently difficult to elicit accurate information concerning vocal image, because many patients are not consciously aware of their subconscious biases.

2. Individuals also vary in their receptiveness to **addressing the psychodynamic aspects** of their problem. When patients initially deny any need to discuss emotional factors related to their voice problem, treatment may begin with a symptomatic approach and proceed through other phases as readiness occurs. The following sequence may be implemented:

   a. **Education** about the disorder

   b. **Practice** of symptom modification

   c. **Identification** of difficult voice interactions/situations

d. Analysis of patterns and highrisk factors

e. Cognitive restructuring

IV. SUMMARY

Voice treatment is multifaceted and incorporates techniques and insights from a number of professional disciplines. A team approach is frequently optimal. The specific type of treatment depends on the nature of the problem, and every patient needs an individualized treatment plan. Sometimes surgical and medical treatments are necessary prerequisites of voice therapy. On other occasions, trial voice therapy may be implemented first in an effort to determine whether behavioral changes are possible. Usually an eclectic approach to voice therapy is used. We have seen how symptom modification, counseling regarding the disorder, and protection and conservation of voice are usually part of the process. Additionally, we have explored how adaptations to physical constraints and vocal retraining may be necessary. Psychodynamic analysis and cognitive restructuring has also been illustrated. Finally, we have reviewed record keeping, documentation of progress, dismissal criteria, and service delivery models.

CHAPTER

3

Pediatric Phonatory Disorders

I. PRESCHOOL-AGE CHILDREN

A. Congenital and Acquired Neonatal Conditions

1. **Incidence.** Respiratory tract problems are seen in 10% of all newborn infants. Most respiratory distress is due to hyaline membrane disease, but 5% of cases suffer from congenital anomalies of the upper airway.

2. **Clinical manifestations** of congenital laryngeal anomalies include respiratory distress, stridor, absent or weak cry, dysphonia, tachypnea, or rapid breathing, and aspiration.

3. Both **congenital and acquired disorders can cause obstruction of the airway** or laryngotracheal stenosis in children. Many infants are intubated as a result of airway obstruction or cyanosis. Although intubation is a necessary and

frequently life-saving procedure, it is not without risks. Damage to the vocal mechanism may occur during intubation or extubation or can result from protracted intubation. Tracheostomy also may result in complications that affect subsequent vocal behavior.

4. The **most important function of the laryngeal sphincter** (made up of the epiglottis and the true and false vocal folds) is **protection of the airway.** An impaired protective mechanism may result in recurrent aspiration and may signal neurological dysfunction or aerodigestive abnormalities.

5. **Surgical procedures** may be necessary for airway restoration and improved swallowing, respiration, and phonation. Pediatric otolaryngologists attempt to achieve laryngo-tracheal reconstruction with minimal trauma to the vocal fold mucosa.

B. Embryonic Development and Growth of the Pediatric Larynx and Trachea

1. The **tracheal bronchial tree** derives from the 5th and 6th brachial arches arising specifically from the tracheal bronchial groove. This groove is completely developed by the end of the 4th week of gestation, and a primary lung bud bifurcates into two main bronchi. The tracheal bronchial groove is located in the ventro-medial aspect of the foregut, caudal to the pharyngeal pouches. Furrows along the lateral aspect of the tracheo-bronchial groove gradually deepen and eventually unite. This forms the wall between the laryngo-tracheal tube and the esophagus.

2. The **tracheo-esophageal septum** is completed by the 5th week of gestation. Incomplete formation of this septum allows direct communication between the airway (trachea) and the food pipe (esophagus).

   a. **Tracheo-esophageal fistula** (derived from the Latin word for "pipe or tube" but currently meaning any opening) has an incidence of 1 in 500 live births.

   b. **Esophageal atresia or web, laryngo-tracheo-esophageal clefts,** and **fistulas** may be suspected when infants experience respiratory distress, aspiration, and pneumonia.

3. A definite **larynx** can be identified by the 41st day of gestation. The epiglottis develops by the 8th week.

4. **Failure of the true vocal folds to separate** during the 10th week of gestation may result in congenital laryngeal atresia or, more commonly, laryngeal web.

5. At birth, the **pediatric larynx** is one-third its eventual adult size. The length of the vocal folds is 4 to 4.5 millimeters (mm).

   a. Hirano, Kurita, and Nakashima (1983) reported that **before 10 years** of age there is **little variation in the length of the vocal folds** of males and females. They measured the entire length of the folds including the membranous part (anterior portion of the fold) and the cartilaginous part (posterior portion of the fold as well as the vocal process of the arytenoid cartilage). At age 10 years, both males and females have membranous folds that are 6 to 8 mm in length.

   b. There is a **gradual increase during adolescence** culminating by age 20 years in membranous fold length of 14.5 to 18 mm in males and 8.5 to 12 mm in females.

6. Smith and Gray (1993) note the **significance of the increases in length** of the **membranous versus the cartilaginous portions of the vocal fold** during maturation.

   a. The ratio of the membranous portion to the cartilaginous portion is approximately **1:5 in neonates** and **4:0 in female adults,** and **5:5 in male adults** (Hirano, et al., 1983). Smith and Gray (1993) explain that the posterior area forms a larger proportion of the glottis in infants and young children. This may be because the respiratory and protective functions of the larynx are more critical than phonatory function at this stage of development.

   b. Additionally, the **anterior membranous part of the folds,** which is at risk for edema that may reduce the glottic opening, is a **proportionally smaller part of the glottis in infants** than it is in adults.

   c. The infant larynx also has **aryepiglottic folds** and **aryte-**

noid cartilages that are **disproportionately** large in comparison to the adult relationships between structures.

7. The fetal **larynx is positioned at** the **level of the 2nd and 3rd vertebrae,** descends to the level of the 4th vertebrae at birth, descends again to the 5th vertebrae at 6 years of age, and to the 6th or 7th at puberty.

C. Obstructions of the Infant Airway

The infant larynx is extremely vulnerable because the airway is small and can be seriously obstructed by even a slight amount of swelling. It has been estimated that 1 mm of swelling reduces the opening by 35%. Even in normal full-term infants, the subglottic lumen is the narrowest part of the airway, and it is bounded by the rigid cricoid cartilage. Stenosis frequently occurs in this subglottic space.

1. The **pathogenesis of acquired subglottic stenosis** follows these stages:

   a. mucosal edema and hyperemia

   b. mucosal erosion and infection

   c. granulated tissue formation

   d. perichondrial inflammation

   e. cricoid cartilage destruction

   f. scar formation

   g. subglottic stenosis

2. Stenosis and other laryngo-tracheal complications frequently are **secondary** to **prolonged intubation.**

   a. Causes. Factors that can lead to complications are **large endotracheal tubes, cufted tubes, assisted ventilation,** and the **physical properties of the endotracheal tubes.**

   b. Other sequelae. In intensive care unit settings, edema caused by the irritation from nasogastric, nasotracheal and orotracheal tubes has also been linked with **occult sepsis**[1]. An increased incidence of **sinusitis** and **middle ear effusion** has also been noted among tracheotomized, ventilator-dependent children.

c. **Injuries may include:**

(1) dislocation of arytenoids

(2) inter-arytenoid fixation

(3) vocal fold paralysis (sometimes spontaneous recovery occurs)

(4) synechia of vocal folds or laryngeal web

(5) perforation of the piriform sinus or esophagus

(6) laryngeal and tracheal stenosis

(7) ulcers and granulomas on the vocal processes of arytenoids

d. **Treatments** include steroids, antibiotics, and surgery. Jacobs and Potsic (1992) recommend the early removal of fresh granulation tissue before development of a firm subglottic stenosis after intubation injury. Reconstruction of a stenotic pediatric airway is challenging, and when a cartilage graft is used, it is common practice to use a stent[2] to provide support during healing and prevent restenosis. The open-stented tracheostomy tube is advantageous because it allows the patient to talk (Willner, Gereau, & Rubin, 1992). An example of a "talking" tracheostomy tube is seen in Figures 3-1 and 3-2.

3. **Narrowing of the airway.** The cartilaginous framework of the pediatric larynx has little resistance to pressure changes.

a. **Causes.** Narrowing of the airway can occur as a result of trauma, as in the case of intubation injury after birth, or

[1] Sepsis is the presence in the blood of pus-forming microorganisms or their toxins. Occult means hidden or concealed.

[2] A stent is a supporting device used to keep the glottis open. The name is derived from that of a 19th century English dentist and describes any mold, cylinder, or tube used to position structures.

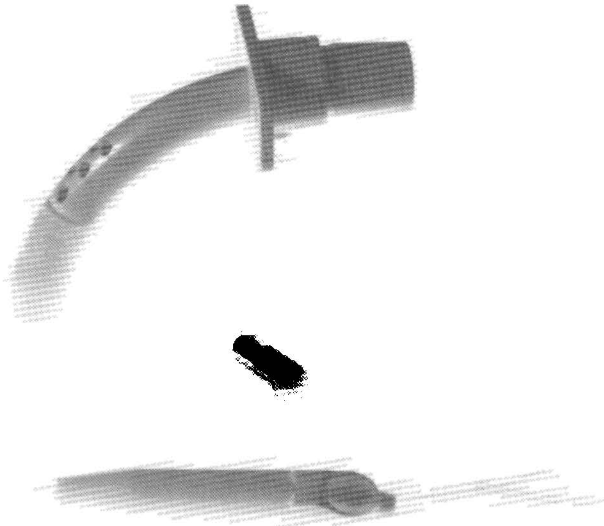


Figure 3-1. COMMUNItrach™ tracheostomy tube. (Available from Spectrum Medical of California, P.O. Box 16215, Irvine, California 92713. Phone: 800/328-0925.)

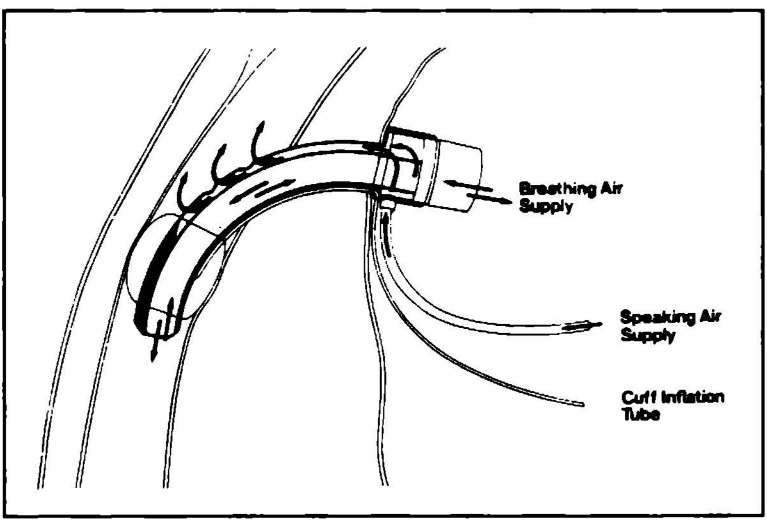


Figure 3-2. COMMUNItrach™ tracheostomy tube inserted in the patient's neck.

result from congenital anomalies or be due to delayed neuromuscular development (laryngomalacia, tracheomalacia).

b. **Stridor is a symptom of airway obstruction.** It is a noise that occurs as the result of abnormal airflow during inspiration and expiration because of narrowing of the airway. The narrowing may be due to anatomical or physiological constraints, and dyspnea, tachypnea, and cyanosis may also be associated with stridor.

c. **Diagnosis.** Videoendoscopic evaluation is usually diagnostic, and the location of the obstruction can sometimes be ascertained by the type of stridor that is heard. Magnetic Resonance Imaging (MRI) also is useful in the diagnosis of congenital anomalies of the airway, chronic airway obstruction resulting from vascular compromise, and airway obstruction following cardiac surgery (Mahboubi, Meyer, & Hubbard, 1992). Warren and Jankouskas (1993) reported on the use of barium swallow and airway fluoroscopy with infants who presented with stridor and wheezing prior to 5 months of age. Gastroesophageal reflux (GER) was present in 32 of 48 infants (66%) studied, and the stridor improved when the GER was controlled.

   (1) **Laryngomalacia** is the most common cause of stridor, and this disorder accounts for 75% of all congenital anomalies of the trachea. During inspiration, the omega-shaped epiglottis collapses inward over the glottis because of negative interlumenal pressure. This condition is usually manifested by abnormal cry, health, and development and resolves as the infant matures (around 16–18 months). Similar symptoms with later onset, however, have also been seen in older children with severe central nervous system insult. Paciorek and Gruber (1992) reported on acquired laryngomalacia developing after infancy in developmentally delayed children with airway obstruction. Cunningham and Anonsen (1991) reported on neurologically intact older children who developed collapse of the supraglottic structures following otherwise uncomplicated adenotonsillectomies. They postulated that increased inspiratory pressures, preoperatively due to obstructive adenotonsillar hypertrophy, re-

sulted in acquired flaccidity and secondary airway obstruction that was unmasked by the surgery.

(2) **Tracheomalacia** occurs when the tracheal walls collapse inward during breathing and is similar in symptomatology to laryngomalacia. Stridor is often more apparent in older, more active infants but may be present at birth. This condition also spontaneously resolves with maturation.

(3) **Laryngeal webs** result from partial failure of recannulation of the embryonic larynx. Webs may be glottic, supraglottic, or subglottic, but 75% occur at the glottic level. Symptoms of webs include airway obstruction, weak cry, and dysphonia or aphonia. Treatment is determined by the extent and thickness of the web. Thin webs may be removed with biopsy forceps or a laser. Thick webs may require tracheostomy, thyrotomy, lysis[3], and stenting to prevent restenosis.

(4) **Impaired vocal fold motion** may result from cricoarytenoid joint fixation, vocal fold paralyses, or interarytenoid scarring. Congenital interarytenoid fixation also may occur as a form of web but may look similar to bilateral vocal fold paralysis when visualized. Surgical techniques include lateralization or resecting the arytenoid for airway improvement. Children with posterior laryngeal stenosis have been treated with posterior cricoidotomy and cartilage grafting (Cotton, 1991; Zalzal, 1988), and arytenoidectomy has been described by Choi and Cotton (1990) and Cohen (1993).

d. Surgery

(1) **Bilateral impairment of vocal fold mobility** in children has been treated surgically by procedures such as arytenoidectomy, fold lateralization, partial cordectomy, and laryngeal reinnervation to improve the airway, voice, and swallowing. Gray, Kelly, and Dove (1993) reported on the use of posterior cricoidotomy with cartilage graft and stenting. Since interaryten-

[3]Lysis is from the Greek word meaning to loosen or cut.

oid muscle function may be critical in adduction and help prevent post-operative aspiration, they emphasize the need to minimize surgical injury to this muscle. The authors feel the procedure is useful for patients who have residual adductor fold motion and no aspiration preoperatively. Smith and Gray (1993) discussed the application of laryngeal-framework surgery used with adults to the pediatric population. They advocate surgical approaches tailored to the pediatric larynx and reported that the medialization laryngoplasty and arytenoid adduction procedures seemed appropriate for selected pediatric patients.

(2) **Glottal insufficiency** in infants usually has a central etiology, and developmental delay and chronic aspiration may be present. Smith and Gray (1993) note that medialization laryngoplasty may improve glottal competence to minimize aspiration. This is a less drastic alternative than a procedure such as laryngotracheal separation which results in aphonia.

4. **Vocal fold paralysis** accounts for 10% of all laryngeal anomalies. A central nervous system etiology of vocal fold paralysis/paresis is routinely considered in the pediatric population. Lesions affecting motor nerve supply of the folds may occur anywhere from the brain stem to the neuromuscular junction of the laryngeal muscles. However, the left side is more vulnerable than the right because of the longer course of the left recurrent nerve. Lesions may be associated with birth trauma or secondary to congenital cardiac anomalies, surgery, or medical procedures. Recurrent aspiration is a common sequela of motor laryngeal paralysis; however, it also may be seen in children with lack of laryngeal sensation but no motor paralysis. Lack of endolaryngeal sensation with aspiration is documented by videofluoroscopy and fiberoptic examination (Heatley & Muntz, 1992).

a. **Unilateral paralysis** of the vocal folds may remain undiagnosed if partial recovery of compensatory movement of the unaffected fold occurs.

b. Patients with **bilateral vocal fold paralysis** may have respiratory distress if the folds are paralyzed at the midline.

If the folds are paralyzed in the abducted position crying will be aphonic. A strong association exists between bilateral vocal fold paralysis and central neurologic abnormalities.

(1) **Clinical manifestations** of bilateral paralysis include respiratory distress, severe stridor, cyanosis, and aspiration. Symptoms will depend on the position in which the folds are fixed and sometimes symptoms will resolve spontaneously.

(2) **Treatment.** Rosin, Handler, Potsic, Wetmore, and Tom (1990) reported that 16% of patients requiring tracheotomy for bilateral vocal fold paralysis had spontaneous resolution allowing decannulation. Gray et al. (1993) reported the use of posterior cricoidotomy with cartilage grafting to cause a wider glottis in children with neurological reduction of vocal fold motion bilaterally. Selection criteria for this procedure include some residual adduction of the vocal folds, presence of laryngeal sensation, and intact swallowing function. In pediatric patients with no vocal fold mobility, standard arytenoidectomy or lateralization procedures are the procedures of choice. When respiratory distress occurs, tracheostomy has been the traditional procedure used.

(3) **Complications** occurring in children who have had tracheostomy include the following:

(a) Obstruction of the tracheostomy tube by mucous plugs

(b) Recurrent laryngeal nerve injuries

(c) Perforation of the tracheo-esophageal wall resulting in a fistula

(d) Placement of the tracheostomy tube too close to the cricoid cartilage with the consequence of impaired vocal fold movement

(e) Tracheal erosion with subsequent stenosis

(f) Erosion of the innominate artery

(g) Accidental extubation

5. **Congenital laryngoceles** are most commonly not symptomatic in infancy. Symptoms usually occur in later life.

   a. **Description.** Laryngoceles are sacs or dilations that appear in the laryngeal ventricle of Morgagni between the true and false vocal folds. An air-filled sac, formed by the outpocketing of the laryngeal mucosa, reaches upward and outward between the true and false folds. It may be connected to the ventricle by a stalk and open directly into the larynx. The sac may be contained within the thyroid cartilage (internal type), outside the thyroid cartilage (external type), or both internal and external (combination type). If the laryngocele is external, it may be discernible as a bulge on the patient's neck. A congenital predisposition exacerbated by straining and overexertion that increases tracheo-laryngeal air pressure is thought to contribute to the formation of laryngoceles. Most symptoms occur in mid-life in males such as wind instrument players.

   b. Medical and surgical **treatment** rather than voice therapy is the treatment of choice if symptoms warrant intervention.

   c. Approximately 20% of cases occur in children, but these cases usually are asymptomatic. **Symptoms,** if noted, may include:

      (1) Hoarseness if the dilation impinges on the true vocal cords

      (2) Stridor if sufficiently obstructive

      (3) Intermittent and compressible bulging of the anterior neck

      (4) Swelling of the aryepiglottic folds and false folds

      (5) Dysphagia if the enlargement is severe

6. **Congenital laryngeal cysts** are fluid-filled sacs that may also be found in the ventricle and are similar to laryngoceles al-

though they do not open into the larynx. There may be localized swelling in the neck that increases during crying. Cysts may impinge on the airway and cause obstruction with consequent dysphagia. The cyst is usually sessile with a thin glistening wall. Occasionally, cysts are treated by aspiration of the fluid, but frequently they are surgically removed.

7. **Congenital hemangiomas** of the larynx are attached directly; firm but compressible; and pink, bluish, or red in color. They most commonly develop in the submucosal layer and subglottic area. Half of the patients present with associated subcutaneous hemangiomas of the face, head, and neck. They progressively increase in size during the first 6 to 8 weeks. Depending on the location and size, symptoms include varying degrees of stridor and respiratory distress. Treatment includes tracheostomy, steroids, and laser surgery.

8. **Cri du chat** is a rare genetic syndrome **characterized by a distinctive high-pitched cry** (similar to that of a cat) with stridor during inhalation.

   a. **Voice therapy is difficult** with these children, because they have so many other problems.

   b. **Characteristics,** in addition to abnormal laryngeal development, include:

      (1) micrognathia

      (2) microcephaly

      (3) hypotonia

      (4) hypertelorism

      (5) mental retardation

      (6) a bird-like profile

      (7) strabismus

      (8) failure to thrive

9. **Failure to thrive** is a condition that is unfortunately relatively common in many parts of the world, including the United States. Malnourished children frequently have hoarse voices due to recurrent upper respiratory infections, excessive secretions, and repetitive coughing. The cries of malnourished infants may resemble those of neonates with central nervous system disease. Babies born to drug-addicted mothers also have characteristic cries that are high-pitched and identifiable.

10. **Down syndrome babies** sometimes have a cry characterized by lower than normal pitch and a harsh, tense quality. Some Down syndrome babies may have normal cries, however.

11. **Papillomas** in children may be seen in the larynx or the oral cavity, and most probably are caused by a virus. Transmission of these lesions is by autoinoculation, sexual oral-genital contact, or nonsexual contact. Yoshpe (1992) suggested that all papilloma tissue be biopsied and subtyped. Suspected child abuse should be investigated if autoinoculation and nonsexual contact can be ruled out.

12. The **aspiration/ingestion of foreign bodies** continues to be a problem in preschool children despite a significant reduction in deaths over the past century. Austin, Blair, Stool, and Reilly (1991) reported that 97% of deaths occur at home and diagnosis is delayed (>2 weeks) in about 15% of cases. Ingestion of coins (52%) and food were the most frequent causes of hospitalization. Stridor, voice changes, coughing, and choking may alert caregivers to this condition. Sometimes the results of a barium esophagram may be normal when an esophageal foreign body has been long-standing. Esophagoscopy may be needed for definitive evaluation of the esophagus in some children with stridor.

13. **Bacterial, viral, and fungal infections** of the airway cause stridor and voice changes in infants and young children and may also cause severe airway obstruction. Respiratory distress in neonates, for example, may occasionally occur as a result of the herpes simplex virus Type-2 (Vitale & Haddad, 1991). Viral croup most commonly affects children between 3 months and 3 years of age. It usually occurs in late fall or early winter and is due to parainfluenza virus type 1, but also

can be caused by other viruses. Inflammation and edema in the subglottal area are characteristic. Hemophilus influenza type b (Hib) is an organism that causes severe life-threatening diseases in infants and young children. Most cases of epiglottitis and meningitis, some ear infections, and pneumonia are among these diseases. In spite of major advances in diagnosis and antibacterial treatment as well as the use of Hib vaccine, Hemophilus influenza remains a major cause of serious invasive infection in the pediatric population.

D. Voice Treatment Issues

1. Abnormalities of the respiratory tract and laryngeal sphincter mechanism may have significant effects on the development of vocal behavior. Surgical and medical treatments may result in acute or chronic complications and alterations in structure and function. Conditions that result from previous treatments are usually referred to as **iatrogenic disorders.** Thus, a complete medical history and videolaryngostroboscopy of the larynx should always be obtained. Consultation between the physician and the speech pathologist is always advantageous when sequelae of congenital or acquired neonatal respiratory tract conditions persist or are suspected.

2. **Treatment goals**

   a. In pediatric otolaryngology, **restoration or maintenance of an efficient airway and functional swallowing** are primary goals.

   b. **Preserving or restoring voice** is also a basic concern when procedures that affect laryngeal biomechanics are considered by the otolaryngologist. The voice clinician does not make surgical or medical treatment decisions; those decisions are the responsibility of the physician. The voice clinician's responsibility is to obtain information from the physician and from the patient's records concerning any temporary or permanent changes in the structure of the vocal mechanism and constraints on vocal function. In particular, the voice clinician is concerned about the potential for behavioral adaptations and compensations.

(1) **Data from the surgeon concerning prognosis** after healing and the results of the voice clinician's own stimulability testing and trial therapy are crucial to informed decisions about realistic communication goals. Many factors impinge on decisions concerning approaches to communication training.

(2) Especially problematic is the decision concerning the timing of the **introduction of alternative or augmentative communication.** Some clinicians feel it is always wise to introduce AAC techniques early in the treatment program, along with trial voice therapy, so that all bases are covered. Other clinicians adopt a wait-and-see attitude, preferring to emphasize the vocal training alone believing that it maximizes the child's chances of success. There are no efficacy research data to clarify this question. Each clinician must make these individualized decisions in consultation with the physician and family.

(3) Some of the **pertinent factors** include:

(a) Parent/caregiver support

(b) Child's cognitive level

(c) Availability of ongoing services

(d) Results of stimulability/trial therapy

(e) Visualization of the larynx

(f) Reports from other professionals

(4) When reviewing the medical, surgical, and family history and other reports, the clinician will rely on **specialized input from other professionals** as well as on certain **theoretical assumptions.** These include:

(a) Each child presents with a unique array of factors pertinent to the treatment program;

(b) Glottal insufficiency in children may be related to a central nervous system problem and there may be cortical dysfunction and developmental delay;

(c) Injury to the vocal fold mucosa affects voice production. Hirano et al. (1983) described the layers of the vocal folds and maturational changes. Smith and Gray (1993) note that the high density of fibroblasts in the submucosa of children's vocal folds may increase susceptibility to trauma during surgery.

(d) Surgical treatments for laryngotracheal stenosis frequently manipulate the thyroid and arytenoid cartilages. This may change the position and movement of the vocal folds. For example, anterior cartilage grafts in the cricoid region may inhibit the action of the cricothyroid muscles to lengthen and tense the folds. Posterior cricoid cartilage grafts widen the posterior glottis and may prevent the vocal folds approximating at the vocal processes or constrain the action of the interarytenoid muscle (Smith & Gray, 1993). Thus, the voices of infants treated to alleviate laryngotracheal stenosis may be changed, not only by the presenting problem, but also by treatment techniques used to address it (Zalzal, Loomis, & Fischer, 1993). Some procedures to increase the width of the airway may not be facilitating in terms of phonatory adduction.

(e) Voice-related characteristics following laryngotracheal reconstructive (LTR) surgery to ameliorate stenosis include glottic incompetence, breathiness and rough quality, phonation during inhalation, supraglottic phonation, vertical asymmetry of the folds, and absent mucosal wave due to scarring. Smith, Marsh, Cotton, and Meyer (1991) found speech intelligibility could also be affected.

(f) The effects of stent/intubation on laryngeal structures have been implicated as possible antecedents to voice disorders. Cotton (1991) found that better voices resulted when the duration of stenting was 12 weeks or less.

(g) The effects of pediatric laryngeal surgery on subsequent growth and development are not yet well documented. Cotton's (1991) reports suggest that generally laryngeal growth continues despite surgical intervention.

3. **Long-term tracheostomy** may be necessary in patients with excessive mucus that must be periodically suctioned or in other conditions where there is chronic airway obstruction.

   a. The **development of oral communication** will be hampered by tracheostomy, although some research suggests that receptive language abilities may be age-appropriate.

   b. **A team approach to management** with parent participation is an important aspect of delivery of service to ensure that communication stimulation and training is consistent and effective.

   c. **Communication**

      (1) Some young patients may be taught to use a **finger to occlude the stoma** during speech. When vocalization using a viable laryngeal mechanism is possible, goals may include:

         (a) Increased duration of prosthesis use

         (b) Parent counselling

         (c) Improved voice onset

         (d) Increased length of exhalation

         (e) Improved phrasing and prosody

         (f) Stimulation of developmentally appropriate speech and language

         (g) Vocal play, rhymes, songs, and stories to encourage pleasurable feelings about voice.

(2) Others may use a "talking trach" or Passy-Muir valve (see Figures 3–3 and 3–4). The Passy-Muir Tracheostomy Valve was developed by David Muir for tracheostomized and ventilator-dependent patients with a functional larynx. The valve stays closed except when the patient inhales. The valve begins to close at the end of the inspiratory cycle providing a positive seal. It is available on physician's order from Passy-Muir, Inc., 4521 Campus Drive, Suite 273, Irvine, California 92715. Telephone: (714) 833-TALK.

4. **Inadequate function of the vocal mechanism** may become apparent during early childhood only after the respiratory or medical conditions necessitating tracheostomy have been resolved. After decannulation,[4], the physician, parents, and speech pathologist will need to ensure that appropriate voice training is provided immediately. It may take some months for vocalization patterns to emerge. Unfortunately, in some cases, laryngeal inadequacy may persist.

   a. **Signs of laryngeal inadequacy** include:

      (1) Aphonic or weak crying

      (2) Absent cough and inaudible laugh

      (3) Soundless or absent babbling or sound play

      (4) Formal or informal evidence that hearing sensitivity is adequate

      (5) Formal or informal evidence that receptive language is age-appropriate

      (6) Inadequate vocal fold closure observed during transnasal laryngoendoscopy when the child is crying (or soundless crying and reflexive behaviors, e.g., coughing)

      (7) Restricted or absent mobility and vibratory patterns when vocal folds are observed during attempted

[4] A cannula is a tube inserted into the body. Thus, decannulation refers to its removal.

Figure 3-3. Twins wearing Passy-Muir Tracheostomy Speaking Valves.

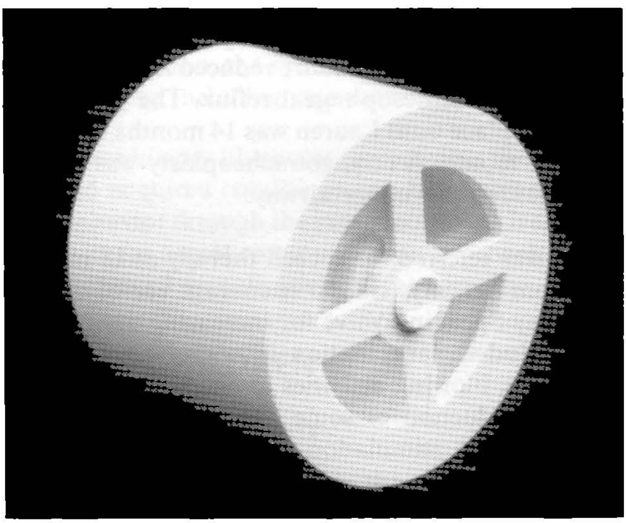


Figure 3-4. Passy-JMuir Tracheostromy Speaking Valve (005). This valve is used with ambulatory patients and facilitates communication development in young children.

speech (older, cooperative children) under transnasal videoendoscopy

b. When aphonia persists following capping or removal of the tracheostomy tube, despite voice therapy and cooperation on the part of the child and the family, it may indicate extensive scar tissue, glottic incompetence, or other limitations that require further medical/surgical intervention. In such cases, while voice stimulation activities should be continued, communication training should also include supplementary alternative communication strategies.

E. Case Study

Consider the regimen that was employed with Lauren, a 6½-pound infant delivered by caesarean section with acute respiratory distress at birth. Unsuccessful attempts were made to intubate immediately following delivery.

It was found that Lauren had an almost complete laryngeal web and tracheal stenosis with only a small hole in the web for ventilation. An emergency tracheotomy was performed in the delivery room and a size 00 neonatal tracheostomy tube was inserted. Lauren later had surgery to remove the webbing and create a glottic aperture. Because of feeding difficulties, a gastrostomy tube was also inserted and a Nissan wrap procedure was performed on the esophagus. This procedure reduced irritation in the laryngeal area due to gastroesophageal reflux. The gastrostomy tube remained in place until Lauren was 14 months old when she began eating by mouth. A laryngotracheoplasty was performed at this time to widen the upper airway.

Lauren was referred for speech therapy at 18 months with a request from her physician to encourage use of a Passy-Muir Tracheostomy Speaking Valve for increasing periods of time. Other goals included participation in sound play, imitation of oral movements, blowing activities to encourage airflow through the glottis, introduction of some basic sign language, and general communication stimulation.

Lauren did not tolerate the valve for longer than 5-minute periods of time, preferring to occlude the stoma by covering it with her chin. Strategies to motivate Lauren and familiarize her with the valve included taking the valye on and off her special doll. Play skills were age-appropriate. She initiated her own play, separated easily from her mother in familiar situations, obeyed simple rules, resisted help, and was proud of her own achievements.

Testing revealed receptive language abilities in excess of chronological age. However, Lauren was not able to produce sound except for occasional weak, short, barely perceptible, gruff sounding bursts during coughing or crying. At 24 months, the tracheostomy tube was removed, and intensive therapy to direct air flow, produce bilabial plosives, increase length of exhalation, and stimulate vocal fold adduction was provided. The mother participated in all sessions, and reported that voice stimulation activities were repeated frequently at home.

Lauren enjoyed therapy and made progress in all areas except vocalization, although she seemed to try hard and mouthed recognizable words and phrases. The physician had warned Lauren's parents that Lauren's voice might not sound normal but had hoped that vocalization would occur. At 2 years 6 months, a videolaryngostroboscopy was done transnasally. Lauren was crying throughout the procedure. The physician noted some mobility of the folds but hypothesized that severe scar tissue appeared to be present. The folds looked rough along the free margins and were not observed to adduct at any time. It also appeared that there were some signs of webbing anteriorly. Pending further medicosurgical intervention, the speech pathologist continued communication training, including increased emphasis on sign language.

Lauren's case history illustrates the way that the sequelae of congenital and acquired conditions can handicap the development of vocal behavior through the preschool years. It also underscores the necessity for a total communication approach and the importance of repeated visualization of the larynx.

II. SCHOOL-AGE CHILDREN

A. Functions of the Larynx

The laryngeal sphincter **protects the airway and provides critical physiological functions in addition to phonation**. The laryngeal valve adjusts in a number of ways to ensure air flows easily in and out of the lungs.

1. **The folds abduct** by moving away from the midline during inhalation, and the degree of abductory movement and the width of the glottis are most marked during inhalation combined with physical exertion. During inhalation and exhalation at rest, when the body requires less oxygen, the vocal fold movements away from (abduction) and toward (adduction) the midline are less marked. Breathing during highly emotional states also is characterized by changes in both the number of breaths per minute and the width of glottic excursion.

2. **Closure of the airway** also occurs during swallowing. As the larynx is elevated, the epiglottis tip tilts backward, and strong intrinsic muscle contraction occurs. This ensures that no food, liquid, or foreign substance can penetrate the airway from above. Closure also is activated when it is necessary to prevent air from the lungs from escaping through the laryngeal valve when effort must be exerted. There is complete adduction of both the true and false vocal folds and approximation of the laryngeal walls during bearing-down activities (e.g., defecation), effortful lifting, pulling and pushing, and reflexive actions like vomiting and coughing.

3. During **phonation**, the vocal folds periodically open and close because of the interaction between aerodynamic (exhaled airstream) and myoelastic (vocal fold tissue) forces. The myoelastic-aerodynamic theory of phonation is described by Van den Berg (1958) and Lieberman (1968).

B. Conditions That Disrupt Vocal Function

By the time a child enters school, severe congenital disorders usually have been identified and treated. The speech pathologist always needs a complete medical and surgical history to be informed about a child's current status and, particularly, the current status of the vocal folds and their movement patterns. If a child has been treated in a hospital or clinic previously, transfer of the child's care frequently is made to a school speech pathologist with periodic check-ups continuing in the medical setting as needed.

1. **Voice therapy** for children who have had medical and surgical treatments for laryngeal problems prior to entering school is usually recommended. A child with an altered laryngeal mechanism must:

a. **understand the condition** and how to manage it

b. **avoid inappropriate compensations**

c. maximize respiration, articulation, and resonance **to compensate for phonatory constraints**

d. develop efficient **self-monitoring skills**

2. Common **symptoms of vocal disruption** in school-age children.

a. **Hoarseness is the most common symptom of laryngeal distress** and may occur in association with a number of acute and chronic conditions. Any increase in size and mass of the vocal folds that interferes with even closure of the folds (leakage of air) and smooth vibration of the folds (aperiodicity of vibratory pattern) causes the perception of hoarseness. Mild degrees of hoarseness are perceived as "fuzzy" vocal quality that lacks clarity. Moderate to severe hoarseness is perceived as rough quality with episodes of aphonia when the vocal folds do not vibrate evenly during intentional phonation. Voice breaks, or gaps in the flow of voicing, frequently occur on unstressed syllables. More force is required to produce voice when the folds are swollen or lesions are present. Thus, the voice quality usually sounds best when the speaker speaks loudly and forcefully adducts the folds. This ability to improve quality by using more effort causes speakers with chronic hoarseness to increase effort and strain which is, of course, counterproductive. The original problem is exacerbated by the adoption of effortful and irritating compensations that can eventually lead to complete voice breakdown.

b. **Harshness** is another symptom of laryngeal distress and occurs when compensations such as extreme tension and effort are used to produce voice. Tension in the entire vocal tract, including the pharyngeal walls, changes the characteristics of the entire acoustic tube as well as the resonance characteristics of the voice. When voicing is accomplished with extreme effort and tension, the quality sounds rough and unpleasant and is described as harsh. A harsh quality may be also perceived as strident or described as having "an edge" that causes discomfort to listeners.

3. **Hyperfunction** is the term used to describe a pervasive pattern of excessive effort and tension that affects many different structures and muscles.

   a. A hyperfunctional voice pattern may be **characterized by tension** affecting:

      (1) stance and posture (e.g., locked knees, misaligned body)

      (2) head position

      (3) respiration

      (4) upper torso (e.g., shoulders and arms)

      (5) neck, face, and mandible (e.g., hyperextension of jaw)

      (6) phonation (e.g., smoothness and continuity of voicing)

      (7) articulation (e.g., devoicing of voiced sounds)

      (8) resonance (e.g., tight jaw reduces size of mouth cavity)

      (9) prosody (e.g., jerkiness, omission of unstressed syllables)

      An individual with mild hyperfunction will not exhibit all of the characteristics listed above. Severe hyperfunction usually involves tightness, constriction, and the visual and auditory perception of strain and struggle as the speaker attempts to force voice production. Naturalness and ease are sacrificed.

   b. Generalizations concerning **hyperfunctional behavior patterns**:

      (1) May be desirable or undesirable **accommodations for structural deviations** (e.g., congenital malformation, laryngeal web, papilloma, paralysis, velopharyngeal deficits)

      (2) May be **temporary or habituated responses** to acute or chronic medical conditions of the upper respiratory tract (e.g., allergies, bacterial, viral or fungal infections, effects of medication)

(3) May or may not result in **tissue change** (e.g., swelling, nodules)

(4) May involve **generalized tracheal constriction** and adduction and vibration of the false (ventricular) folds

(5) May be related to a **deviant sensory system** (e.g., hearing loss, neurological impairment)

(6) May be related to **social and emotional adjustment** (e.g., aggression, anxiety, inappropriate self-concept, faulty learning)

(7) May be related to **cognitive function** (e.g., developmental disability)

(8) May be a component of **cerebral dysfunction** (e.g., spasticity in children with cerebral palsy)

4. **Vocal nodules** are the most common acquired lesions of the vocal folds seen in school-age children.

   a. **Description.** Nodules occur at the junction of the anterior one-third and posterior two-thirds of the true vocal folds. This is the place of maximum amplitude of vibration, because it is the midpoint of the membranous portion of the vocal folds. Nodules begin as swelling in the submucosal layer of loose connective tissue in the fold and may later evolve into hyalinized[5] fibrotic lesions. They are inflammatory and benign, result from vocal abuse and irritation, and occur with a higher frequency in school-age males.

   b. **Susceptibility** to the development of vocal nodules may be related to long-term exposure to airborne irritants; excessive thick secretions (e.g., throat clearing and coughing), excessive dryness (may be pharmacologically induced), and other factors that may occur in children with allergies. Psychosocial determinants also may be implicated. School-age boys with nodules frequently are described as aggressive and attention-seeking with social behaviors that inhibit the development of satisfying relationships.

[5] Glassy or translucent in appearance.

c. Children with vocal nodules usually demonstrate overall hyperfunction and a number of the following **symptoms:**

(1) hoarseness

(2) harshness

(3) periodic aphonia

(4) improved quality when loudness is increased

(5) inefficient inhalation patterns

(6) short duration of exhalation phase

(7) inefficient use of replenishing breaths

(8) throat clearing

(9) hard glottal attacks

(10) observable tension

(11) abusive vocal practices

(12) dryness of the vocal tract

(13) vocal misuse (inappropriate loudness and pitch levels)

(14) vocal variation limited to loudness increases

Figure 3–5 provides examples of glottal configurations during both inspiration and phonatory adduction. It can be noted that the margins of the folds are smooth in the absence of nodules. Even approximation of the folds is inhibited, however, when nodules are present.

5. **Vocal fold polyps** are benign, epithelial lesions of the vocal fold margins and may be sessile (broad-based) or pedunculated (attached by a stem). They are fluid-filled and usually unilateral.

a. Poor voice habits and vocal trauma are the usual **causes** of polyps.

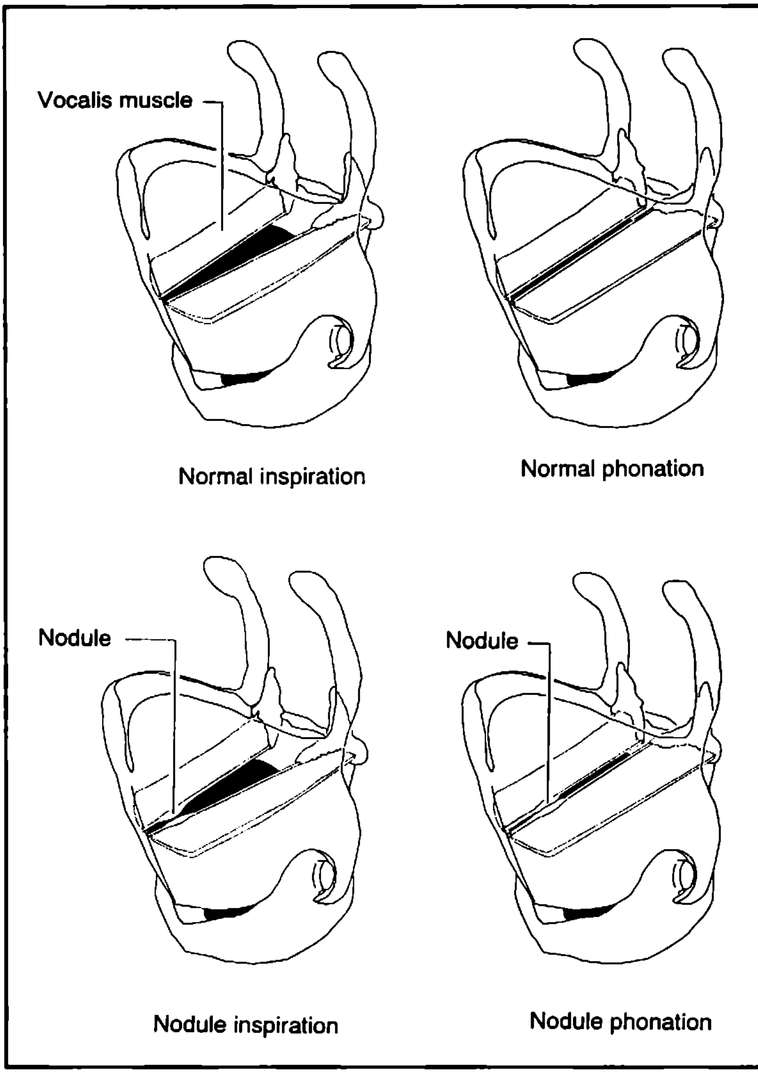


Figure 3-5. Comparison of inspiration and phonation with normal vocal folds and in the presence of bilateral nodules. (Jim Hull, Graphics Services, Indiana University)

b. Voice therapy and surgical removal are the common **treatments.** Most commonly, a period of voice therapy is implemented prior to surgery for small sessile polyps, which are most likely to respond to voice therapy. Large sessile and peduculated polyps usually are surgically removed with post-surgery voice therapy to avoid recurrence. Polyps are rarely seen in young children.

c. **Goals for treatment** may include:

(1) 1 week of vocal rest post-surgery

(2) elimination of hard glottal attack

(3) reduction of abuse and misuse

(4) information concerning voice hygiene

(5) improvement of resonance and tone focus

(6) improvement of respiration patterns during speech

6. **Ventricular phonation or dysphonia plicae ventricularis** is phonation that occurs when the false vocal folds (see Figure 3–6) are approximated and vibrate. This may occur in conjunction with vibration of the true vocal folds so that diplophonia (a double sounding voice pattern) results. Sometimes, constriction of the aryepiglottic folds also occurs. In these cases, the ventricular pattern is a manifestation of hyperfunction with extreme constriction of the entire vocal tract. It may also occur as a compensation for lack of true vocal fold function as in the case of paralysis of the true folds. Because the mass of the false folds is greater than that of the true folds, they cannot vibrate as rapidly or as smoothly.

a. Therefore, **symptoms of false vocal fold vibration** include:

(1) tension and constriction

(2) low pitch

(3) reduced loudness

(4) harsh quality

(5) restricted variability

(6) arrhythmic discontinuous voicing

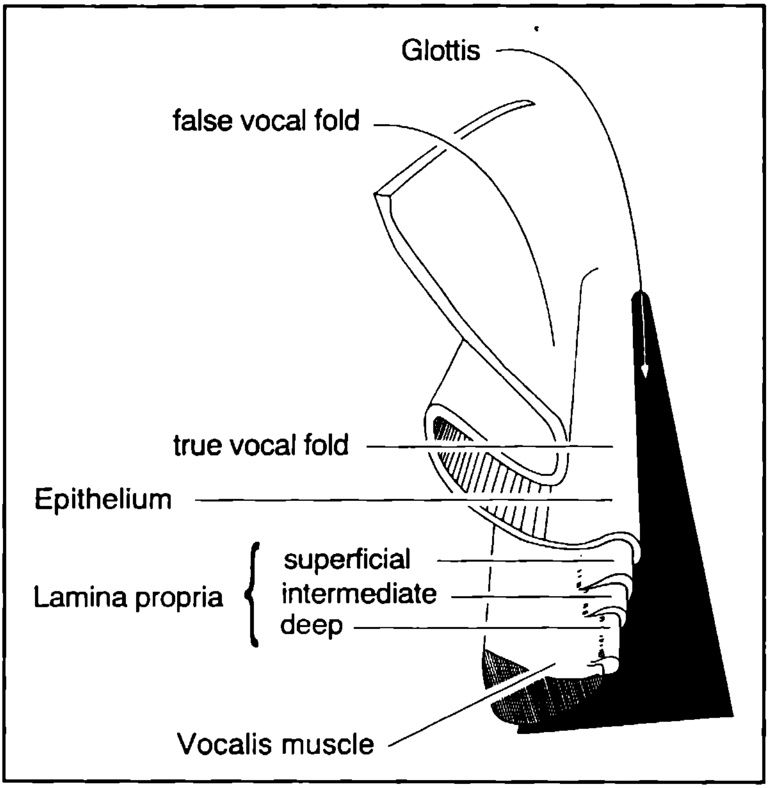


Figure 3-6. Schematic representation of true and false vocal folds. (Jim Hull, Graphics Services, Indiana University)

b. Voice therapy is always the **treatment** of choice.

(1) The first step is for the speech pathologist to **ascertain whether the true vocal folds are capable of phonation.** If this is the case, therapy should include elimination of false fold vibration and retraining of true fold vibration. Images of "opening" and relaxing the tract, reduction of tension, and improved aerodynamics are facilitating. Prolonged vowels preceded by /h/ are frequently used. Boone (1983) suggests using inhalation phonation to begin shaping the target voice.

(2) When true vocal fold vibration is impossible, ventricular phonation is viewed as an acceptable compensation and may be shaped by therapy so that some limited improvement occurs. Goals include improved respiration, increased mouth opening and articulatory precision, and added resonance.

7. **Hypofunction** is the term used to describe inadequate muscular tone in the laryngeal mechanism and associated structures or systems.

   a. The **symptoms** of hypofunction include breathiness because of inadequate closure of the laryngeal valve, weak vocal power and intelligibility, and reduced vocal endurance.

   b. **Hypofunction usually is the result of neurologic disorders or due to systemic disease or injury.** Disruption of nerve pathways of the central nervous system and particularly the vagus and accessory cranial nerves affects laryngeal behavior. Hypofunctional voice and speech patterns also may result from damage to the central processing sites in the frontal (e.g., Broca's area), and parietal areas. The central fibers that control the cranial nerves relevant to speech and voice arise in the precentral gyrus and join the corticobulbar tracts (lower motor neuron). Toxic, metabolic, degenerative, or inflammatory processes can affect the integrity of the pathways. Injury to the nucleus ambiguus or lower motor neuron ganglia results in flaccid paralysis of the fold.

   c. **Therapy** for hypofunction may include:

      (1) respiration training

      (2) techniques to increase laryngeal tension

      (3) improved articulatory precision

      (4) improved resonance

      (5) amplification or alternative communication

8. Absent or very limited voice use also may be associated with **psychosocial problems.**

a. **Elective or selective mutism** is an extreme example of the complete or partial withholding of vocal communication due to severe psychological distress (Kolvin & Fundudis, 1981). Children who are physiologically capable of vocalization but deliberately refuse to speak at school are thought to be reflecting severe family conflicts. Psychiatric family counseling is the treatment of choice. Children who are electively mute should not be bribed or threatened to make them talk. Rather, adults should try to establish warm, trusting relationships with these children, and accept nonverbal responses as evidence of participation in class (Andrews, 1991).

b. Extremely **reticent children** who speak almost inaudibly and with only slight movement of the articulators are demonstrating a type of psychologically induced hypofunctional communication behavior. Some children with fragile self-concepts and severe psychosocial disequilibrium seem unable to use voicing to establish connections with others. Again, these symptoms may indicate conflicted family relationships where communicative withdrawal signals an attempt to protect the self from unbearable pain. The speech pathologist needs to refer these children for psychiatric services and consult with teachers concerning the need to ensure that these children have opportunities to develop trusting relationships with adults at school. Concurrent voice therapy is frequently very successful with reticent children, and they may benefit greatly from the individual attention the speech pathologist can provide to develop their self-esteem and confidence.

9. **Generalizations concerning hypofunctional behavior patterns**

   a. May be **secondary to structural deviation or damage** (e.g., bowing of folds, neurological impairment, atrophy of folds, post-intubation changes, surgeries)

   b. May be related to **accommodations** to acute or chronic upper respiratory tract conditions (e.g., soreness or fear of pain)

c. May be indicative of **social or emotional maladjustment** (e.g., reticence, mutism, hysteria, abusive family)

d. If severe, may necessitate **use of substitute communication** system (e.g., ventricular phonation, artificial larynx, sign language, electronic device)

e. May occur in combination with **altered motor ability and/or sensory feedback** (e.g., dysarthria, dyspraxia, impaired hearing)

f. May be a component of **cerebral dysfunction** (e.g., weakness and flaccidity in children with cerebral palsy)

g. May occur **subsequent to prolonged hyperfunction**

h. May be related to cognitive function (e.g., due to developmental delay). Table 3-1 compares behavioral patterns associated with hyper- and hypofunction in areas relevant to voice.

i. It is important to remember that **no one child will demonstrate all of the behaviors** on any list and that there will be differences in severity. However, a review of possible negative behaviors is useful as a checklist when a clinician is writing individualized educational programs for specific children.

10. **Metabolic and systemic diseases and genetic syndromes** may also influence vocal function. Dysphonia is sometimes a presenting sign of metabolic and systematic illnesses or can be a secondary manifestation of these illnesses. Hypothyroidism, for example, produces generalized hypotonicity and flaccidity of the vocal folds as well as edema. Gaucher's disease creates hypertonicity, dysphagia, and laryngospasm. Children with acquired immunodeficiency syndrome (AIDS) suffer from chronic ear infections and recurrent upper respiratory tract infections which occur because of reduced immunity to infection, and hoarseness may be a persistent symptom. Genetic disorders that manifest dysphonia as part of the syndrome include Cri du Chat, diastrophic dwarfism, Bloom's syndrome, G syndrome, osteochondromuscular syndrome, and DeLange's syndrome. Medical management is

Table 3-1. Comparison of hyper- and hypofunctional patterns.

	Hyperfunctional Patterns	*Hypofunctional Patterns*
Respiration	Quick, shallow inhalation Inspiratory voicing Inefficient control of exhalation: talks on residual air does not take replenishing breaths runs out of air air escapes in a rush at beginning of utterance	Difficulty maintaining erect head, neck, and thorax. Inhalation insufficient in depth and timing. Exhalation weak and short. Inadequate control of exhaled air. Weak muscle tone and movement. Inadequate use of replenishing breaths. Reduced prolongation of /s/.
Phonation	Abrupt initiation of phonation. Folds approximated too tightly, voice is squeezed. Constriction of trachea, adduction of false folds. Arrhythmic short words and phrases. Observable tension sites. Inappropriate or uncontrolled loudness and pitch. Phonation breaks and non-intentional pitch changes. Uses laryngeal valve (not respiratory muscles) to control exhaled air. Voice sounds hoarse, harsh, diplophonic, ventricular, jerky, and arrhythmic.	Inconsistent or breathy voice onset. Inadequate, irregular laryngeal valving. Reduced laryngeal diadochokinetic rates. Excessive air escape during phonation. Voice sounds weak, aphonic, cuts in and out, fades. Voiced consonants are devoiced. Limited audibility and endurance. Minimal vocal variation.
Resonance	Tension in supraglottal resonators. Voice sounds strident; has an "edge". Lack of reverberation of sound on facial bones. Minimal mouth opening, tight jaw. Inappropriate balance of oral-nasal resonance. Tense, posterior tongue carriage.	Inadequate oral resonance. Inadequate nasal resonance. Minimal movement of lips and tongue to shape cavity. Vibrating column of air not projected forward. Voice sounds thin, weak, muffled. Lack of resonance may affect intelligibility of speech sounds. Inadequate or imprecise velopharyngeal closure.

(continued)

Table 3-1. *(continued)*

	Hyperfunctional Patterns	*Hypofunctional Patterns*
Psychodynamics	Talks too much; does not take turns. Insistent bids for attention with loud talking. Limited awareness of effect of own tense behavior on others. Does not ask questions or asks them constantly. Few "other" referenced statements. Does not adjust vocal behavior to feedback.	Initiates speech infrequently. Minimal facial movements or expression. Does not increase loudness level in response to feedback, situation, or listener's needs. Withdrawn, reticent, depressed demeanor. Responds minimally to questions. Does not volunteer for participatory activities. Does not share feelings.

the primary method of treatment with referral for voice treatment as needed. Inflammatory and infectious diseases such as tuberculosis (some strains of the bacteria are resistant to antibiotic therapy); the herpes virus; fungal infections such as candida, influenza, and pneumonia may be secondary to autoimmune diseases and other systemic conditions that increase vulnerability to infection. Social conditions such as homelessness, malnutrition, and inadequate medical care increase children's risk of contracting these infections. Speech pathologists frequently must seek out sources of funding from philanthropic community groups to ensure that all chronically hoarse schoolchildren are referred for medical evaluation.

III. PEDIATRIC VOICE PROBLEMS ASSOCIATED WITH OTHER CONDITIONS

Voice problems frequently are seen as part of a larger pattern of problems that may include cognitive, sensory, skeletal, or neuromuscular components. In many cases, these children have so many symptoms that the dysphonia seems to be a low priority when treatment programs are designed. Yet, voice is the foundation on which oral communication is built and inappropriate vocal patterns frequently stigmatize children unnecessarily. Early attention to voice training can be extremely advantageous. The speech pathologist can employ individual treatment, the consultation model, or provide classroom sessions specifically designed to teach improved vocal behaviors.

A. Hearing Impairment

One in every 1000 infants is born profoundly deaf and 24 of every 1000 have moderate to severe hearing loss (Kempe, Silver, O'Brien, & Fulginiti, 1987). Various childhood ear disorders increase this incidence through the childhood years. Hearing loss is commonly related to voice problems, and the severity of the loss and the type of amplification and speech training affect the extent and the prognosis for amelioration of the voice symptoms.

1. Intervention programs targeting children with hearing loss usually include activities to improve:

   a. **Vocal quality**

   b. **Resonance** (cul de sac pattern; tongue retraction)

   c. **Vocal variety**

   d. **Rhythm and rate**

   e. **Pitch characteristics**

   f. **Auditory, oral, tactile and visual monitoring**

2. **To improve the voice patterns** used by hearing-impaired children, the speech pathologist should implement intensive stimulation of vocal variability beginning in the preschool years.

   a. **Goals** should include teaching the relationship between feeling states and vocal patterning, meaning, and "voice pictures," and the pairing of large motor activities with rhythmic vocalization patterns (Andrews & Summers, 1993; Flynn, Andrews, & Cabot, 1990).

   b. Throughout the elementary school years, this **attention** to vocal variety **should be continued.**

   c. **Rules for vocal variation** can be taught in association with written language tasks in the classroom setting. Examples include:

(1) each new thought is marked with a voice change

(2) direct speech is marked vocally and must be contrasted with indirect speech

(3) voice reflects the action in action verbs

(4) choose at least one voice picture in every sentence

(5) pitch, loudness, and duration changes must match the meaning of each picture word

(6) match the rate to the mood and feeling

Consider the materials presented in Table 3-2, that were designed as part of a therapy program for Emily, a 10-year-old with bilateral, moderate, sensorineural hearing loss.

3. Forner and Hixon (1977) noted that children with hearing impairments had normal tidal respiration patterns but **abnormal respiration function** when speaking. Some hearing-impaired children seem not to inhale automatically when

Table 3-2. Practice in vocal variation.

Rule	***Practice Materials***
New thought/new voice	Today's news headlines include fighting in Somalia, torrential rain in Florida, and the birth of a panda cub at the zoo.
Contrast direct/indirect speech	The girl said "It's not fair" when her sister got more cookies.
Reflect action in verbs	She *jumped, stumbled,* and *giggled.*
Picture word/duration	She *yawned* a lot in class.
Picture word/loudness	She heard the *thunder.*
Picture words/pitch	The dolphin *flipped* out of the water then *sank.*
Rate matches feeling and actions	I was so very tired, but she was marching ahead.

preparing to speak and do not take replenishing breaths effectively. Some may exhale air before beginning to talk. The poor respiratory control adversely affects voice quality and must be addressed in therapy. Inadequate laryngeal valving, in combination with poor respiratory control, adversely affects both vocal quality and carrying power.

4. **Abnormal posturing of the tongue** in the hypopharynx produces cul-de-sac resonance (Boone & McFarlane, 1988). Subtelny, Li, Whitehead, and Subtelny (1989) reported on the cephalometric and cineradiographic analysis of resonance patterns in hearing-impaired speakers. They found that, compared to normal speakers, hearing-impaired individuals

   a. Show greater variation in basic tongue posture during production of vowels,

   b. Show significant retrusion of the tongue for front vowels.

   c. show consistent retrusion of the dorsum or root of the tongue during contextual speech.

   Cul-de-sac resonance, hypernasality, and hyponasality patterns all may contribute to the perception of deviant voice quality in deaf and hearing-impaired speakers. This underscores the need for careful instrumental and perceptual analysis, feedback, and early intervention to stimulate and shape vocal development.

B. Cerebral Palsy

Cerebral palsy, which is the result of damage to the central nervous system before, during, or shortly after birth, may result in various degrees and types of communicative dysfunction depending on the site and extent of the damage.

1. **Symptoms** involving respiration, phonation, articulation, and resonance may include both sensory and motor components and aspects of flaccidity and spasticity in muscle tone. Overflow, chorea, or tremor may be present. Negative behaviors relevant to voice can be mild, moderate, or severe or can disrupt oral communication development completely, necessitating the use of an alternative/augmentative communication system.

2. Decisions concerning **voice treatment** must be made in the context of the overall habilitation approach adopted by all members of the treatment team (e.g., physical and occupational therapists, physicians, and teachers). Descriptions of management approaches appear in Mysak (1980) and Scrutton (1984).

   a. **Dysphonia** is usually part of an overall dysarthric pattern. and both facilitative and compensatory approaches to the shaping of vocal behavior are employed.

      (1) **Facilitative strategies** include using vegetative functions such as breathing and feeding actions and other nonspeech activities as a basis for developing vocalization patterns and speech.

      (2) **Compensatory strategies** focus on direct manipulation of the dysarthric speech functions, adapting and shaping responses to make adjustments for the sensorineural constraints. Techniques include:

      use short phrases

      use slow rate

      use phonetic approximations

      pause before key words

      practice prosodic patterns

      (3) **Early intervention and parent involvement** in activities such as positioning the child and moving the child's body and limbs to maximize respiratory and phonatory patterns are helpful in the process of developing voluntary phonation.

      (4) Prolongation of vowel sounds for 4–5 seconds, control of pitch during vowel prolongation, and the inhibition of undesirable habits (e.g., voicing during inhalation, extension or retraction of jaw) are sensible **early goals.**

      (5) The effect of overall **posture,** the influence of **primitive reflexes,** and the need for **physical manipulation**

based on a complete understanding of the child's neuromotor deficits are important aspects to consider. Neurodevelopmental spasticity or dyskinesia involves complex symptomatology, and voice therapy must be integrated into the total management program.

C. Craniofacial Dysmorphology

Craniofacial morphology, velopharyngeal dysfunction, and disorders affecting the nasal cavities may also exert an influence on laryngeal behavior and/or affect voice treatment. Golding-Kushner (1992) studied skeletal morphology in individuals with overt or submucous cleft palate associated with Stickler syndrome, Treacher Collins syndrome, velo-cardiofacial syndrome, and van der Woude syndrome.

1. **Velopharyngeal insufficiency and incompetence.** In the Golding-Kushner (1992) study, the **prevalence of resonance and voice disorders and compensatory speech disorders** such as glottal stops was identified. Results indicated that craniofacial morphology and resultant airway size and configuration were related to differences in velopharyngeal closure patterns. For example, there was a lower prevalence of velopharyngeal insufficiency (VPI) in the presence of an acute cranial base angle that shortened the pharyngeal depth and a higher prevalence when an obtuse cranial base angle was present. However, syndrome diagnosis was a more accurate indicator of the prevalence and severity of VPI than was pharyngeal width.

2. **Severity of hypernasality and specific speech disorders** (e.g., glottic stops) also were related to syndromic diagnosis. In the past, differences in communication outcome following repair of palatal clefts have been attributed to treatment effects, such as age at the time of palate repair, extent of cleft, surgical procedure, and therapy. The Golding-Kushner (1992) study (**N** = 129) focused on the effect of skeletal morphology as a predisposing factor relevant to predictable communication outcomes.

3. **Le Blanc, Jablon, Gereau, and Rubin (1993) reported on the incidence of voice disorders** in the craniofacial population and found that 47% of patients studied retrospectively

(N = 300) had vocal problems. A prospective study of 76 children with facioaurico-vertebral malformation complex indicated that dysphonia occurred in 38%, and laryngeal pathology was identified in 25% of the subjects. These findings underscore the importance of evaluation and treatment of laryngeal function in children wtih craniofacial anomalies.

D. Nasal Obstruction

Nasal obstruction in children may be related to masses in the nasal passages, deviation of the nasal septum, sinusitis, turbinate hypertrophy, chronic rhinitis, adenotonsillar hypertrophy, and foreign bodies. One of the most common surgical procedures is functional endoscopic sinus surgery (FESS) to treat symptoms of asthma, cystic fibrosis, and chronic sinusitis and ciliary dyskinesia.

1. **Symptoms** include obstruction, hyponasality, rhinorrhea, chronic cough, headache, and behavioral change.

2. **Computed tomography** (CT) scans, serial plane radiographs, immune studies, allergy tests, ciliary biopsy, and sweat chloride testing may be employed diagnostically.

3. **Treatment.** Failure to cleanse mucus, organisms, and other debris in the nose and paranasal sinuses when there is inflammation or anatomical aberration easily leads to recurrent or chronic sinusitis. Hypertonic saline solution is an inexpensive therapeutic modality that is effectively used with young children with congenital nasal abnormalities (Parsons, Wilder, & Wolf, 1993).

4. An **Odor Identification Test** for children, developed at the University of California-San Diego Medical Center, can be used to evaluate olfactory deficits that may occur as a result of paranasal sinus disease, head trauma, Kallman or Down syndrome, and cystic fibrosis. Baby powder, bubble gum, chocolate, coffee, mustard, cinnamon, peanut butter, and Play-doh are the odor stimuli used. Results with 395 normal children show that, by age 6, virtually all odors can be identified. Girls score significantly higher than boys, and children with sinus problems score significantly lower than age-matched controls (Myer & Duncan, 1993). Voice therapy for hyponasality may include tactile and aerodynamic feedback, hum-

ming, and chanting to emphasize the facial buzz, singing, and olfactory training for hyposmia (reduced sense of smell).

5. The **removal of an obstruction** may result in post-operative hypernasality. Usually the child adapts to the changes in the mechanism and a normal balance of oral and nasal resonance is restored in about 6 weeks post-operatively. If hypernasality persists post-adenoidectomy, the surgery may have unmasked a velopharyngeal dysfunction. Videonasalendoscopic evaluation is then needed to assess velopharyngeal function. Pre-operative assessment of velopharyngeal function should be conducted to avoid post-operative problems of this kind.

E. Obstructive Sleep Apnea Syndrome

Obstructive sleep apnea syndrome (OSAS) has become a well recognized disease process in children.

1. It is **characterized by** loud snoring, restless sleep, and partial or complete obstructive events during sleep that result in labored breathing, hypoxemia[6] and hypercapnia[7].

2. **Treatment**

   a. Although adenoidal and tonsillar hypertrophy is the most common etiology of OSAS, **adenotonsillectomy** has been a subject of controversy. This is because the role of the tonsils in local and general immunity has not been clearly defined. Additionally, some patients do not seem to benefit from this surgery because of other complications. For example, in some children, obesity, neurological disorders, or craniofacial malformations may contribute to OSAS.

   b. **Continuous positive airway pressure** (nasal CPAP) has been used with children (Traquina & Rosen, 1991) as an alternative to tracheostomy when adenotonsillectomy failed to relieve their symptoms.

[6]Abnormally low content of oxygen in the arterial blood, also called anoxemia. Abnormal reduction of oxygen in body tissues, or oxygen deficiency is referred to as hypoxia.

[7]Hypercapnia means that there is an abnormally high concentration of carbon dioxide present in the blood. Also referred to as hypercarbia.

c. Additionally, the surgical technique of **Uvulopalatopharyngoplasty** is sometimes used for OSAS in children with craniofacial anomalies, obesity, and Down syndrome. Voice clinicians should question parents about patients' sleep habits during history taking especially when children present with hyponasality. Figure 3-7 shows some of the characteristics of enlarged adenoids in children. Fatigue, mouth breathing, slowness in eating, circles under eyes, enlargement of bridge of the nose, snoring, and slowed growth may be noted in children with chronically enlarged adenoids.

F. Trauma

Impalement injuries of the soft palate and oropharynx are sometimes seen in children. Occasionally there will be neurologic sequelae secondary to thrombus propagation in the internal carotid artery. Complications can occur anytime from 3 to 60 hours after injury. Additionally, trauma is the most frequent cause of acquired clefts in children.

G. Lesions

Lesions of the hard palate are rare in infants and children. Differential diagnosis includes consideration of torus palatini[8], osteoma[9], odontogenic[10] cyst, odontoma[11], and sarcoma[12]. Ling and Haddad (1992) reported on an unusual case of an 11-month-old infant who presented with a bony, fixed, nontender mass of the lateral hard palate. Surgical evaluation revealed a half shell of an undyed pistachio nut. The convex surface had adhered by suction to the palate mucosa and become embedded. The findings in this case emphasize the importance of the possibility of foreign bodies in consideration of the etiology of palatal lesions in children.

[8] An overgrowth of bone, usually in the midline of the palate.

[9] A benign, osseous (bone) tumor.

[10] Derived from tissues involved in tooth formation.

[11] A tumor of tooth-related tissue (benign).

[12] A malignant tumor composed of connective tissue.

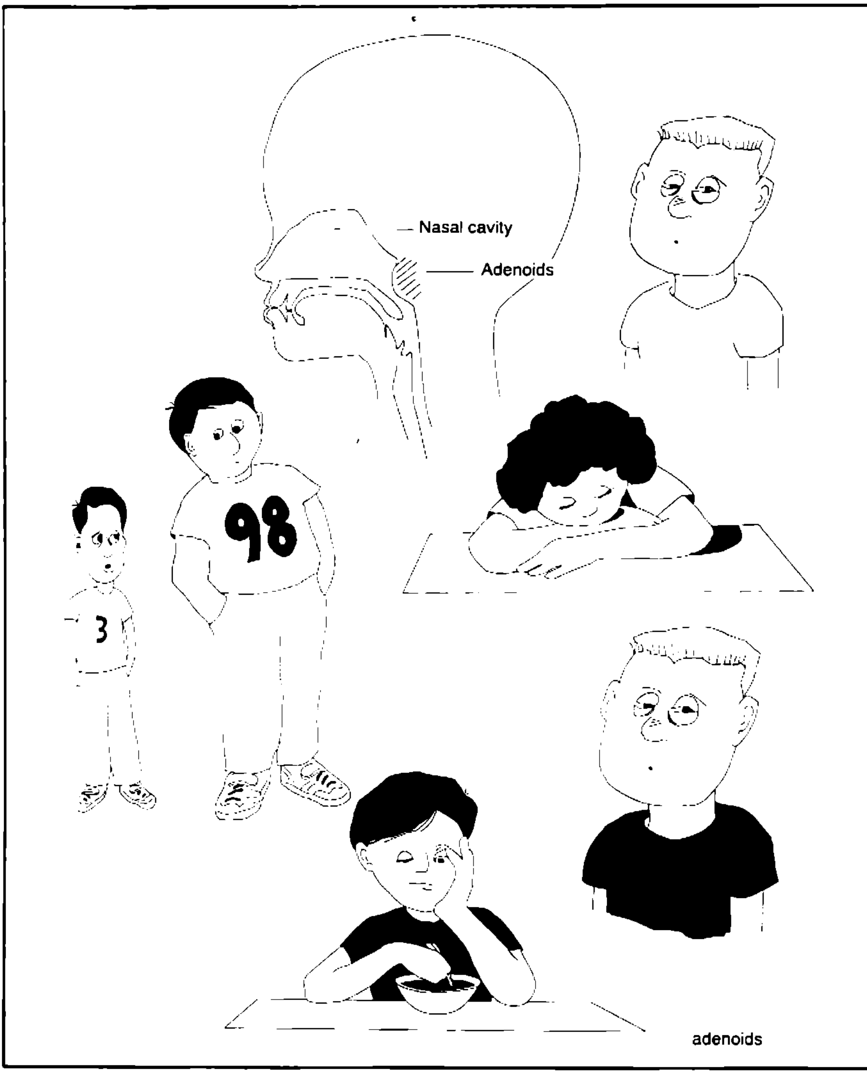


Figure 3-7. Possible behavioral and physical manifestations of severely enlarged adenoids. Children may be slow eaters resulting in below average physical size, be sleepy in school, and have discernible facial signs. (Jim Hull, Graphics Services, Indiana University)

IV. THE VOICE AT PUBERTY

A. Changes in the Larynx During Puberty

The larynges and the voices of prepubertal males and females are similar. At puberty, the larynx descends; and the dimensions of the infraglottal, sagittal, and transverse planes increase. The anterior-posterior dimensions of the larynx also increase, with greater increases in the male larynx than in the female larynx. The angle of the male thyroid lamina decreases to form a more distinctive "Adam's apple." Kahane (1978) compared prepubertal and pubertal cadaveric larynges and consistently noted several morphological relationships. Pubertal cartilage and soft tissue measurements were significantly larger than prepubertal measurements for both sexes, but within-sex differences were greater among males than females. There was significantly greater growth in the male larynx, especially in the anterior aspect of the thyroid cartilage, than in the female larynx from prepuberty to puberty. In both males and females, however, the vocal folds increase in length, the mucosa becomes stronger, and the epiglottis increases in size. When measurements of the entire length of the folds (including membranous and cartilaginous portions) are made, the average increase is 4.2 mm in females and 10.9 mm in males.

1. The **adolescent growth spurt** is the first overt sign of puberty. Boys develop, on the average, 2 years later than girls. The growth spurt affects nearly all skeletal and muscular dimensions but in different degrees. Boys develop larger lungs, relative to their overall size, which increases their respiratory capacity. Boys also have greater increase in the length of their bones. Skeletal maturity is often measured to ascertain developmental age and is closely related to the age at which adolescence (maturity measured by secondary sex characteristics) occurs. Klock (1968) reported that, in general, the growth of the larynx is directly proportional to an individual's height rather than age. Andrews and Summers (1988) discuss vocal mutation and its timing in relation to the overall process of puberty.

   a. Although the timing of the onset of puberty varies, the **sequence of events** is similar among individuals. Pubic hair, genital development, and growth spurt (height increases) are the earliest changes; laryngeal maturation, and axillary and facial hair occur later in the process. Increased resonance capacity occurs as a result of the enlargement of facial structures and sinuses.

b. **Girls complete the growth spurt earlier than boys** — about age 11 to 13 versus as late as 15 for boys. Sebaceous and sweat gland development is more marked in boys.

c. **Changes in the size and mass of the vocal folds** are also less for girls, and their pitch levels lower only about 3 or 4 semitones (Zemlin, 1988) versus approximately an octave for males. Some adolescent males experience embarrassment because of uncontrollable pitch breaks during voice change (vocal mutation). However, most adolescents proceed through vocal mutation uneventfully and do not suffer from these stereotypical behaviors of the adolescent male (Andrews & Summers, 1988).

B. Conditions Affecting Vocal Behavior at Adolescence

The teenage years are characterized by considerable voice use, and both the amount and type of voice use are significant. Vocal demands seem to increase just at the time when the mechanism is undergoing changes. Although healthy laryngeal structures are capable of withstanding a great deal of use, resilience of tissues in relation to severity of insult may vary among individuals.

1. **Factors that increase susceptibility to voice problems** during adolescence include:

   a. asthma

   b. infections

   c. allergies

   d. trauma

   e. chemicals (ingested and airborne)

   f. vocally demanding activities

   g. alcohol and drugs

h. dryness

i. sinus problems

j. life stresses

2. **Chronic sneezing and coughing secondary to allergic rhinitis.** Reflexes such as coughing, sneezing, and vocal fold adduction are protective mechanisms to maintain the airway. For example, sneezing results from complex coordinated communications from the afferent fibers of the trigeminal and nervus intermedius nerves as well as from the glottic and inspiratory muscles. Many adolescent patients exhibit chronic sneezing and coughing secondary to allergic rhinitis. Occasionally paroxysmal intractable reflexive behaviors are reported. Park and Hotaling (1992) presented the case of an adolescent male who had experienced debilitating chronic sneezing for over 1 year. His attacks would progress to 25–30 sneezing episodes per hour for weeks at a time and caused disruption of school and other activities.

   a. Reflexive behaviors that are **physiologic responses to irritants** and become chronic are debilitating and may also be implicated in vocal fold abuse.

   b. Sometimes symptoms such as chronic coughing, paradoxical vocal fold motion, shortness of breath, throat clearing, and wheezing are due to **functional upper airway obstruction or pseudo-asthma.**

   c. **Behavioral therapy** can alleviate these symptoms, and treatment programs typically include pulmonary testing, stroboscopic examination, and analysis of the effects of prescription and nonprescription medications. Edema and erythema (redness) of the folds may be noted as well as thick stranding mucus secretions. The drying effects of medications, and limited hydration, contribute to these problems and must be addressed together with modification of habituated reflexive behaviors. Patient re-education is an important part of the treatment plan. Figure 3–8 depicts the constriction of the air passages experienced as a result of asthma. Figure 3–9 shows the difference between normal sinus cavities and those charac-

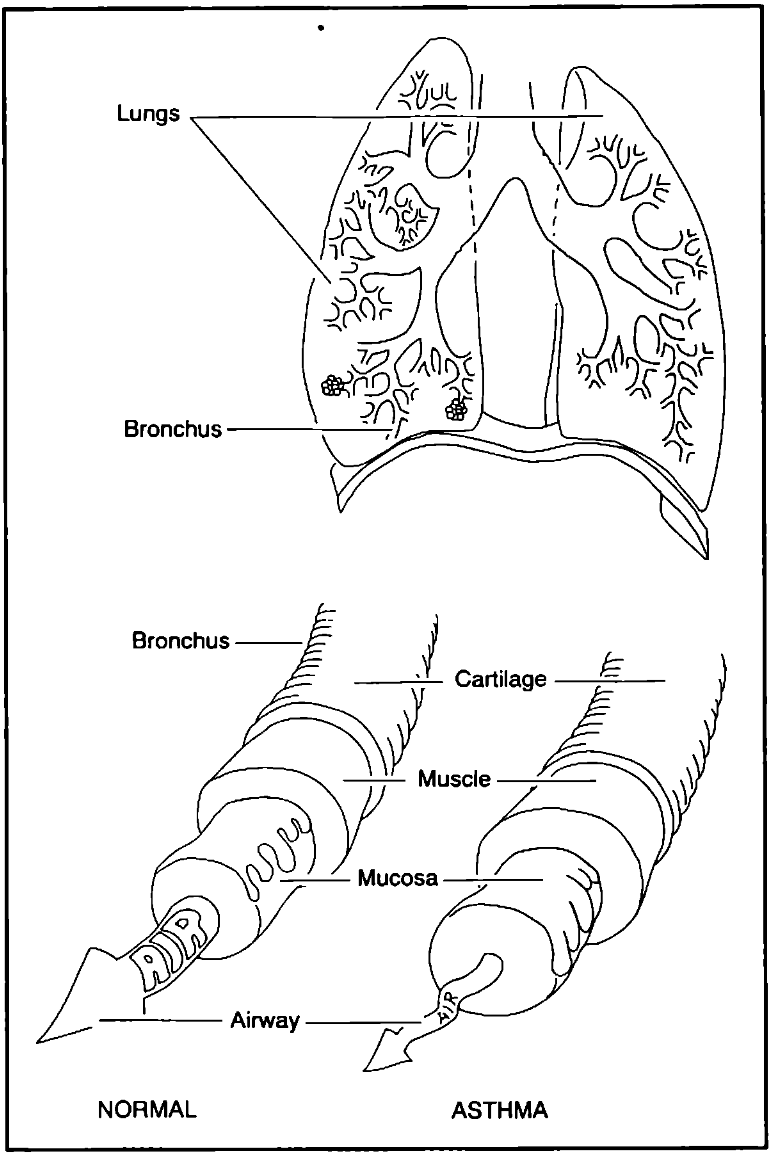


Figure 3-8. Respiratory disorders such as asthma may result in constriction of the airway. Audible signs may include wheezing during exhalation. (Jim Hull, Graphics Services, Indiana University)

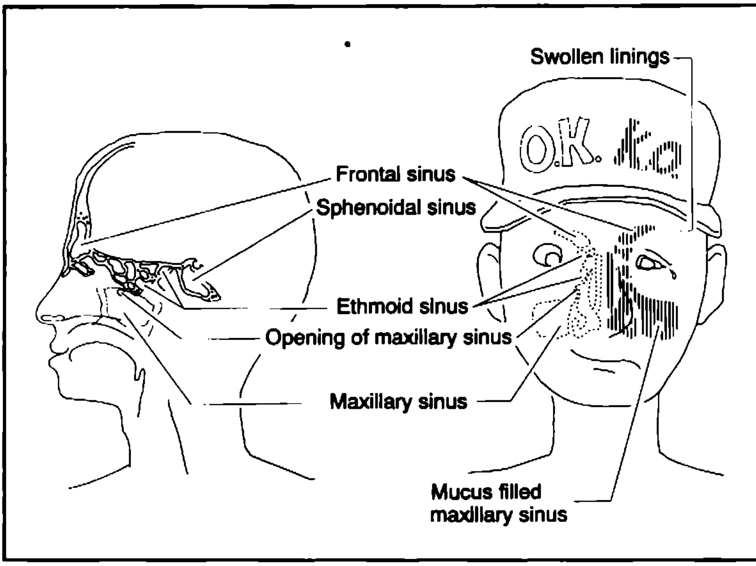


Figure 3-9. Diagram showing the sinus cavities with mucus obstructing one maxillary sinus. (Jim Hull, Graphics Services, Indiana University)

teristic of sinusitis. Note the shaded areas on the left indicating the presence of swollen membranes and congestion in the cavities.

3. **Recurrent epistaxis** (nosebleed) may be due to mild trauma to the anterior portion of the nasal septum. It may result from falls or fights or vigorous nose rubbing, nose blowing, or picking. Other contributing factors that must be ruled out include:

   a. allergic rhinitis

   b. chronic bleeding disorder

   c. aspirin use

   d. vascular malformation (e.g., hemangiomas or varicosities)

   e. hypertension

f. nasopharyngeal angiofibroma[13] (seen in adolescent males)

g. trauma resulting in fracture, hematoma, or nasal septum abscess.

4. **Mutational falsetto** is the maintenance of a childlike vocal pattern after the process of puberty has been completed and laryngeal changes have occurred. In other words, the patient has a mature larynx but fails to adopt mature vocalization patterns.

   a. **Diagnosis.** Laryngoscopy may indicate excessive tension, especially in the posterior cartilaginous area, with vibration of the folds restricted to the anterior membranous portion. Elevation of the larynx may also be observed.

   b. **Treatment.** The first step in treatment is to **ensure that laryngeal maturation has** indeed **taken place.** Medical examination to ascertain the absence of endocrinologic or structural problems (e.g., a small, previously undetected web) is a sensible policy. Overt signs, such as completion of the height spurt and the presence of facial hair, also can be used to ascertain whether a young man has begun the process of puberty. Systematic diseases such as collagen diseases, anemias, cardiac disorders, renal diseases, malabsorption of nutrients, and obesity can inhibit puberty. Bulimia and anorexia are also sometimes seen in males as well as females and may affect growth and development.

   c. **Voice Treatment.** Many clinicians hypothesize that retention of a high-pitched voice is related to underlying **psychosocial conflicts** and rejection of the male role model.

      (1) Techniques to **elicit lower pitched phonation** include:

         (a) coughing and prolonging the sound into a vowel

         (b) beginning a vowel with a glottal attack

         (c) decreased tension in the musculature

[13]A benign tumor.

(d) dropping the larynx from an unusually high position

(e) humming resonantly down the scale

(f) sliding down the scale

(g) matching visual patterns on a screen (e.g., Visi-Pitch™; IBM Speech Viewer™)

(h) digital manipulation (gently pressing the thyroid cartilage during a sustained vowel)

(2) **Demonstration of the availability of lower pitches** is sometimes all that is necessary if the male demonstrates a readiness for change.

(3) When **resistance to habituation** is demonstrated, either overtly or implicitly, the speech pathologist must explore maintaining factors, habituation hierarchies, and counselling.

(4) **Additional symptoms** that may need remediation include:

(a) thin, breathy, or hoarse quality

(b) inadequate resonance

(c) shallow breathing

(d) muscle tension

(e) pitch breaks

(f) lack of appropriate variability

(g) reticence and embarrassment

(h) nonauthoritative intonation patterns

(i) weak carrying power and projection

C. Vocal Abuse

Vocal abuse is frequently seen in teenagers and may be associated with chronic, nonspecific laryngitis, nodules, polyps, cysts, hematoma, thickening, and edema.

1. Appropriate **treatment** includes medical evaluation and reduction of abuses and maintaining factors in addition to increased hydration and understanding of the basis of the problem.

2. The major **differences in working with a teenager,** as opposed to a younger child with vocal abuse, is that the partnership between the speech pathologist and the patient is quite different.

   a. Adolescents, because of their emerging sense of autonomy and more advanced cognitive skills, benefit greatly from co-managing their program.

   b. Choice, however, does not preclude structure and **clearly specified goals.** Although goals should be clearly defined, the methods used to achieve the goals may be negotiable.

3. **Case Example**

   Consider the environmental controls and alternative voice strategies that were arrived at through collaboration between the speech pathologist and Diane, a 15-year-old cheerleader with vocal nodules. Diane had a very demanding schedule. She participated in a lot of vivacious talking, shrieking, and laughing during the day. In the evenings, she spent hours on the telephone or invited friends over to work on homework. She constantly played loud music on her CD player and talked over it. She was constantly "hyped-up," stayed up very late at night, and argued loudly with her sister. Diane's biggest fear seemed to be that the speech pathologist would make her into a "drab, mousy person with no personality." The clinician's first task was to win her confidence and convince Diane that she would be the one who researched her problem and decided how to make changes that were comfortable for her. Blager et al. (1993) reported that cheerleaders

(9) Practice yoga to relax and decrease tension in face and neck

(10) Improve breathing patterns/breath support during cheering

D. Vocal Behavior in High-Functioning Autism

The Diagnostic and Statistical Manual of Mental Disorders, Third Edition-Revised (DSM 111-R, 1987) lists four major symptom areas indicating the presence of autism. These are onset during infancy and early childhood, qualitative impairment in verbal and nonverbal communication and in imaginative activity, qualitative impairment in reciprocal social interaction, and markedly restricted repertoire of activities and interests.

1. **Autism** is a developmental disability that is not caused by poor parenting and is not curable. It is a life-long disability which is, however, sometimes markedly improved by intervention.

2. **High-functioning autism** is seen more frequently in males but occurs in both sexes. This condition may also be described as residual autism, Asperger syndrome, able autism, near-normal autism, mild autism, and socially-aware autism.

   a. Such individuals may "talk at" people about their obsessive interests for long periods of time. They are unaware of **subtle social cues** signalling listeners' lack of engagement or interest. The following symptoms may be noted.

      (1) Loudness control problems

      (2) Lack of turn talking

      (3) Impaired initiation and termination of conversation

      (4) Literal or rigid interpretation of messages

      (5) Limited social repertoire

      (6) Rapid rate

(7) Poor eye contact

(8) Tactile defensiveness

(9) Inappropriate body language

(10) Difficulty making friends

(11) Inappropriate topic selection

(12) Inability to see the perspective of others

(13) Lack of empathy

(14) Inaccurate identification of facial expression of others

(15) Repetitive verbal arguments

(16) Outbursts of inappropriate vocal behavior

b. The voice clinician may be asked to work with a psychologist or psychiatrist treating a patient with high-functioning autism who exhibits vocal abuse or other **patterns of obsessive vocal behavior** in the presence of high verbal skills.

(1) Subtle and sophisticated **methods of behavior management** (see Donnellan, LaVigna, Negri-Shoultz. & Fassbender, 1988) are recommended.

(a) Programming takes a positive approach by **teaching appropriate behaviors** to replace the inappropriate patterns.

(i) Parents, teachers, and peers are participants in **shaping the behaviors** in response to the patient's environmental and social needs.

(ii) The use of written activities can be especially fruitful in **exploring the patient's ability** to problem solve and generate solutions.

(2) Many patients are intellectually gifted, analytical. and speak rapidly in an effortful manner. Periods of

written work, sipping water frequently, and other **strategies to interrupt the lengthy periods of talking** are helpful.

(3) Ritualistic **relaxation activities** and **deep breathing** can also be used. Many of the patients seen with excessive "pushed" talking exhibit psychosocial difficulties, and the compulsion to express every thought before it is forgotten. Hoarseness may be related to long periods of talking such as telephone conversations lasting many hours. Information concerning management of this disorder may be obtained by writing to Maap Services, Inc., P.O. Box 524, Crown Point, Indiana 46307.

V. THE TREATMENT OF RESONANCE DISORDERS

Resonance disorders may result from structural deviations, defects in neuromuscular function, secretions, presence of foreign bodies, or faulty learning due to sensory impairment, poor models, or faulty phonological learning.

A. Evaluation of Velopharyngeal Function

Instrumental and perceptual analyses are used to evaluate velopharyngeal function. Clinicians who do not have access to laboratory equipment may refer patients to centers where instrumental assessment is available.

1. **Voice therapy should not be instigated until the possibility of velopharyngeal insufficiency has been thoroughly investigated with visualization of structures** (e.g., endoscopy). Otherwise, efforts to produce velopharyngeal closure can lead to behaviors that are inappropriate and result in frustration and inappropriate compensations such as laryngeal stops (glottal stops), velar fricatives, and pharyngeal fricatives.

2. It is especially important to investigate velopharyngeal **closure during connected speech.** Some children may be capable of closure only during production of isolated speech sounds and during nonspeech activities (e.g., blowing). This does not necessarily suggest that behavioral therapy will be successful.

3. **Instrumental techniques** used to supplement listener judgments, articulation testing, and oral examination include:

   a. **Radiological assessment** (e.g., videofluroscopy, Multiview, Base and Towne views, tomography, and magnetic resonance imaging)

   b. **Endoscopy** (flexible, transnasal)

   c. **Simultaneous radiologic and endoscopic evaluation**

   d. **Aeromechanical** (airflow and pressure) and nasometer

B. Management of Velopharyngeal Insufficiency and Incompetence

Management of hypernasality includes medical, surgical, prosthodontic, and behavioral modifications.

1. **Pharyngeal flap pharyngoplasty** is the most common surgical procedure. A flap of tissue from the posterior pharyngeal wall is permanently attached to the velum. Spaces on either side of the flap allow the patient to breathe but are closed (due to lateral pharyngeal movement) during speech and swallowing. Occasionally, this surgery is done during basic palatoplasty to close a cleft. It is then considered a primary procedure. More often, however, it is done as a secondary procedure, later in life, to improve speech. Flaps may be individualized to fit particular patient's needs (e.g., may be superiorly, medially, or inferiorly based) and are most successful when there is active lateral pharyngeal wall movement to close the openings on either side of the flap during speech.

   a. **Velo-cardio facial syndrome** (VCF) is the most common syndrome of clefting and is associated with velopharyngeal insufficiency (VPI) in almost all cases. Because patients with this syndrome have limited lateral pharyngeal wall motion, pharyngeal flaps must be very wide to be effective. Some experts believe that pharyngeal flaps should be avoided in patients with VCF because of their frequent history of obstructive sleep apnea in infancy, their cardiac disease, the need for nearly complete obstruction of the nasopharynx for surgery to be effective, and the frequent finding of pulsations in the pharynx related to medial displacement of the internal carotid artery. Golding-Kushner and Argamaso (1993) however, reported on a series of over 50 patients with VCF who were treated successfully with pharyngeal flaps.

b. Sprintzen, Goldberg, Kucherlapati, and Scambler (1993) noted that a conservative estimate of the **incidence of VCF** is 1:5,000 live births. They note the recent discovery of later-onset mental disorders, including schizophrenia and other personality disturbance, in adolescents and adults with VCF. They also report confirmation of a microdeletion of the long arm of chromosome 22 at the 22q11 locus. Included in the genes in the region of 22q11 may be major candidate genes for cleft palate, schizophrenia, learning disabilities, and congenital heart disease. Of major importance to clinicians is the fact that VCF syndrome patients are identified primarily on the basis of their profile of communication disorders.

2. **Teflon injection for pharyngoplasty.** Teflon and other substances have been used to increase the bulk of the pharyngeal wall so that closure can be achieved despite a short or insufficient velum or a wide pharyngeal space. This is similar to the anterior inbulging of the pharyngeal wall that occurs spontaneously in some patients and is known as Passavaunt's pad. Although teflon injections have been used experimentally, they are not approved by the FDA and may cause obstructive sleep apnea to develop in some patients.

3. **Speech appliances** are prepared and fitted by prosthodontists. Speech obturators and lift-obturator prostheses are used for velopharyngeal inadequacy and insufficiency when surgery is contraindicated. Beery, Rood, and Schramm (1983) reported on increased lateral and posterior pharyngeal wall activity of five adults who wore prosthetic speech appliances for more than 20 years with positive long-term results.

4. **Voice therapy** for hypernasality in children may utilize feedback devices such as the See-Scape™ (available from Pro-Ed, Inc., 8700 Shoal Creek Boulevard, Austin, Texas 78758) or the Kay Elemetrics (Pinebrook, New Jersey 07058) Nasometer.

5. An approach to **behavioral modification of hypernasality,** that may be used *subsequent to* surgical or prosthodontic treatment resulting in the capacity for adequate closure, is outlined in Table 3-3. Such an approach would, of course, not be appropriate if closure capability has not been documented.

6. **Another method of decreasing hypernasality** is advocated by Shprintzen, McCall, and Skolnick (1975). It involves pairing whistling and blowing with vocalizations to improve velopharyngeal closure.

C. Management of Hyponasality

The treatment of hyponasality usually requires **medico-surgical treatment.** Hyponasality occurs because of blockage in the nasal cavities. Obstruction may be due to foreign bodies (some children may put small objects in their nostrils) or excessive secretions. Chronic obstruction may result in mouth breathing and noisy breathing, snoring, or obstructive apnea during sleep.

1. **Tonsils and adenoids** are lymphatic tissue that may become chronically infected and enlarged and cause obstruction and also block the opening of the eustachian tube causing middle ear problems. Since some children with velopharyngeal inadequacy (e.g., submucous cleft) make closure against adenoidal tissue, careful assessment including visualization should always precede adenoidectomy.

2. **A deviated nasal septum** occasionally may cause obstruction and occlude the opening to the frontal sinus cavity.

3. **Edema of the lining of the nasal cavities** and congestion may be due to allergic rhinitis, infections, premenstrual syndrome, or turbinate disease.

4. **Nasal polyps** may obstruct breathing and resonance. They typically are seen in patients with allergic rhinitis; are benign; attached to a stalk (pedunculated); and are soft, movable, and not painful. They occur usually in adult or adolescent patients.

5. **Papillomas** also may occur in the nasal cavity in the squamous epithelium. They are benign, wart-like growths that are viral in origin.

Table 3–3. Some strategies for a child with the capacity for behavioral modification. Note the emphasis on teaching basic concepts relevant to appropriate resonance.

Awareness	
Step I:	The first step involves teaching the child characteristics of nasal versus oral sound and air emission. Even with very young children, this is an important basis for all future evaluations of productions. Activities using a Nose House and a Mouth House and color-coded flashcards can be used to teach the distinction between nose and mouth sounds. Children can place the cards in the appropriate house as the clinician makes the sounds and describes the characteristics.
Question:	How can you tell it's a nose sound? "mm"
Answer:	Mouth is closed; vibration in the nose; air comes from the nose
Question:	How can you tell it's a mouth sound. "aaa"
Answer:	It's a vowel; it comes out of the mouth; can't feel any vibration in the nose (hands on nose)
Step II:	Because the action of velopharyngeal closure cannot be seen, the child may need to think of a "trap-door" at the back of the throat. A simple model may be made to illustrate the opening and closing action. The child can be taught that the trap-door is closed when mouth sounds are made and open for nose sounds.
Question:	Is the trap-door open or closed? "aa"
Answer:	"aa" is a vowel and so it's a mouth sound, so the trap-door is closed.
Step III:	Monosyllabic words can be said in slow motion and coded in terms of trap-door action.

P	A	M
mouth sound	mouth sound	nose sound
↕	↕	↕
trap-door closed	trap-door closed	trap-door open

Step IV:	Discrimination of oral and nasal sounds in CVs and VCs.
Production	
Step V:	Spontaneous production of sentences produced with appropriate oral resonance (words include only vowels and oral consonants)
Step VI:	Production of structured phrases (words include nasal consonants only in the final positions)

(continued)

Table 3-3. *(continued)*

Step VII:	Production of structured phrases (words include nasal consonants in initial positions)
Step VIII:	Production of structured phrases (words include nasal consonants in all positions)
Step IX:	Production of longer, more complex sentences (reading)
Step X:	Production of oral and nasal sounds in self-generative sentences.

Note: The rationale for the above program and a more detailed summary is found in Andrews, Tardy, and Pasternak (1984).

6. **Malignant tumors** of the nasal cavities fortunately are rare but occasionally may develop and cause obstruction, hyponasality, secretions, and pain.

7. **Cocaine use** can cause destruction of nasal tissues.

D. A Balance of Oral and Nasal Resonance

An effective voice is characterized by a balance of oral and nasal resonance.

1. **When confronted by a puzzling resonance pattern or the perception of mixed resonance characteristics,** the speech pathologist should:

   a. Refer for medical evaluation

   b. Conduct (or refer for) instrumental evaluation

   c. Ascertain velopharyngeal adequacy

   d. Ask patient to read a sentence with no nasals (e.g., "Charley wears a black hat.")

   e. Ask patient to read a sentence loaded with nasals (e.g., "No one knows Norman's nickname.")

   f. Open and close nares during prolonged vowels to observe the effect on quality.

2. **Stimulability techniques** to shape behavior include:

   a. Greater mouth opening

   b. Humming

   c. Chanting

   d. Altered tongue position

   e. Increased articulatory precision

   f. Improved frontal tone focus

   g. Visual feedback

   h. Negative practice

   i. Exaggerated "mouth gymnastics"

   j. Sentences loaded with front vowels and tongue tip consonants (e.g., "Tillie typed Bill's list of titles.")

   k. Word pairs to contrast the presence and absence of nasal vibration in words, for example:

tone	toad
loom	loop
long	log
mail	pail
neat	feet
Danny	Daddy
spoon	spoof
whine	white
sign	side
leaner	liter

VI. SUMMARY

This chapter began our review of vocal behavior across the life span. The physiologic systems relevant to voice production are discussed from a developmental perspective. Structural anomalies and diseases of the respiratory tract and medical and surgical treatments are noted. The aim is to emphasize how a great number of congenital and acquired conditions may affect the development and habituation of appropriate voicing patterns. To emphasize the importance of complete case history information, the relevance of the possible effects on voice of infant airway obstruction and medical and surgical treatments to alleviate it were reviewed. The discussion of voice problems seen in the preschool population was followed by a discussion of school-age children and conditions and treatment approaches relevant to their life stage. Next, maturational changes occurring at puberty, and an outline of an intervention program designed for a cheerleader were presented. Finally, because phonatory and resonance disorders may, in some instances, co-exist, a brief summary of factors affecting resonance and some suggestions for the treatment of resonance disorders seen in the pediatric population was presented.

CHAPTER

4

Adult and Geriatric Disorders

I. ANATOMY AND PHYSIOLOGY

The larynx is made up of a cartilaginous framework connected by intrinsic and extrinsic muscles, lined with mucous[1] membrane. It is suspended from the hyoid bone, the only bone in the neck, and considerable movement and flexibility of neck posture is possible.

A. Laryngeal Structures

1. Cartilages

There are nine cartilages. The arytenoids, corniculates, and cuneiforms are paired; the thyroid, cricoid, and epiglottis are individual cartilages.

[1] Muc*ous* membranes are membranes consisting of, resembling, or producing muc*us*.

a. The **epiglottis** protects the airway by acting as a movable leaf-shaped cover, attached by ligaments to both the thyroid cartilage and the hyoid bone. It projects upward toward the base of the tongue and prevents food or liquid from entering the trachea during the act of swallowing. The aryepiglottic folds of mucous membrane encompass fibers of the arytenoideus muscle, and run down either side of the epiglottis to the arytenoid cartilages and contain the small cuneiform cartilages.

b. The **triangular arytenoid cartilages** rest on the top of the posterior elevation of the cricoid cartilage. The arytenoids' rocking and sliding actions are responsible for moving the true vocal folds which are attached posteriorly to the arytenoids' vocal processes. On the flat apex of each arytenoid lies a small corniculate cartilage.

c. The **thyroid cartilage,** so named because it forms a protective shield in the front and sides of the larynx, has two sections. Posteriorly, each section has a superior and inferior cornu. The shorter, inferior cornu articulates with the cricoid cartilage below. This is the cricothyroid joint which permits both a rocking action and an anteroposterior sliding motion. The thyroid and cricoid cartilages are also connected anteriorly by the cricothyroid ligament. The fusion of the two sections or lamina of the thyroid cartilage is the most anterior point of the larynx and is the anatomical landmark known as the thyroid eminence or Adam's Apple. It forms a 90° angle in postpubertal males in whom it is most noticeable.

d. The **cricoid cartilage** that forms the base of the larynx (and the highest tracheal ring) is wider at the back and therefore looks like a signet ring. On this posterosuperior aspect, it supports the two arytenoid cartilages. The cricoarytenoid muscles are attached to the muscular processes of the arytenoids. The posterior cricoarytenoid muscles are responsible for abducting the vocal folds and thereby opening the glottis. The lateral cricoarytenoid muscles are responsible for adducting the vocal folds. Adduction is also aided by the oblique and transverse fibers of the interarytenoid muscles that help medial compression of the folds by sliding the cartilages together.

There are two pairs of joints, the cricoarytenoid and cricothyroid joints, that also affect vocal fold adjustments.

e. While the two arytenoids and the unpaired thyroid and cricoid cartilages are the major cartilages of the laryngeal framework, the others are considered **accessory cartilages.** The corniculate cartilages are mounted on the arytenoids. The cuneiform cartilages lie in the aryepiglottic folds anterior to the corniculate cartilages.

2. Muscles

a. Intrinsic muscles of the larynx, listed in Table 4–1, also include the thyroarytenoid muscle that, with the vocalis muscle fibers, forms the vocal folds. The thyroarytenoids meet at the nonmoving anterior commissure of the folds attaching to the thyroid cartilage anteriorly. Posteriorly, they attach to the vocal processes of the arytenoids. Contraction of the thyroarytenoid muscle pulls the arytenoid muscles forward, causing anteroposterior closure of the glottis. Intrinsic muscles are listed in Table 4–2, and their innervation is shown in Table 4–3.

b. The **extrinsic muscles of the larynx** are important, because they stabilize the laryngeal neck posture and can raise or lower the larynx. Their actions can also cause changes in relationships and tension inside the larynx. The extrinsic muscles are grouped according to whether their attachments are above or below the hyoid bone. These muscles are sometimes referred to as the strap muscles of the neck.

(1) Infrahyoid muscles listed in Table 4–4 and illustrated in Figure 4–1, include the thyrohyoid, sternohyoid,

Table 4–1. Intrinsic muscles and closure.

Abduction	*Adduction*
Posterior cricoarytenoid	Lateral cricoarytenoid Oblique arytenoid Transverse arytenoid Interarytenoid

Table 4-2. Intrinsic muscle actions.

Muscle	*Actions*
Thyroarytenoid/vocalis	Lowers, shortens, thickens (stiffens body of fold). Contraction alters the height of the fold surfaces and affects relaxation and adduction.
Posterior cricoarytenoid	Elevates, elongates, thins (stiffens all layers of fold). Abducts vocal folds, acts as an antagonist to the lateral cricoarytenoid.
Lateral cricoarytenoid	Lowers, elongates, thins (stiffens all layers of fold). Adducts vocal folds.
Interarytenoids	No stiffening effect on folds. Both the oblique and transverse muscles adduct the arytenoids and thus the folds.
Cricothyroid	Lowers, stretches, elongates, thins (stiffens all layers of folds). Increases distance between the thyroid and cricoid cartilages during contraction.

Table 4-3. Innervation of intrinsic muscles.

*Recurrent Laryngeal Nerve**	*Superior Laryngeal Nerve**
Thyroarytenoid/vocalis Posterior cricoarytenoid Lateral cricoarytenoid Interarytenoids (transverse and oblique)	Cricothyroid (motor innervation by the pharyngeal and caudal ramus of the external branch).

*Portion of 10th Cranial Nerve (Vagus)

Table 4-4. Infrahyoid muscles and their action.

Muscle	*Action*
Thyrohyoid	Contraction of this muscle reduces the space between the thyroid cartilage and hyoid bone most obvious in the front.
Sternothyroid	Contraction lowers the thyroid cartilage.
Sternohyoid	Contraction lowers the hyoid bone.
Omohyoid	Pulls the hyoid bone lower.

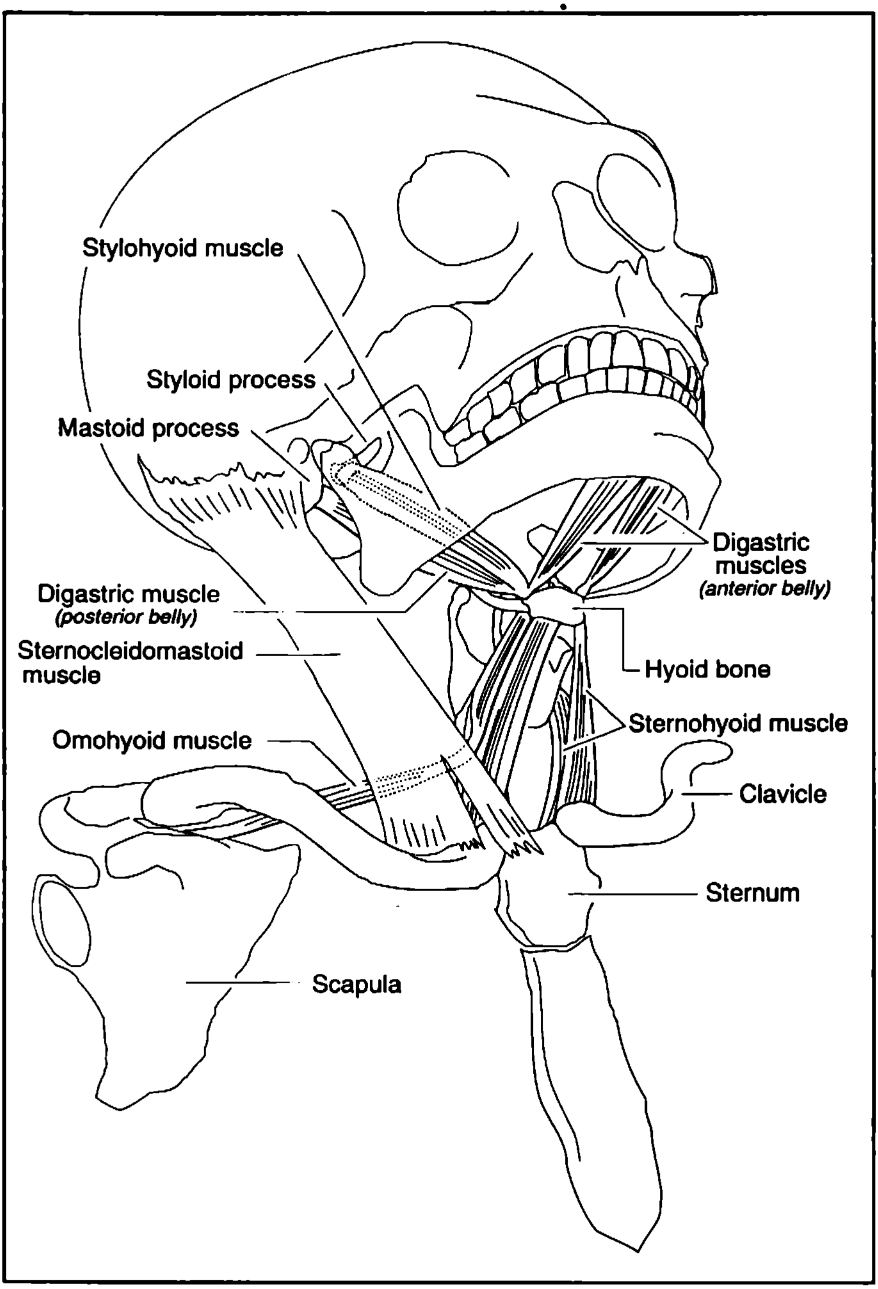


Figure 4–1. Illustration showing the infrahyoid and suprahyoid muscles. (Jim Hull, Graphics Services, Indiana University)

sternothyroid, and omohyoid. Their action pulls the hyoid bone and the larynx down lower in the neck.

(2) **Suprahyoid muscles** shown in Table 4-5, include the digastric, mylohyoid, geniohyoid, and stylohyoid. They pull the hyoid bone forward, upward, and backward.

(3) An example of the important **role played by the extrinsic muscles** can be seen when a patient hyperextends the jaw during phonation. The hyoid bone is raised and the larynx automatically assumes a higher posture. Tension is communicated through the muscle groups when postural misalignments of this kind occur. The infrahyoids and suprahyoids exert a strong influence on the larynx itself, because it is suspended from the hyoid bone by a sling of muscles and ligaments. The hyoid bone has a body and major and minor horns. Aronson (1990, pp. 121-122) explains that the thyroid cartilage can be felt by the clinician placing a forefinger on the patient's thyroid prominence and then moving up to feel the thyroid notch. Then the clinician can encircle the top edge of the thyroid cartilage with the thumb and middle finger. Subsequently, if the fingers are depressed inward, they will sink into the thyrohyoid space and the clinician will feel the lower border of the patient's hyoid bone. Gentle massage, and also pulling-down motions, are sometimes used to unlock tension in the extrinsic musculature (Aronson, 1990).

Table 4-5. Suprahyoid muscles and their action.

Muscle	*Action*
Digastric	
anterior belly	Pulls the hyoid bone forward and raises it (originates from interior aspect of mandible).
posterior belly	Pulls the hyoid bone backward and raises it (originates form the mastoid process).
Mylohyoid	Raises the hyoid bone and pulls it forward.
Geniohyoid	Raises the hyoid bone and pulls it forward.
Stylohyoid	Raises the hyoid bone and pulls it backward.

B. Vocal Folds

1. Structure

Histological study of the vocal folds (Hirano, 1981) reveals that they consist of a muscle referred to as the thyroarytenoid (with longitudinal fibers of the vocalis) and the mucous membrane that covers the muscle.

a. The **mucosa** can be subdivided into the epithelium and the lamina propria.

(1) The lamina propria can then be subdivided into three layers: superficial[2], intermediate, and deep. Hirano (1981) describes these layers in the following way.

(a) The **superficial layer** appears loose and pliant, and it is here that edema often develops.

(b) The **intermediate layer** is made up primarily of elastic fibers.

(c) The **deep layer** is dense with mostly collagenous fibers. The structure, consisting of the intermediate and deep layers of the lamina propria, is known as the **vocal ligament.**

b. The **epithelium** and the superficial layer (also known as Reinke's space) of the lamina propria is described as the **cover.** Most lesions invade the cover and affect mass and stiffness. The muscle does not move as vigorously as the mucosa during vibration of the folds and the mucosal wave is like the "leading edge."

2. Effects of Pathology

Hirano (1981) lists the following aspects of pathology that may interfere with normal vibratory function.

a. Location and size

b. Glottal incompetence

---

[2] Zemlin (1988) noted that a soft, pliant, superficial layer may be essential with respect to the movement of the mucosal wave across the upper surface of the vocal fold.

c. Symmetry of both folds

d. Uniformity within each fold

e. Layer structure (see Figure 4-2)

f. Mass and stiffness of each layer

g. Interference with vibratory movement of opposite fold (can occur with polyps, polypoid vocal fold, cyst, epithelium hyperplasia, papilloma, and carcinoma)

Table 4-6 lists pathological conditions and their histological effects.

3. Important Characteristics

Sataloff (1991) notes that the epithelium lining the vibratory margin of the vocal folds is stratified squamous epithelium which is suitable for withstanding the mechanical trauma of contact. The superficial layer of the lamina propria (Reinke's space) contains few fibroblasts, but the deep layer is rich in them. This is significant, because fibroblasts are responsible for scar formation. This means that removal of lesions, such as cysts, that occur in the cover and do not invade the intermediate and deep layers, usually can be treated surgically without the risk of scar formation.

II. DYSPHONIAS RELATED TO TENSION, HABITS, AND TRAUMA

Hoarseness is the most common complaint of patients seeking voice therapy. At first, this symptom usually is associated with an acute inflammatory condition of the vocal folds. Later, vocal abuse and inappropriate compensations made because of vocal fold swelling may lead to chronic inflammatory conditions. Hoarseness also may be related to systemic disease, chemical irritation, neurologic conditions, or trauma. The onset of hoarseness may be associated with infections and trauma (such as coughing violently and persistently), but it is the way an individual attempts to compensate for the hoarseness, and the continuous use of the folds while they are swollen or irritated, that often leads to full-blown voice disorders. It is believed

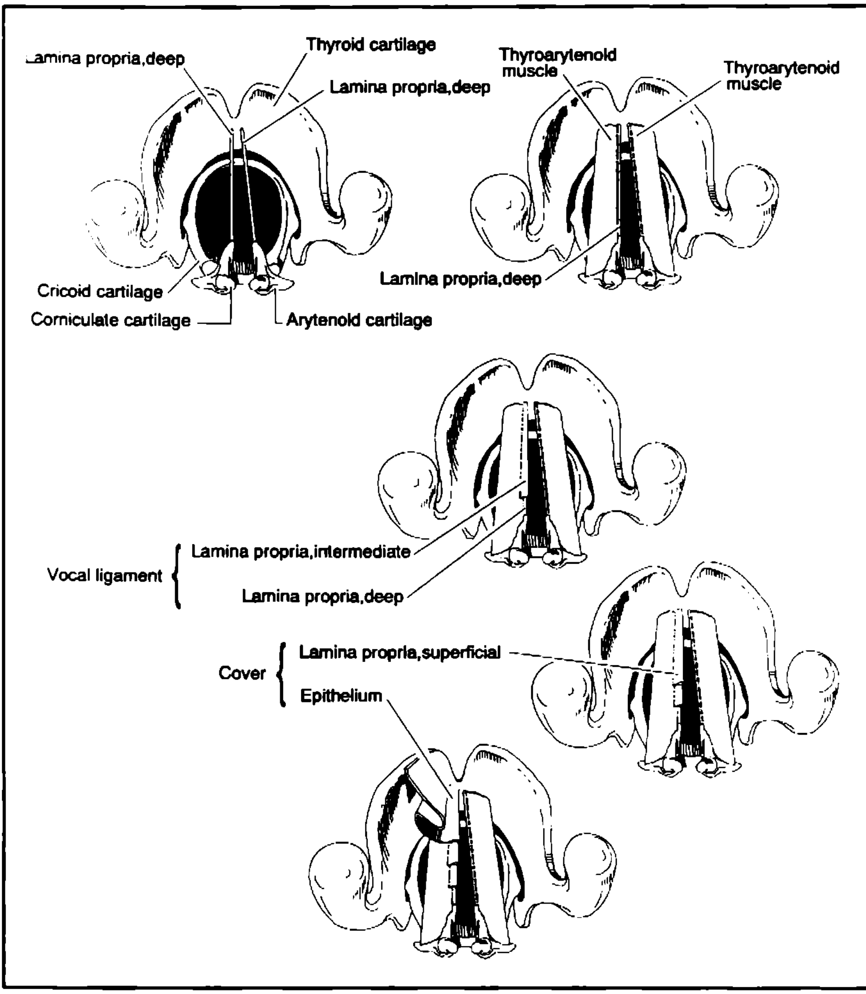


Figure 4-2. Schematic drawings of vocal fold layers. (Jim Hull, Graphics Services, Indiana University)

that vocal abuse and misuse lead to tissue changes such as the development of nodules, polyps, contact ulcers, hypertrophy of the laryngeal epithelium, and thickening of the vocal folds (see Table 4-7). Abusive behaviors and consistent misuse of the voice result in disturbed vocal mechanics that cause injury to the folds and vocal processes. Dryness of the laryngeal mucosa increases the risk of irritation and injury.

Table 4-6. Pathological conditions and their histological effects.

Condition	***Histological Effect***
Nodules and polyps	Mass of superficial layer of lamina propria increases; stiffness changes; no invasion of vocal ligament.
Edema	Stiffness decreases
Fibrosis Intra-tissue bleeding Hyaline degeneration Cell infiltration	May increase stiffnes
Epithelial hyperplasia[1]	Increases mass and thickness of the cover.
Papilloma[2]	Usually enters the superficial layer and occasionally the intermediate and deep layer of the lamina propria; may also invade the vocalis muscle.

Source: Adapted from Hirano, 1981.

[1] Any pathology causing hyperplastic thickening of the epithelium as the chief lesion.

[2] Benign neoplasm originating from the squamous cell epithelium. Wart-like and due to a virus.

Table 4-7. Common causes of vocal fold tissue irritation and injury.

Generalized tension and hypertonicity of laryngeal and associated muscles
Overcontraction of the posterior cricoarytenoid muscle
Elevation of the larynx
Suprahyoid muscle tension
Anteroposterior squeezing and/or lateral squeezing of folds
Hyperadduction of the folds and supraglottal structures
Use of inappropriate pitch level
Use of excessive loudness levels
Prolonged stressful voice use under poor environmental conditions
Frequent singing with poor technique
Abusive practices (e.g., coughing, throat clearing)
Gastroesophageal reflux irritating laryngeal mucosa
Smoking, alcohol, and drug use
Inhalation of airborne irritants and chemicals
Excessive thick secretions/dehydration
Endocrine imbalance (e.g., hypothyroidism)
Protracted or sudden forceful cheering and yelling
Hyperextension and tension of the jaw and neck
Intubation injury
Bulimia induced spasms and acidity
Constriction of the entire laryngeal and supralaryngeal tracts

A. Vocal Abuse and Misuse

1. Definition

Wilson (1972) defined **vocal misuse** as inappropriate pitch and loudness and **vocal abuse** as inappropriate and injurious vocal practices.

2. Causes

Excessive musculoskeletal tension is often seen in patients demonstrating misuse and abuse. Aronson (1990), as shown in Table 4–8, believes that no single voice type is associated with musculoskeletal tension, and says it may produce an array of diverse symptoms. It may be a primary or secondary cause of dysphonia. Thus, it may be functional in origin or related to compensations adopted to deal with organically based problems.

Table 4–8. Symptoms of musculoskeletal tension.

Life stress and psychosocial conflicts
Aphonia/dysphonia
Breathiness
Hoarsenes
Excessively high pitch
Extrinsic and intrinsic muscle cramping
Spontaneous pain in laryngeal region
Referred pain to ears or chest
Sensations of a lump or tightness in the larynx or pharynx
Tension in the tongue
Rubbing or kneading muscles relaxes them
Laryngeal elevation in the neck
Swallowing water reduces tension
Lowering laryngeal position helps phonation
Pain in response to pressure in the region of the larynx
Voice improvement following tension reduction

Source: from Aronson, A. E. (1990). *Clinical voice disorders* (3rd. ed.). New York: Thieme, Inc., p. 314, with permission.

3. Treatment Approach

Aronson (see Table 4–9) uses a two-pronged approach to treatment involving:

a. **Probing of psychosocial dynamics** that may be precipitating or maintaining factors.

b. **Physical manipulation** of muscle tension and lowering laryngeal position in the neck to elicit normal phonation.

Table 4–9. Aronson's therapeutic protocol.

1. Use thumb and middle finger to encircle hyoid bone and posteriorly feel tips of the major horns.
2. Use light pressure and circular motion over tips of the major horns. Note whether discomfort or pain accompanies pressure.
3. Repeat the circular motion with fingers in the thyrohyoid space. Begin at the thyroid notch and move backward.
4. Find the posterior borders of the thyroid cartilage just medial to the sternocleidomastoid muscles and repeat the procedure.
5. With the fingers over the superior borders of the thyroid cartilage, begin to work the larynx gently downwards, with some lateral movements at times. Check for a lower laryngeal position by estimating the increased size of the thyrohyoid space.
6. In some patients, the tongue may be elevated in addition to the larynx and hyoid bone. It should be pressed down with a tongue depressor.
7. Ask the patient to prolong vowels during these procedures. Note changes in quality or pitch. Sips of water and rest periods should be provided.
8. When voice change occurs, the patient should be encouraged to experiment with voice use, repeating vowels, words, and sentences.
9. Patients' rate of improvement varies. Some patients may be unable (not ready) to relinquish the abnormal voice, because it is secondary to conversion reaction.
10. Soreness following this type of therapy will disappear within a day or two.

Source: From Aronson, A. E. (1990). *Clinical voice disorders* (3rd ed.). New York: Thieme, Inc., p. 315, with permission.

c. Aronson (1991) also notes that **chewing therapy, progressive relaxation,** and **biofeedback** are also used as therapy for hyperfunction.

d. Additionally, **yawn-sigh** and use of **increased air flow** during speech have been used to relax laryngeal constriction.

B. Disorders Due to Vocal Abuse/Misuse

1. Contact Ulcers

Contact ulcers, seen primarily in middle-aged males, develop on the vocal processes of the arytenoid cartilages because of strenuous hyperadduction of the folds and abuse. Voice therapy is the treatment of choice and focuses on vocal re-education (Block, Gould, & Hirano, 1981) and elimination of emotional and environmental stress. Surgical treatment usually is not recommended. Additionally, complete voice rest is not recommended, and forced whispering should be avoided. However, the patient must minimize the amount of talking and particularly the effort used in talking, while the ulcer heals. Aronson (1990) suggests that both quantity and intensity of voice use be reduced approximately 50% for 1 month. Both drinking alcohol and smoking also should be eliminated during this time to facilitate healing. Voice therapy involves attention to the reduction of abusive patterns (e.g., excessively low pitch), relaxed phonation, and psychodynamic analysis of life style and stressors.

a. **Abuses and trauma associated with the formation of contact ulcers.**

(1) Vocally demanding activities

(2) Talking in noisy environments

(3) Talking across distances

(4) Coughing and throat clearing

(5) Excessive medial compression of the folds

(6) Alcohol consumption and smoking

(7) Intubation trauma

(8) Postural deviations (e.g, cradling telephone under chin)

(9) Excessive gargling with mouthwash

(10) Esophageal reflux

(11) Inappropriately low pitch level

Providing information about the risk factors and pathogenesis of the disorder is an important part of the clinician's role. This involves discussion of relevant anatomy and physiology, the benefits of hydration, the effect of various practices on structure and function, and principles of vocal hygiene.

b. **Vocal symptoms** associated with contact ulcers. The patient who develops this condition frequently uses an inappropriately low pitch and an effortful, explosive initiation of phonation. The rhythmic speech pattern may sound staccato, as though words are "punched" out. Postural misalignments and musculoskeletal tension may be present. Excessive talking using inefficient breathing patterns, minimal mouth opening and resonance, forced whispering (the arytenoids rotate to form a posterior chink and there is tight approximation of the vocal processes), vocal fatigue, and pain are characteristic of ulceration. When granulation tissue develops around the ulcers, the entire posterior region of the glottis (the cartilaginous glottis) may be involved, and voice symptoms will be more severe. Lumpkin, Bishop, and Katz (1989) reported that 36% of the patients they studied who experienced gastric reflux had contact ulcers with granuloma development.

c. **Symptomatic voice therapy** aims at substituting or shaping more appropriate behaviors to maintain long-term vocal health. At first, the patient may adopt a low intensity, "easy," breathy vocal pattern as the target voice during the healing process. Once healing is well underway (and by this time the patient has usually developed insight concerning the nature of the problem), vocal behaviors can be shaped further to demonstrate clearer vocal quality and more normal vocal fold adduction patterns. Examples of goals and strategies for symptomatic voice therapy appear below.

(1) An **excessively low pitch** may be adopted in an attempt to appear authoritative. Typically, the patient uses an habitual pitch level that is near or at the lower limit of his pitch range. This means that when downward inflections occur, the patient phonates using pulse register or vocal fry. Although true vocal fry is produced with relaxed vocal folds, the syncopated vibratory pattern is not musical or smooth.

(a) The patient should be given **information concerning** both the musical and physiological **limits of his or her pitch range.** Visual feedback can be provided using the VisiPitch™. For example, the speech pathologist can demonstrate sliding from a high pitch through the pitch range into vocal fry. The smooth, continuous line on the VisiPitch™ screen will disintegrate into irregular dots when the voice enters the pulse register or vocal fry. A patient usually needs about four usable pitches below the habitual pitch level in order to allow for downward inflections that do not "dip into fry."

(b) The **rationale of raising** the **habitual pitch level** so that the voice does not "fall off" the bottom of the musical range every time a downward inflection occurs seems to make sense to patients, especially when they are given visual as well as auditory feedback. True vocal fry does not always constitute the only problem at inappropriately low levels for these patients. Some exert considerable effort and tension to maintain their low pitch and use excessive medial compression of the folds to "push" the pitch level and downward inflections lower. When excessive tension like this is used, the vocal processes may be injured, and tension and strain cause a harsh quality. When aperiodicity is due to extreme effort, it is not the "relaxed syncopated popping sound" of true vocal fry.

(c) Techniques to raise the pitch level are usually **most effective** when the pitch changes are practiced in relation to the meaning of what is being said. A pitch pipe, digital metronome, or a keyboard may be used to cue a target pitch and a hum matched to the tone. The hum may then be shaped into a word beginning with an /m/ (e.g., "Mom"). The next step may involve the sentence "Mom, lie down." A sentence of this kind fits, in terms of meaning, with a downward progression of the voice. The patient's task is to be sure to start the first word high enough so that the remaining words can be produced with musical quality (i.e., not below basal pitch or the terminal note of the musical range).

(d) The patient should be encouraged to use a **conversational range** that allows for natural variability of pitch and flexibility. This is usually preferable to trying to habituate one optimal level. The speech pathologist can establish an area in the overall pitch range that is comfortable for conversation. If instrumentation is available, the clinician can provide visual feedback on an oscilloscope screen to aid the client's understanding of the concepts and monitoring of the practice. Pitch changes and intonation patterns should be explored. Because patients with contact ulcers have been habituating low pitch levels, techniques to stimulate the voice to rise (e.g., asking questions) are appropriate (see Table 4–10).

Sentences that facilitate upward inflections in the voice often include exclamations; positive feelings; onomatopoeic words; and meanings associated with height, lightness, or energy. The patient can be helped to allow his voice to reflect the meaning and feeling inherent in the sentences. It is always more natural to approach pitch variation from this perspective (i.e., in a meaningful

Table 4–10. Techniques to address use of excessively low pitch.

Sample Questions to Help Voice Rise

1. Anybody home?	6. Any beer?
2. Are you ready?	7. Want a game?
3. Is this the way?	8. Got a date?
4. Any coupons?	9. Where's the check?
5. Is the cat in?	10. Have you lost it?

Contrastive Words / **Contrastive Levels**

high	low	squealed	rumbled	ding		ding
ding	dong	hiss	boom		dong	
up	down	flute	tuba			
treble	bass	frisky	doddering	ping		ping
comic	tragic	floated	sank		pong	

Sentences

1. The kitten jumped up on the table.
2. It was a wonderful surprise.
3. I wonder if I should call her?
4. But what would I talk about?
5. The balloons soon floated out of sight.
6. When I awoke, I was rearing to go.
7. Oh my, a lemon meringue pie.
8. Beat the eggs until they are light and fluffy.
9. This drink tastes marvelous!
10. It was such an exciting game to watch.

context). The words and sentences shown in Table 4–10 are appropriate stimuli.

(2) **Elimination of hard glottal attack** is another goal of therapy. Because these patients tend to punch out their words in a jerky, aggressive manner, it is wise to emphasize the need for smooth, flowing, or "blended" phrasing. Usually, this can be accomplished by suggesting a more aspirated or breathy onset for words, beginning with vowels and the linking of words (see Table 4–11). The patient should be encouraged to use

Table 4-11. Techniques to address use of hard glottal attacks.

Word Pairs

("think" the "h" and elogate the vowel)

haul	all
heel	eel
his	is
harm	arm
whose	ooze
hail	ale
whore	ore
howl	owl
high	eye
home	ohm

Sentences for Blending

1. Vivian_Allen_is_always_amusing.
2. No_one_at the Stock_Exchange is_anxious.
3. The score_is_even_and the fans_are_in_an_uproar.
4. Robert_authorized that_exciting_exhibit.
5. His_executive_office_is_extraordinary_and_ostentatious.

plenty of air, and breathe out on the words to counteract squeezing or constriction.

(3) **Tension reduction** may be approached through a number of strategies, depending on the severity of the pattern. Progressive relaxation, biofeedback, deeper and more relaxed respiratory patterns, postural realignment, and musculoskeletal tension reduction (see previous section) may be implemented. Additionally, facilitative materials may be helpful to encourage an easy, breathy pattern to counteract excessive medial compression of the folds or a squeezed or pressed phonational pattern. Words loaded with breathy sounds and front sounds (to unlock posterior tongue tenseness) can be practiced (see Table 4-12). A tactile clue, such as feeling the air flow on the hand throughout the utterance, is sometimes effective.

d. **Psychodynamic analysis** is another aspect of the process of voice rehabilitation with patients presenting with con-

Table 4-12. High air-flow practice materials.

Breathe Out on These Words

hashed	sheets	deity	hyacinth	hachet
perception	weight	militia	mischief	smashed
chips	Haiti	facility	Hiroshima	trash

Breathe Out on These Sentences

1. Politicians from Haiti, Russia, Lithuania, and Africa hashed out their differences in a hotel in Hawaii.
2. Spanish and Scottish officials approached the cashier at the station and asked for whiskey.
3. Ancient myths told by Aristophanes delighted youths of past generations.
4. The militia used machetes to crash through the vegetation, smashing precious statues.
5. It is a gracious tradition to serve cappuccino in the fashionable penthouse.

tact ulcers. Clinicians have noted that these patients tend to be ambitious, even aggressive, competitive males who engage in vocally strenuous activities. This profile does seem to be prevalent; however, contact ulcers are not confined to this group. It is always useful to explore the emotional environment in which the patient operates and to identify vocational and personal pressures that exist. Interpersonal problems that result in anger and irritability that are not overtly expressed can be particularly relevant to this disorder. Swallowing anger and resentment can result in tension in the face, jaw, and laryngeal musculature and be seen in hyperfunctional vocalization patterns such as explosive initiation of phonation and abrupt phrasing. One way to begin to work on analyzing the psychodynamic features of the problem is to instigate a discussion of the work conditions, work schedule with respect to vocal demands (e.g., presentations, meetings), and interpersonal relationships with key associates. This was the approach that was used with Martin K., a senior-level executive in a large midwestern food manufacturing plant, described in the following case study.

e. Case Study

At 55 years of age, Martin was finding his energy levels were not as high as he would like, but he continued to drive himself to compete with younger colleagues whom he perceived to be encroaching on his turf. Although he was a very talkative person, it was difficult for Martin to verbalize his feelings, because he had fears about exposing his vulnerability. To overcome his anxieties, he drove himself harder and harder, scheduled frequent out-of-town travel, and made an exhausting number of business presentations in the course of each week. Martin had always used the strategy that when one had a problem, one merely tried harder. As his voice worsened, he used this approach to deal with his voice problem.

Martin had a great many fears about losing control, and his voice weakness exacerbated these fears. It became clear to the speech pathologist that Martin would benefit from some counselling. Martin, however, rejected this proposal. Although he was beginning to feel comfortable discussing his situation with the speech pathologist and could see that work-related factors were relevant to his voice problem, he was extremely threatened by the suggestion that additional counselling might be helpful. Martin was, essentially, a well-balanced individual who was dealing with predictable, life-stage stresses that are commonly encountered by competitive, success-oriented people. He needed help in focusing on his considerable record of success and in allowing himself to delegate some of the burdensome travel and speaking tasks. Fortunately, Martin was secure in his position and had sufficient prestige and power in the organization that he could afford to explore other organizational options. Martin was encouraged to analyze his methods of demonstrating his authority. He began to see that trying to do everything himself was not his only option. By cutting back on his punishing travel schedule, he could, in fact, direct more of his energies to more important and valuable activities that were appropriate to his position. Martin began to see that if he used less "micro-management," he could engage in more long range, strategic planning. Martin read materials related to management techniques and stress reduction and arrived at the following goals:

- Practice ways to be authoritative while reducing vocal strain and fatigue.
- Use amplification in large meetings.
- Use relaxed, easy, vocal production techniques.
- Use vocal variety to gain and hold attention.
- Use more visuals in presentations and meetings.
- Do "warm up" vocal exercises each morning in the shower.
- Build in regular times in the schedule for exercise and stress reduction.
- Clearly state deadlines and expectations when delegating tasks to staff.
- Do not let unexpressed resentments build.

2. Vocal Nodules

a. Occurrence

Vocal nodules frequently are seen in adults with vocally demanding occupations and environmental or lifestyle stress.

b. Therapy involves

(1) Providing information concerning the condition

(2) Analysis of vocal misuse and abuse

(3) Vocal re-education, and

(4) Symptom modification

The following case history illustrates the approach to treatment designed for Melanie, a 20-year-old student with bilateral vocal nodules.

c. Case Study

Melanie had been a cheerleader in high school and was a vivacious and outgoing member of her sorority. She had received voice therapy intermittently in high school and for a brief period in her freshman year in college. She reported that she had not been serious about her voice problem then. However, now she was tired of people asking her what was wrong with her voice, and she wanted to work on it seriously. Melanie enrolled in "Voice Group" which consisted of 6–8 college-aged, young adults with problems related to abuse and misuse. The group met once a week for an hour and spent approximately half an hour working on vocal exercises and half an hour discussing topics related to voice and psychodynamics. During the group sessions Melanie worked on:

- improved respiration for speech
- frontal tone focus
- elimination of hard glottal attack
- increased vocal variety

As a result of practicing words beginning with vowel sounds, Melanie discovered that vowels followed by a voiced continuant consonant were easier for her to produce with an easy onset. This led to a group discussion of facilitating contexts. The group created sentences in a hierarchy of difficulty and worked in pairs to refine their production and provide feedback for each other. Melanie and her partner came up with the following practice materials.

Step I

Vowels followed by voiced continuants (m, n, l, v, r, and z)

Amy Allen easily eavesdropped unerringly on everyone.

Hint: Prolong the consonant following the initial vowel to "smooth out" the beginning of the word.

Step II

Vowels followed by breathed and voiced plosives made at the front of the mouth (p, b, t, d)

Apples and apricots are eaten ably in Eden.

Hint: Prolong the vowel and move through the breathed consonant gently until you find a voiced continuant to linger on.

Step III

Vowels followed by breathed and voiced back sounds (k, g)

Exaggerated echoes exasperate egotists.

Hint: Breathe out on the vowel followed by k and g to help avoid tensing. These combinations seem hardest.

Melanie enjoyed the group discussions of such topics as:

- Avoiding vocal abuse in bars.
- How to be interesting at a party without straining your voice.
- Leading questions — how to get everyone else to do the talking.
- Scheduling quiet times into a hectic week.
- How to practice voice conservation and not become frustrated.

Melanie developed the concept that voice was like money. You only have a certain amount and have to decide how you'll spend it so that it is most satisfying to you emotionally. She realized voice is not an inexhaustible resource. Her list of priorities concerning when to spend and when to save her voice included:

When to spend

When my boyfriend comes for the weekend.

When I'm upset and need to talk about a problem.

When I need to participate in class (but sit near the front).

One-to-one conversations with really good friends.

When telephoning my family.

When to save

In group singing, just mouth the words.

Ask for nonspeaking jobs at sorority rush.

Don't scream and yell at games.

Schedule quiet times (movies, studying alone) after periods of strenuous voice use.

In large groups with background noise.

When tired or sick.

When with people I don't care about or who do not help me feel good about myself.

The group format was helpful for Melanie. She enjoyed interacting with others of her own age with similar life styles. She benefited from their appreciation of the creative ideas she shared during discussions and the dynamics of the "self-help" group itself. For example, she had never realized that, although she thought of herself as a good communicator, she had never really developed her receptive communication skills and didn't listen well or make reflecting statements. As the semester progressed, Melanie became much more reflective and began stopping by the speech pathologist's office before group meetings to provide an update on how she had been trying to apply some of the insights she had gained. The more she began to internalize the information, the more relaxed her voice began to sound.

3. **Laryngeal hyperkeratosis** is a plaque-like thickening of the laryngeal mucosa caused by abnormal growth of the epithelium. It usually is seen on the true vocal folds which also may be swollen and inflamed. Laryngeal hyperkeratosis may, on occasion, be premalignant, thus medical treatment involves biopsy and avoidance of substances or practices that cause irritation of the laryngeal mucosa. Voice therapy involves analysis of abuses and misuses, symptom modification, and life-style modification. Factors that may be implicated in the development of laryngeal hyperkeratosis include:

   a. Environmental pollutants, noxious gases, dust, and smoke

   b. Cigarette smoking

   c. Heavy alcohol use

   d. Long-term, strained, tense, speaking habits

e. Throat clearing, coughing, and post-nasal drip secondary to chronic sinus or pharyngeal infections

f. Injury to tissues (e.g., radiation)

4. Laryngeal Leukoplakia

a. Description

Laryngeal leukoplakia is characterized by white patches on the laryngeal mucosa and histological evaluation may reveal premalignancy. If the condition involves the vocal folds, hoarseness will be the presenting symptom. As in the case of laryngeal hyperkeratosis, chronic irritation of the tissues seems to be the primary etiologic factor.

b. Treatment

Cessation of cigarette smoking is of primary importance. Medical and surgical procedures together with life-style modifications have been used as treatments. Voice therapy may be recommended to assist the patient to be compliant with suggestions for life-style modification. However, symptomatic voice therapy usually is not needed for this condition.

C. Disorders Due to Trauma

1. Description

Severe trauma to laryngeal structures occurs as a result of accidents, domestic violence, burns, and medicosurgical procedures.

a. **Direct injury to the larynx** results from impact, penetration of sharp objects, attempted strangulation, and blows. Medical and surgical treatment depend on the type and extent of the injury.

b. **Burning of laryngeal tissue** may result from inhalation of smoke and gases during a fire or chemical ingestion during suicide attempts. Ingestion of chemicals is also seen in young children. Medical management usually involves the administration of antibiotics and steroids. Supraglottic stenosis, scarring, and adhesions may occur.

c. **Complications following surgical procedures** such as tracheostomy, endotracheal intubation, and the long-term presence of nasogastric tubes may result in injury to structures relevant to voice production. The types of injury that may occur include:

(1) Irritation of mucosa

(2) Edema

(3) Granuloma of the area around the vocal processes of the arytenoids

(4) Formation of webs or adhesions

(5) Dislocation of joints or structures

(6) Vocal fold paralysis

(7) Fracture of laryngeal cartilages

2. Treatment

Voice therapy following trauma to the larynx will depend on the type of injury sustained and whether re-education or compensatory approaches need to be implemented. The physician and the speech pathologist must work closely on post-trauma cases. The psychological effects of trauma also must be dealt with during the recovery period. During periods of voice rest necessitated by severe damage to laryngeal structures, the speech pathologist may consult concerning alternative communication aids and provide assistance to nursing staff.

III. DISORDERS RELATED TO PSYCHOLOGICAL TRAUMA

A. Aphonia and Dysphonia as Conversion Reactions

Aphonia and dysphonia may be behavioral responses to emotional distress. The loss of voice, or disturbed voicing, may be an unconscious attempt to avoid dealing with a distressing situation or interpersonal conflict. The patient truly believes he or she is unable to communicate because of some physical complaint and is not aware of any primary or secondary gains. The voice problem is a conversion reaction, the translating of the emotional disequilibrium into another set of symptoms.

1. The choice of **symptoms** is relevant both to the causative factors and short-term resolution by avoidance of direct confrontation. Consider, for example, the wife who is traumatized by a husband's extramarital affair and is unable to confront him about it. Her anxiety concerning her marriage is heightened by her own needs for, not only emotional, but also financial support, because she has no job skills and grandchildren live in her home. Conversion aphonia is unconsciously adopted, which makes it impossible for her to speak with her husband about the affair, thus dealing with her ambivalence about a confrontation. Additionally, because she is now suffering from a physical disability, her vulnerability is increased, therefore making it less likely that her husband will abandon her and their grandchildren. It must be emphasized that the patient is not consciously aware of this mechanism. She is a conscientious person, terrified of conflict, and threatened by a major disaster, and she unconsciously, not volitionally, adopts a coping mechanism.

2. **Management**

Because the patient believes she has a physical or organic problem, she will consult a physician and a speech pathologist quite willingly. This provides the speech pathologist with the opportunity to help the patient deal with the problem. Speech pathologists are highly trained professionals with a mandate to treat disorders of psychological as well as physiological origin. Yet, for many years speech pathologists have been reluctant to deal with conversion reactions.

a. Aronson (1990, p. 321) believes this is due to the following **misconceptions:**

(1) Psychiatrists and psychologists are the only professionals qualified to deal with psychogenic problems. This is not the case.

(2) Symptom removal in a conversion reaction is dangerous if the underlying cause is not treated, and the conversion symptoms will merely occur elsewhere. This is not the case.

b. Aronson (1990), the leading authority on psychogenic disorders, believes thåt **premature referral** of aphonic and dysphonic patients **to psychiatrists and psychologists** is almost a guarantee of failure to improve voice (p. 321). Instead, he advocates the following steps in the treatment sequence.

(1) **Laryngological evaluation** (to rule out organic laryngeal disease and systemic illness).

(2) **Symptomatic voice therapy** in combination with **ventilation of emotional problems.**

(3) **Referral** to a psychiatrist or psychologist to achieve more enduring stabilization of the patient's life adjustment if necessary.

B. Characteristics

Patients, the majority of whom are women, who present with conversion reactions may exhibit the following characteristics.

1. **Dissociation of the voice disorder** from conscious awareness of emotional problems.

2. **Intact vegetative functions** (e.g., coughing, throat clearing, laughing, crying).

3. **Normal laryngoscopic findings** with respect to structure. During attempted phonation, however, the folds may abduct or only partially adduct.

4. **Onset** of the voice symptoms may be described as sudden or the result of an upper respiratory tract infection.

5. The **course** of the disorder may be described by the patient as intermittent voice symptoms interspersed at first with periods of normal voice, with gradual worsening and continuous symptoms.

6. **Musculoskeletal tension** and laryngeal elevation.

7. Evidence of **communication breakdown** between the patient and a significant other such as a family member, boss, or

authority figure. (The patient may report this quite calmly, since the loss of voice has removed the patient's responsibility for the relational disruption.)

8. A **variety of vocal symptoms,** primarily aphonia, breathiness, hoarseness, high pitch, or strained or intermittent voicing.

C. Treatment of Conversion Reactions

1. Treatment of conversion reactions begins with an **interview** and **thorough history.**

   a. The speech pathologist attempts to **build a nonthreatening relationship** with the patient and gain insight concerning the patient's life style, significant relationships, financial concerns, and possible sources of conflict and stress.

   b. Some clinicians (e.g., Aronson, 1990) make a point of reading and discussing the otolaryngologist's report with the patient to **assure him or her no serious condition is present** (e.g., carcinoma). This discussion also sets the stage for the patient to accept the possibility that the condition may be emotionally based.

   c. Generally, the speech pathologist suggests to the patient **that stress and tension can interfere with voluntary muscle action.** The amount and type of explanation depends on the patient. However, some relevant information is usually provided, and the speech pathologist suggests that they try some exercises to help the voice to come back.

2. **Voice elicitation** can include a variety of activities, including physical manipulation of the musculature as described previously in Section A, dealing with the extrinsic musculature. Usually, some form of tension reduction is employed during treatment.

   a. Progressive relaxation techniques

   b. Head rolls and shoulder shrugs

   c. Musculoskeletal tension reduction

   d. Chewing

e. Deep, relaxed breathing

f. Yawning and sighing

g. Additionally, the elicitation of voice usually involves **shaping of a vegetative function** such as throat clearing, coughing, laughing, sighing, yawning, or grunting. Typically, the voicing that is produced is then prolonged into a vowel sound or hum and repeated. Case (1991) stresses that since a number of techniques can be used, the speech pathologist should explain that "a number of things will be tried" to help the patient to "regain your ability to make your voice work" (p. 202).

h. **When voicing occurs, it should be instantly reinforced** with such words as "There it is, we've got it working again" and other supportive statements.

3. Aronson (1990) cautions that patients who have suffered from aphonia or dysphonia for long periods of time will go through various stages of dysphonia in the **process of recovery.** They initially may sound very harsh or hoarse. Others may become normal very rapidly, and those who are not psychologically ready to relinquish their symptoms will resist change. Although some patients do recover with an hour of therapy, others need subsequent appointments and/or referrals.

4. Once voicing is achieved, it is important to keep the patient **using the voice vigorously** to exercise the musculature and provide positive feedback. Automatic utterances, such as counting or saying the days of the week, can be used initially, followed by reading and conversation. Case (1991) suggests that comments such as "There, you have your voice back" are reinforcing and should be followed by statements such as "You have done the right thing(s) to get it going again."

5. Aronson (1990) believes that there is another step which he refers to as **"Catharsis and Counselling."** He notes that some patients become aware of emotional conflicts only *after* the voice has returned. He believes that the commonality among those patients is the need to express anger, dissatisfaction, and grief but the inability to do so. Discussion of the patient's

future, following the direct work on the voice symptoms, allows both the speech pathologist and the patient to make decisions about whether a referral to a mental health professional for counselling would be helpful.

IV. TREATMENT OF DYSPHONIA RELATED TO OCCUPATIONAL DEMANDS

Professional voice users have a special investment in voice, especially singers, actors, stock traders, teachers, politicians, and others who rely on their voices to succeed in their occupations. When they encounter voice problems, their very livelihood may be threatened. Performers are particularly sensitive to even subtle changes in their voices. Because their goal is superior performance at all times and their fields are extremely competitive, even a minor vocal problem can cause extreme anxiety and may adversely influence career opportunities. See Sataloff (1991) and Benninger, Jacobson, and Johnson (1993) for detailed descriptions of vocal arts medicine for professionals.

A. Factors Related to Dysphonia

1. **Allergies** that affect the upper respiratory tract are of particular concern to professional voice users. Allergens that are inhaled (e.g., mold, animal dander, dust, pollen, and smoke) directly affect the mucous membranes lining the vocal tract, but symptoms involving the ear, nose, and throat may also result from ingested, injected, or contact allergens.

   a. **Symptoms** of allergies are:

      (1) Headaches and fatigue

      (2) Congestion, drainage, throat clearing, coughing, mouth breathing, sneezing

      (3) Watering, itching eyes, running nose

      (4) Sore ears and throat

      (5) Seasonal, exacerbated in certain environments, or chronic and varying in intensity

b. **Medical treatment** involves a thorough history, physical examination, and skin tests or blood tests such as the radioallergosorbent test (RAST) to confirm the diagnosis. Treatment, once the allergens are identified, involves lifestyle modification (see Figure 4–3) to avoid the significant allergens as much as possible, medications, and allergy shots for desensitization.

(1) The most frequently used **medications** are antihistamines, decongestants, and nasal sprays.

(a) **Antihistamines** may cause drowsiness and excessive dryness of the mouth and laryngeal mucosa.

(b) **Decongestants** reduce swelling of the mucous membranes and decrease nasal congestion. Medications frequently contain combinations of antihistamine and decongestant, and some physicians recommend that medications of this type

Figure 4–3. Allergic adults may exhibit increased susceptibility to vocal abuse when the laryngeal mucosa is inflamed. (Jim Hull, Graphics Services, Indiana University)

not be taken within 4 hours or so of a vocal performance or sustained voice use.

(c) Nasal sprays deliver **topical anesthetics** to the mucous membranes and decrease swelling.

(d) **Mucolytic agents** may also be used to liquify thick mucus and are helpful in treating symptoms such as postnasal drip, throat clearing, and other conditions where thick secretions need to be thinned.

(e) However, **increased liquid** intake is of primary importance in treating conditions of the upper respiratory tract, and **increased humidification** is of great benefit to professional voice users (see Figure 4–4). Water and saline may be delivered by vaporizer or through generation of steam.

c. Professional voice users should be wary of **inhalers,** especially for prolonged use. Sensitivity to the propellants that are used, laryngitis caused by candida development, and reactions to the aerosol form of the steroid itself may be experienced. This may cause a dilemma for professionals who suffer from asthmatic conditions that are triggered by allergic reactions. They must be monitored closely by an otolaryngologist who is experienced in the care of the professional voice.

d. **Corticosteroids** are strong drugs used to manage acute inflammatory laryngitis. They should be used cautiously and only for short periods of time. The physician and the patient must gauge the importance of a professional engagement when decisions to use these medications are made. If the inflammation occurs in association with an infection, antibiotic medication will also be prescribed.

2. **Life-style factors** that may need to be adjusted by professional voice users include:

a. **Avoidance of environmental irritants** such as chemical fumes, passive smoke, dust, dryness, and wide fluctuations in temperature.

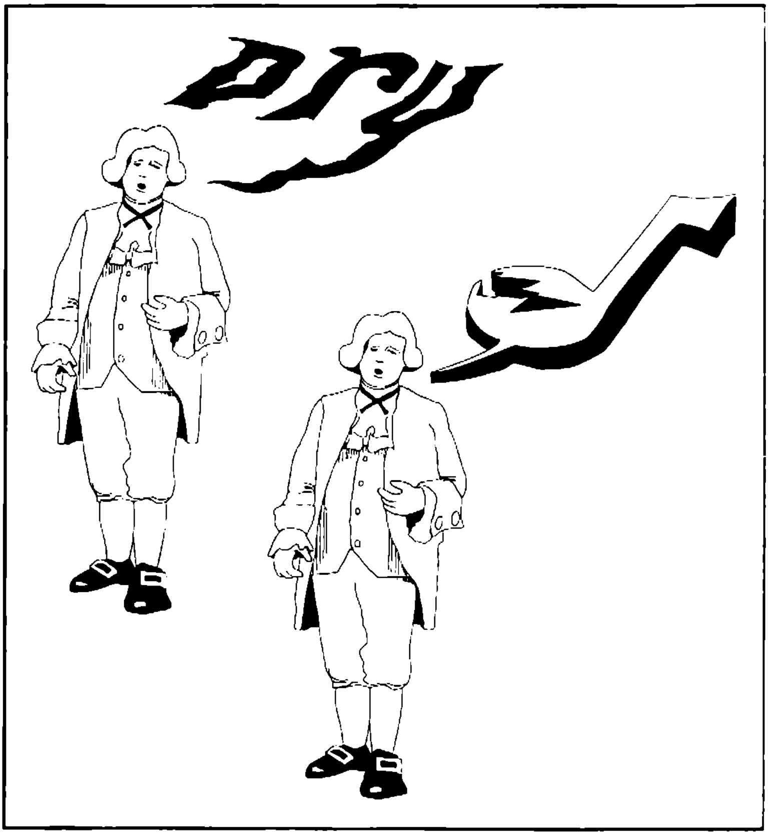


Figure 4-4. Counselling performers involves discussion of hydration and humidification.

b. **Cessation of habits** such as smoking, alcohol consumption, abusive vocal practices, excessive talking or talking in noise, and use of caffeine (drying effects).

c. **Avoidance of medications** such as diuretics, tranquilizers, narcotics (dull sensory feedback), and aspirin (may cause vocal fold hemorrhage).

d. **Avoidance of injurious habits** such as forced whispering or subvocalization, vocal misuse during speaking or singing, and forceful vocalization during exercise or exertion.

e. **Improvement of humidification and hydration** (drink 8 glasses of water a day).

f. Close monitoring of **general health habits** such as balanced nutrition, adequate sleep, rest and relaxation, to minimize chances of infection (wash hands frequently, do not rub eyes and nose).

g. Use of **stress management** techniques consistently (e.g., yoga, meditation, relaxation, exercise, stress management groups); scheduling of quiet, personal time for renewal at regular intervals; maintenance of ties with supportive family members and friends.

h. **Developing a professional relationship with a trusted and experienced otolaryngologist** who is knowledgeable about professional voice use and the demands of a career.

i. Ensuring that **speaking practices** are not abusive to the larynx. (Many singers may use improper speaking techniques that negatively affect the condition of the larynx.)

j. **Monitoring of vocal technique** religiously in the case of singers. Working regularly with a competent vocal teacher or coach or consulting one periodically for checkups throughout the entire career.

B. Treatment of Dysphonia

Strategies used to modify the speaking habits of professionals include:

1. **Learning about the anatomy and physiology** of voice production and principles of vocal hygiene. Readings may be used, because these patients are usually eager for information relevant to their voice.

2. **Relieving muscle tension** both generally and in relation to specific sites. Techniques include posture and alignment activities (Alexander, 1932) (see Figure 4–5); physical manipulation and relaxation activities (see Appendix D); differentiation of articulators by moving them in isolation; massage; relaxed chewing; contrasting tense and relaxed states; and deep, relaxed breathing.

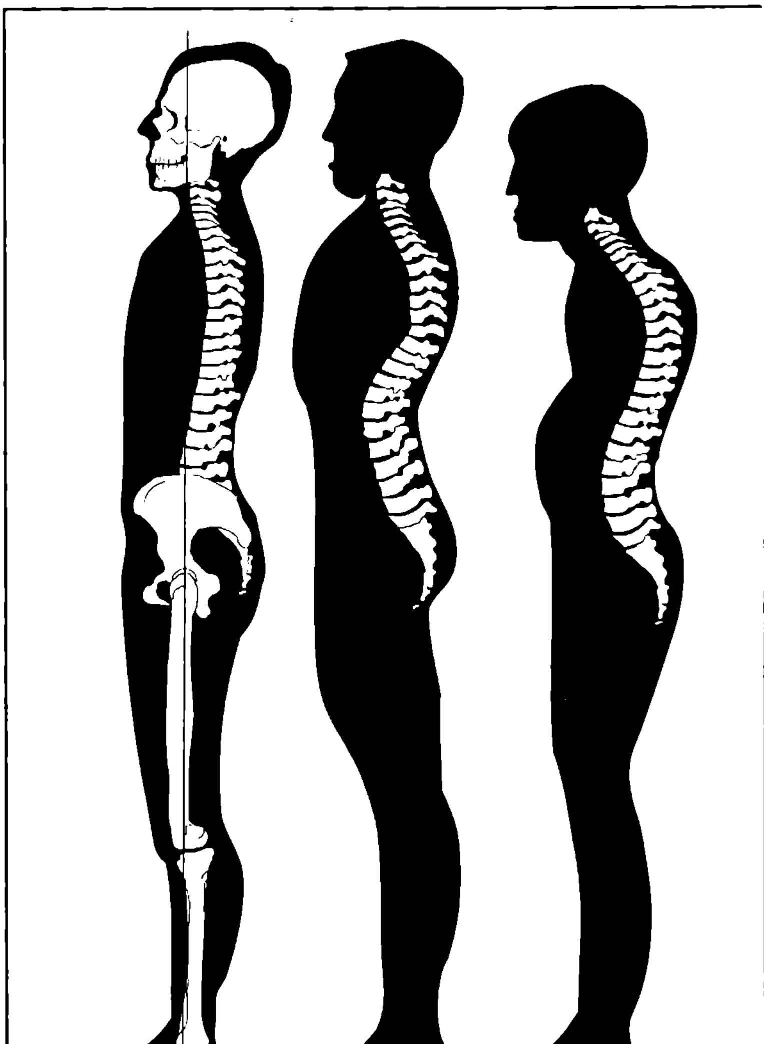


Figure 4-5. Postural alignment showing appropriate alignment on the left. (Jim Hull, Graphics Services, Indiana University)

3. **Coordinating airflow with easy onset of phonation.** Techniques may include prolongation of vowels preceded by breathed continuant consonants. For example, "shoe, she, shy" and "he, who, high" may be used. Loudness and pitch variations may also be incorporated into these tasks. Another activity that allows observation of the transition from airflow to voicing in slow motion is particularly helpful. The patient is asked to prolong a breathed continuant for some seconds and, on a signal from the speech pathologist, add voicing. For example, the cognates "s" and "z" can be used. The articulatory set is similar for both sounds, but one is breathed and the other is voiced. The patient should feel no "jolt" in the larynx as the transition occurs. A helpful cue is to "feel as if the teeth are just changing from the hiss to the buzz," because this serves to distract the attention from the larynx and reduce laryngeal effort. The total prolongation should last about 10 seconds, and the /s/ should be stabilized before the /z/ is initiated. Clients who are tense may show facial changes indicative of tension when voicing is added. Relaxing and "smoothing out" the transition helps them to feel the ease with which phonation should be initiated. Use of sounds that produce a front of the face "buzz" also facilitate focus on the face rather than the neck. Additional sound pairs for practice include h/m, f/v, θ/ð, and s/z. Clients can practice them using various pitch and loudness levels, particularly soft levels.

4. **Linking phrases to produce smooth legato sequences.** This technique (see Table 4–13) also helps patients avoid tense, choppy patterns with hard glottal attacks. The first series begins with phonemes that initiate airflow before phonation begins. Prolonging these phonemes may help, initially, to relax the mechanism and improve the preparatory set.

5. **Forward tone focus.** Singers are usually familiar with the image of the sound vibrating in the bony mask of the face. This image is useful for a number of reasons. It concentrates attention away from the throat, and this is frequently helpful in cases of vocal hyperfunction. Second, it creates a kinesthetic awareness of the lips, alveolar ridge, and tongue tip and tends to be helpful for patients with posterior, tense tongue carriage. Also, the image of the vibrating column of air projected forward can be tied to the importance of increasing the space in the oral cavity and releasing jaw ten-

Table 4-13. Technique for smooth connected utterances.

Hints	Series I
1. Prolong the /h/. 2. Link all words. 3. Use an almost imperceptible /w/ to link the 1st and 2nd words. 4. Linger on continuant consonants. 5. Vary the meaning by emphasizing different words in each phrase during successive trials. Be sure to maintain the flow.	How early? Who are you? How are they? Hoe easily. Show Eve in. Who is Leigh? Show and tell. Who is he? Who are they? How are you?
Hints	**Series II**
1. Use a slight /j/ to connect a word that ends in a vowel such as /eɪ/ /i/ /aɪ/ (ɔɪ) and is followed by a word starting with a vowel. 2. Use a final consonant from a preceding word to link the next word that begins with a vowel. 3. Make the "connections" between words very light, but maintain the flow of the words. 4. Keep the voicing going through all the vowels and voiced consonants.	May(j)I leave now? He(j)is enjoying living there. Henry(j)annoys everyone. My(j)age is unknown. Roy(j)always__empathizes. He'll__expect__another__offer. Iron__is__excellent__ore. Come away in April. Bill enters all arguments. Her exhibits are at the entrance. His one lawn mower is noisy. The buzz is audible.

sion. Lip mobility also is emphasized as a way of propeling the sound forward without forcing or tensing other structures. Tactile and proprioceptive feedback can be intensified, and the hands can be placed on the face to assist self-monitoring. Humming, prolongation of front vowels, chanting facilitating words containing only voiced sounds, and singing modified into speaking are frequently used to elicit a resonant forward tone focus (see Table 4-14).

V. COORDINATING INTERVENTION WITH OTHER PROFESSIONALS

The singer with vocal difficulties should also be working with a singing voice specialist. Some will work with both a singing teacher and a voice coach. The voice coach helps mainly with the repertoire of songs

Table 4–14. Actiivities for forward tone focus.

Step I	Explanation and demonstration using humming, other elicitation procedures, and sensory feedback.
Step II	Repetitions of words and phrases (usually chanted on one pitch) loaded with facilitating vowels and consonants. Mimi Mimi Mimi Maui Maui Maui Yum Yum Yum Yum Warm home, warm home My Mom, My Mom yellow lather
Step III	Longer sentences involving voiced continuant consonants so that /m/, /n/, /l/, /v/, /z/, and /ʒ/ are prolonged as sound carriers. First, chant on one pitch and later use pitch variation. My Mom mails me money. Lovely moonbeams on my arms. Lions lying lazily in the zoo. Measure my new neon nails. Zoe lives near Zionsville. Rosie values all earrings.
Step IV	Move from chanting of sentences to saying them using projected speech. Maintain vibratory continuity and do not allow any sounds to be devoiced.
Step V	Practice materials including some breathed sounds. Use the strategy of "aiming" for, and lingering on, the voiced sounds. Remember not to "scrunch" the vowels — they provide the musicality of the words. Practice words with open vowels, dropping the jaw, to increase vertical space in the oral cavity. Then, maintain this space even when saying spread vowels (e.g., "eeny"). Mabel Arnold likes artichokes and avocadoes. Natalie is an enabler in an alcoholic relationship. "Ho, Ho, Ho" said the joe in the red suit. "Oh no Flo, please don't go." Eeeny weeny kittens are miaowing.

(continued)

Table 4-14. *(continued)*

Step VI	The speech pathologist and the client practice both projected and conversational levels using a few phrases that are especially useful or generic. Hello, how are you? My name is ________________. My phone number is ________________. My address is ________________. The program tonight is ________________. Please be seated. Quiet please. Come here now. Include other sentences that the patient uses frequently at home or at work. Breath support, mouth opening, and lip and tongue movement are emphasized to aid projection. Experiment with supraglottal modifications to increase "the ring" in voice resonance.
Step VII	The speech pathologist and patient practice conversational exchanges/reading/and short, one minute speeches. Reading passages (with white noise through headphones) can be used to see if relaxed production can be maintained in the presence of noise.
Step VIII	The use of self-monitoring and a tape recorder to record voice practice at home are stressed. Client and speech pathologist decide which speaking situations need further attention and design activities to practice.

and their interpretation; the singing teacher usually is the arbiter of technique. It is helpful if the speech pathologist has had some singing lessons. This creates a familiarity with singing terms and techniques and facilitates communication. However, no matter how much singing the speech pathologist has done, evaluation of the singing voice is not his or her province. Communication with the voice teacher (or coach) is important, however, to coordinate the client's rehabilitation.

A. Role of the Voice Teacher

1. **The voice teacher will usually make judgments** concerning:

a. Voice type (soprano, alto, tenor, bass)

b. Singing range

c. Stance and posture

d. Breath control and support

e. Jaw and oral cavity

f. General tension

g. Quality of sound

h. Position and stability of larynx

i. Tongue position—tension

2. Carroll and Sataloff (1991) suggest that **sensible goals** for teachers of singing working with injured voices include:

   a. Encourage carefully supervised singing as appropriate except immediately following surgery or in cases of acute vocal fold hemorrhage.

   b. Understand the pathology and work closely with the otolaryngologist and speech pathologist.

   c. Use exercises to increase vocal strength, endurance, and efficiency (minimize trauma and atrophy).

      (1) 3 or 4 note scales with notes connected

      (2) Slightly more complex vocalises

      (3) Muscle exercises without vocal fold contact

   d. Teach singers to rely on tactile, proprioceptive, and visual feedback rather than on imitation or auditory feedback alone.

   e. Choose and describe appropriate repertoire for the individual's age, technique, and voice type.

f. Stress the importance of restricting use of full voice during early stages of mastering new repertoire.

g. Explain how to recognize and avoid tension and subvocalization when not singing (e.g., during listening or silent practice).

h. Discuss "oversinging" and specific characteristics to be monitored.

i. Send written reports to other members of the professional team.

VI. COORDINATING VOICE THERAPY WITH THE MEDICAL-SURGICAL MANAGEMENT

The otolaryngologist is responsible for the medical and surgical management of the professional voice user. He or she usually will work closely with the speech pathologist, particularly in the case of performers (singers and actors) whose vocal health and hygiene are of utmost concern.

A. Aspects of Patient Care

The following list reviews some pertinent aspects of these patients' care recommended by Sataloff (1991). For a complete discussion of voice surgery see Gould, Sataloff, and Spiegel (1993).

1. **Vocal rest** (absolute silence) is usually never recommended for longer than 1 week. Only in cases of acute injury, such as tearing of the vocal fold mucosa, surgery, or hemorrhage, is it necessary for mucosal healing. Relative voice rest (speaking only when absolutely necessary) always is beneficial.

2. **Warming-up the voice** is always sensible, and soft vocal exercises for a short period before any speaking or singing is undertaken are valuable for all singers and essential for the injured voice. Voice lessons also should be continued when the voice is injured. "Marking" is used during rehearsals to conserve voice. "Marking" involves singing at soft levels in normal voice range and avoiding notes at extremes of the range. Whistling and subvocalizing should be avoided. At

the conclusion of a performance, a singer should "cool down" by humming or speaking gently for a period of time.

B. Care of Specific Disorders

1. Singers are traumatized by the word "**nodules,**" therefore the physician and speech pathologist must be as reassuring as possible and explain how the problem can be treated. Sometimes, after heavy voice use, soft swellings may be seen on the vocal folds. These usually disappear after 24 to 48 hours of rest and they do not appear to heighten the risk of developing nodules. The physician and speech pathologist should not misdiagnose physiologic swellings. Surgery for vocal nodules should be avoided if possible. Submucosal scarring can result in an adynamic segment along the vibratory margin of the vocal fold. Therefore, even large fibrotic nodules should be treated with voice therapy for a minimum of 6 to 12 weeks.

2. **Submucosal cysts** may cause contact swellings on the contralateral side and may be misdiagnosed as nodules. Cysts and polyps may not resolve with voice therapy and may have to be carefully removed surgically. At no time, should the vocal folds be stripped in a professional performer with benign disease (Sataloff, 1991).

3. **Granulomas** and **ulcers** of the vocal processes may be related to prior intubation or gastroesophageal reflux. Treatment of the reflux (raising head of bed, not eating before retiring, drugs such as Propulsin) may resolve the lesions.

4. **Reinke's edema** may be seen in nonclassically trained professional voice users as a result of cigarette smoking and voice abuse. Hypothyroidism may contribute to this condition.

5. A ridge extending through the length of the surface of the membranous portion of the vocal fold is known as **sulcus vocalis.** This condition may increase the stiffness of the cover and cause vocal quality symptoms such as breathiness, hoarseness, and impaired flexibility. The efficacy of treatment (e.g., collagen injection) has not been thoroughly documented.

6. **Revision surgery** may be requested by patients to correct complications of prior procedures on the vocal folds of pro-

fessionals. It often is not possible to correct defects. However. occasionally, it may be possible to remove excess teflon that has been injected, as long as the incision is far from the vibratory margin of the folds. Occasionally, arytenoid dislocation sometimes is mistaken for vocal fold paralysis. Arytenoid dislocation may be the result of intubation or extubation and should be suspected if dysphonia persists 3 days after surgical procedures.

C. Documentation of Treatment

Documentation of pre- and post-operative and pre- and post-therapy status of patients' larynges is extremely important for both the otolaryngologist and the speech pathologist and helps coordinate their efforts. Photographs or videotapes of the larynx and instrumental measures, in addition to perceptual evaluations and histories, are optimal.

VII. NEUROLOGICAL BASES OF VOCAL BEHAVIOR

Damage to any central nervous system tissue or to the sensory and motor pathways (of the central and peripheral nervous systems) that innervate respiratory, phonatory, and articulatory muscles may limit vocal behavior. The degree and type of disruption depend on the site and the type of damage. Injury may occur before, during, or shortly after birth or before communication patterns have been developed and learned. In these cases, as in cerebral palsy, treatment is habilitative, because growth, development, maturation, and learning have not occurred. Voice treatment involves facilitating development and learning in the presence of abnormal structure and function. Patients who demonstrate neurologically based disorders with an onset during the adult phase of their lives receive rehabilitative treatment. In these cases growth, development, maturation, and learning have already occurred, and vocal communication patterns were habituated prior to the onset of neurological trauma or disease.

A. Neural Control of Voice

Our understanding of the neural control of phonation is still not complete. There have been some experimental studies of the central neural mechanisms involved in human vocalization and some clinical reports suggesting that there may be some types of aphonia that result from cortical damage. For example, phonatory apraxia has been associated with damage in Broca's area. Animal studies have also shed some light on the contributions of the brain stem and limbic system mechanisms to vocalization. Although speech and singing are not found in nonhumans, there seems to be evidence that brain stem and limbic system contributions to nonspeech emotional vocalizations are similar in humans and animals. Larson (1988) summarized the literature and concluded that:

> Various parts of the cerebral cortex, limbic system, basal ganglia, and extrapyramidal system[3] have been shown in human and animal studies to be important in vocalization, but the exact function of these areas with regard to vocal control is unclear. The limbic system and diencephalon project to the midbrain periaqueductal gray (PAG) which may be important for coordination of various muscle groups involved in vocalization. The PAG neurons project to the reticular formation, nucleus retroambiguous, and nucleus ambiguous. (p. 301)

(Neurons in the nucleus retroambiguous seem to be involved in the control of functions such as vocalization, swallowing, and breathing.)

Cortical control of vocalizations, for example, in Broca's area and the lateral cerebral cortex, is important for propositional speech. However, subcortical influences may be responsible for the emotional content and expression communicated through voice and prosody during propositional speech. Thus, even though some vocalizations may be described as "voluntary" because they are mediated in part by cortical structures, they also may be influenced by some of the subcortical mechanisms involved in "involuntary" vocalizations such as crying. Larson (1988) explains it in this way:

> It is not inconceivable that the cortical vocalization mechanisms involved in normal, propositional human speech serve partly to modulate subcortical mechanisms. For example, it is possible that limbic system and other subcortical structures initiate vocalization and perhaps coordinate certain muscle groups for vocal production. The cortical mechanisms

[3] "Extrapyramidal" refers to those tracts outside the pyramidal tracts of the central nervous system (e.g., cerebellum, basal ganglia, and thalamus). Diseases that involve the extrapyramidal system and the basal ganglion of the brain have symptoms that include tremors, chorea, athetosis, and dystonia (e.g., Parkinsonism is an extrapyramidal syndrome).

involved in vocalization and speech may modulate the subcortical systems so that the timing, pitch, and intensity fluctuations characteristic of normal speech are coordinated with the segmental and suprasegmental aspects of speech and language. (p. 303)

1. It is essential that the neurophysiological processes underlying human vocalization patterns be considered as **one complex but integrated system.** The contributions of all the individual parts must be viewed in relation to each other. Thus, it would be accurate to describe the neurological control of voice during speech and song as a complex process synthesizing contributions from various parts of the cerebral cortex, the limbic system, basal ganglia, and extrapyramidal system. It is much more difficult, given current information, to delineate the precise nature of the contributions. Clinicians, however, must have some specific information concerning the roles of discrete areas if they are to consider how site of lesion may differentially disrupt vocal behaviors. Generalizations concerning the possible contributions of certain specific areas are listed below.

a. Role of Areas in the Cerebral Cortex

(1) The **lateral convexity** of the cerebral cortex is involved in vocalization (Larson, 1988).

(2) Stimulation of the **precentral gyrus** in either hemisphere and stimulation of the **supplementary motor cortex,** elicits vocalization (Penfield & Roberts, 1959).

(3) There are direct connections between the precentral gyrus and the **nucleus ambiguous** (the subcortical site of laryngeal motoneurons as well as those innervating other articulators). Hirose (1976) and Larson (1988) note that the laryngeal muscles are thus coordinated with the other articulators for precise timing of voice onset.

b. Role of Subcortical Mechanisms

(1) **Limbic and diencephalic structures** appear to be implicated in animal studies of vocalization (Larson, 1988). The anterior cingulate gyrus, hypothalamus,

bed nucleus of stria terminalis, nucleus accumbens and septum, midline thalamus, amygdala, and zone incerta have been electrically stimulated and vocalization has occurred. Pathways have been identified from limbic and diencephalic structures linked to vocalization, to the midbrain periaqueductal gray. It has been noted that the periaqueductal gray matter is the lowest part of the brain that may be electrically stimulated to elicit vocalization (Larson, 1988). Destruction of these cells may result in mutism.

(2) The **basal ganglia and extrapyramidal system** also are involved in vocalization. Meissner, Sapir, Kokmen, and Stein (1987) noted that certain types of infractions involving the midline thalamus lead to hypophonia and hypokinetic dysarthria. Larson (1988) cited studies showing that other disorders involving the extrapyramidal system, such as Shy Drager syndrome, Huntington's disease, and pseudobulbar palsy, also affect vocalization.

2. Innervation During Respiration and Phonation

There seem to be two interrelated neural processes that control both vegetative and speech breathing. Innervation of the musculature is associated with both the spinal nerves (sensory and motor) and the cranial nerves (sensory, motor, or mixed). The motoneurons in the spinal cord (cervical and thoracic segments) communicate with the respiratory muscles via peripheral nerves and influence both vegetative and speech breathing patterns. Differences in respiratory muscle actions are apparent in studies comparing speech production versus quiet breathing. Also, during vocalization, there is direct motor cortical control of the respiratory motoneurons.

a. The **main nerve plexuses** serving the respiratory mechanism are the cervical and the brachial.

(1) The **cervical plexus** has communications with the vagus (X), hypoglossal (XII), and spinal accessory (XI) cranial nerves.

(2) The **brachial plexus** supplies nerves to the upper limb.

(3) During **inspiration** the contraction of the diaphragm causes thoracic enlargement. The motor innervation of the diaphragm is from the phrenic nerve of the cervical plexus. The external intercostal muscles also are important during inspiration and are innervated by the thoracic intercostal nerves.

(4) During **expiration**, the rectus abdominous muscle receives motor innervation from both the thoracoabdominal intercostal and subcostal nerves. The external oblique abdominous, internal oblique abdominous muscle and transverse abdominous muscles are similarly innervated. The lungs are innervated by the anterior and posterior pulmonary plexuses derived from branches of the sympathetic and vagus nerves.

b. The **sensory nerves that innervate the trachea** come from the recurrent laryngeal branch of the vagus and from sympathetic thoracolumbar nerve trunks connecting with the thoracic and upper lumbar segments of the spinal cord. Sensors (e.g., muscle spindles) in the muscles and tissues of the human vocal tract transform mechanical energy into neural signals that are conducted along either a spinal sensory or cranial sensory nerve toward the central nervous system (CNS). They are conducted up the spinal cord (or directly into the brain stem if they came via a cranial nerve). All of these neural responses eventually travel through the brain stem and synapse with sensory nuclei in the thalamus. Fibers travel bilaterally from the thalamus, through the internal capsule to the corona radiata, and finally to the cortex. As the afferent fibers travel to the cortex, they also may make additional connections in the brain stem. Therefore, it is important to remember that sensations are not merely relayed to the brain but are processed and integrated enroute.

3. Bilateral Pyramidal Tracts

The corticobulbar and corticospinal tracts form the bilateral pyramidal systems.

a. The **corticobulbar tract** is made up of individual neurons which descend from the cortex to the brainstem nuclei of one of the motor cranial nerves.

b. The **corticospinal tract** is made up of individual neurons descending from the cortex in each cerebral hemisphere to the ventral horn gray matter of the spinal cord. There they innervate specific spinal nerves. As neurons descend, fibers exit at various levels to synapse with their motor targets. The descending neurons are called upper motoneurons.

c. The **direct motor route** from the cortex is as follows. Each tract (right and left) descends through the corona radiata to the diencephalon. It then enters the brain stem and descends through the cerebral peduncles of the midbrain, the ventral pons, and the pyramids of the medulla. As the left and right tracts pass through the brain stem, fibers exit from each side and synapse onto the nuclei of the motor cranial nerves. The vagus exits in the medulla. After all of the corticobulbar fibers have exited, most of the corticospinal fibers decussate (cross from one side over to the other side). This crossing over of most of the corticospinal fibers in the inferior medulla is responsible for what is known as contralateral innervation (movement on one side of the body is controlled by the brain on the other side).

4. Cranial Nerves

A sensory cranial nerve has cell bodies in the peripheral nervous system with axons conducting toward the brain. A motor cranial nerve is a collection of cell bodies in the central nervous system with axons that exit at a specific level, moving out into the periphery to the muscles to be innervated. Cranial nerves may be sensory, motor, or mixed.

The structure of the cranial nerves is important in relation to the effects of pathology. For example, the nuclei of motor cranial nerves lie in the brain, yet the axons are part of the peripheral nervous system. Conversely, sensory cranial nerves have nuclei in the peripheral system and axons conducting toward the brain. Thus, if a lesion is peripheral, there may be a rather specific effect on sensory or motor function. A central lesion, on the other hand, may result in a more diffuse impairment. Motor impairment resulting from central nervous system damage is very different from that resulting from a peripheral nervous system lesion.

a. **The Vagus** (like all cranial nerves, it is paired) (see Figure 4-6). The vagus is also both sensory and motor in function.

(1) **Sensory receptors** include locations in the:

(a) Pharynx

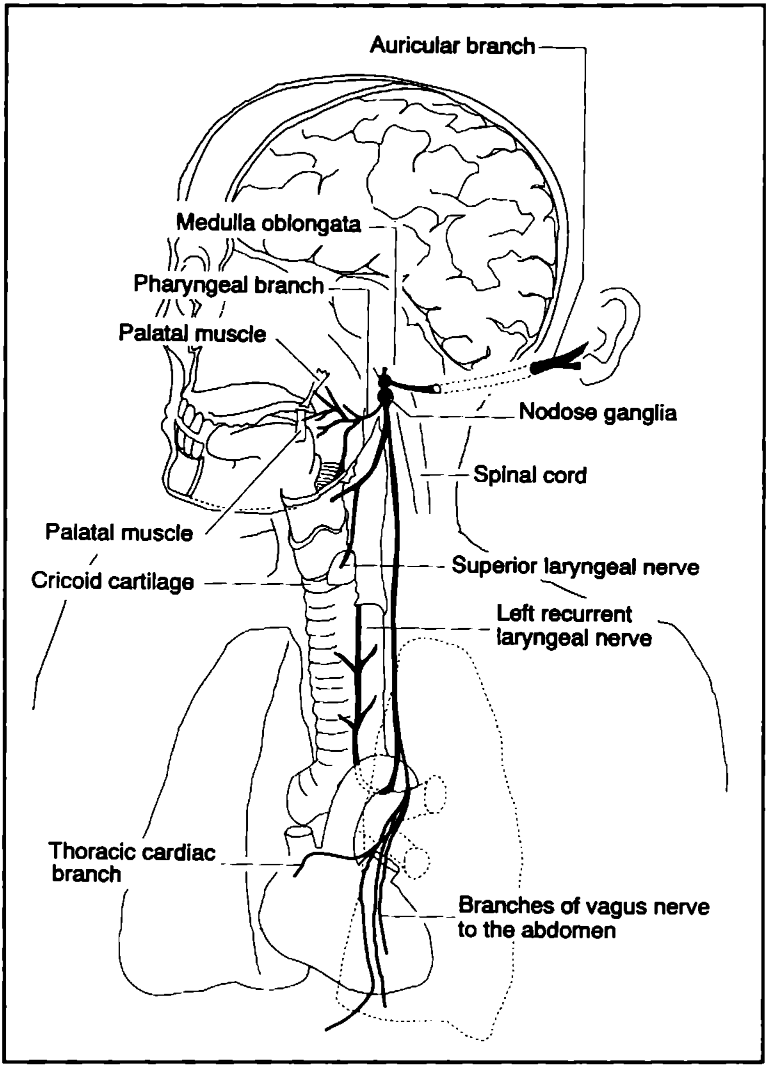


Figure 4-6. Diagram showing the extensive course of the vagus nerve. (Jim Hull, Graphics Services, Indiana University)

(b) Larynx

(c) External ear

(d) Thorax

(e) Abdominal cavity

(f) Heart

(g) Lungs

(2) The vagus contributes to **respiratory and cardiovascular** as well as **digestive sensations.** Motor control includes innervation of the palatal muscles (excluding the tensor veli palatini), pharyngeal muscles, and all intrinsic laryngeal muscles.

(3) There are **two large divisions** of each vagus nerve — the superior laryngeal nerve and the recurrent, or inferior, laryngeal nerve.

(a) The **superior nerve** innervates the cricothyroid muscle of the larynx. The external branch of the superior laryngeal nerve of the vagus innervates the intrinsic laryngeal muscles responsible for pitch control. The internal laryngeal branch of the superior laryngeal nerve of the vagus is mainly sensory and innervates the mucosa of the larynx.

(b) The **recurrent nerve,** however, divides a great deal with branches wandering (vagus means wanderer) into the thorax and abdomen. All of the intrinsic muscles of the larynx, with the exception of the cricothyroid, are innervated on each side by the recurrent nerve. Its lower motor neuron cell bodies are located in the nucleus ambiguous of the medulla oblongata. The left recurrent nerve has a longer course than the right. It divides into a motor and sensory branch before entering the larynx behind the cricothyroid joint.

(4) Yoshida et al. (1989) found the **origins of sensory nerve fibers** in the nodose ganglion of cats. The no-

dose ganglion is a thickening of the vagus near the brain stem in which all fibers innervating the vocal tract are present. The laryngeal sensory cell bodies are unipolar neurons of medium size. Yoshida et al. (1989) described the laryngeal sensory innervation in the following way:

> The laryngeal nerve has three different types of nerve fibers and each type has a specific function: there are the motor nerve fibers that cause the muscles to act, the autonomic nerve fibers that regulate the vessel and laryngeal glands and, finally, the sensory nerve fibers that receive sensations and convey those sensations to the central nervous system.
>
> The sensory nerve fibers of the larynx come off the nodose ganglion of the vagus, which is the site of their cell bodies. and terminate centrally in the nucleus tractus solitarii of the medulla. The sensation of the larynx is innervated by both the superior and inferior laryngeal nerves. On voice production, the brain controls pitch, intensity and tonal quality of voice through a feedback system from not only the auditory apparatus but also the laryngeal sensory innervation. (p. 314)

B. Treatment Considerations

Aronson (1990) states that neurologic voice disorders are subsumed under the general category of dysarthria, and that the classification is based on the location of the lesion in the nervous system and the muscular pathophysiology. Assessment and differential diagnosis involve careful medical history, neurological evaluation, testing (possibly EMG, Magnetic Resonance Imaging, tomography), and speech-language pathology evaluation. The neurologist is responsible for the diagnosis. However, the speech-language pathologist plays an important role, because dysphonia is sometimes the first presenting symptom of neurologic disease. Treatment must be individualized, because the voice and speech characteristics of neurological conditions vary widely. Approaches designed for individual patients frequently must be adapted to deal with multiple neural deficits and pathologies, the effects of medication, depression, and compensatory behaviors. Treatment should focus on the entire speech system so that respiration, phonation, resonance, and psychosocial dynamics all are addressed to maximize communicative effectiveness. The coordination of respiration, phonation, and articulation behaviors also is an important aspect of treatment.

VIII. DYSPHONIAS ASSOCIATED WITH FLACCID MUSCLE TONE AND HYPOADDUCTION

Conditions associated with **weakness or paralysis of the vocal folds** include lower motor neuron, myoneural junction, and muscle disorders disrupting the peripheral nervous system (PNS).

A. Neurological Bases

Phonation results from the creation of a vibrating column of air. Oscillations of the vocal folds depend on certain prerequisite biophysical conditions including:

- changes in glottic configuration (vocal fold size, shape, and approximation)
- aerodynamic changes in airflow and surface pressures
- changes in the tensions of vocal fold tissues
- changes in elasticity, density, and viscosity of structures

The vocal folds are adducted as a result of the approximation of the vocal processes of the arytenoid cartilages and by the medial configuration of the folds themselves. The shape, size, and evenness of the folds influences the medial configuration. Thus, on occasion, the vocal processes may be fully adducted, but the folds may not achieve complete contact longitudinally. The degree of adduction directly influences the quality of the phonation. Deviations in laryngeal approximation and resistance may be so great that the aerodynamic forces required to set the folds in motion are beyond the capability of the respiratory system, resulting in inadequate or absent voicing. This may occur when the folds are not adducted sufficiently or when the folds are adducted too tightly.

1. **Neurological deficits may result in inappropriate adduction patterns** during intentional phonation. Hypoadduction may range from complete absence of vocal fold adduction, for example, subsequent to a brain stem injury, through various degrees of partial closure. Vocal fold paralysis or paresis may be unilateral or bilateral and may result from damage to

the adductor muscles themselves or the recurrent laryngeal nerve branch of the vagus (Xth cranial nerve) which innervates them.

2. Innervation of the Vocal Folds

The vagus comes from the lateral surface of the medulla. Just after emerging from the skull (through the jugular foramina openings together with the IX and XI cranial nerves) each vagus, left and right, divides into three branches.

a. The **pharyngeal branches of the vagus nerve** course downward between the external and internal carotid arteries to innervate the middle pharyngeal constrictor muscles. There, they subdivide and join with branches from the sympathetic trunk and the glossopharyngeal and external laryngeal nerves to make up the pharyngeal plexus. This plexus supplies innervation to the pharynx and muscles of the velum with the exception of the tensor veli palatini muscle. Vagus nerve lesions above this level result in adductor paralysis of the larynx and paralysis of the velopharyngeal muscles.

b. The **superior laryngeal nerve branches** descend from the inferior ganglion and divide into the internal and external laryngeal nerve branches.

   (1) The **internal laryngeal nerve** branches divide into two additional branches both of which contain afferent (sensory) fibers.

      (a) The **upper branch** supplies the mucous membranes of the epiglottis and the vestibule of the larynx.

      (b) The **lower branch** supplies the mucous membrane of the aryepiglottic folds and the dorsum of the arytenoid cartilages. There is also motor supply to the cricothyroid muscle. Thus, lesions (frequently due to thyroid surgery or disease as well as accidental trauma) at this level result in paralysis of the cricothyroid muscle, or sensory deficits in the larynx.

c. The **recurrent laryngeal nerve branches** are not symmetrical bilaterally, as are the paired nerves mentioned above. The left recurrent nerve leaves the vagus trunk near the arch of the aorta. It then ascends and enters the larynx. The right recurrent nerve leaves the vagal trunk in front of the subclavian artery. Running under the artery, it ascends beside the trachea behind the common carotid artery and enters the larynx behind the place where the inferior horn of the thyroid articulates with the cricoid cartilage. It frequently subdivides further into additional branches before entering the larynx. All of the intrinsic muscles of the larynx except the cricothyroid are innervated by the left and right recurrent nerve branches of the vagus. They are also involved in the sensory supply of the subglottic mucous membranes. Vagus nerve lesions occur most frequently in the left recurrent laryngeal nerve. Recurrent laryngeal nerve lesions may be due to heart or circulatory problems if pressure from structures impinge on the nerve (e.g., aneurysms, mitral stenosis). Tumors in the thorax cavity also may damage the nerve and trauma may also occur. With the exception of the cricothyroid, all of the intrinsic laryngeal muscles will be affected. Because of the action of the cricothyroid muscle, the folds may be drawn to the midline but cannot be abducted because of paralysis of the other muscles. Thus, this type of lesion causes an abductor type of laryngeal paralysis.

3. The **peripheral nerve innervation** of the larynx is ipsilateral, thus the right sensory and motor nerves supply the right side of the larynx, and the left sensory and motor nerves supply the left side. Sensory and motor tracts from the CNS (both left and right cortical hemispheres, the basal ganglia, and cerebellum) are known as upper motor and sensory neuron tracts. They lead to nuclei of the peripheral nerves located in the brain stem. These are referred to as lower sensory and motor neurons. These lower motor neurons directly innervate the larynx and pharynx. The branches of the vagus and the result of lesions are shown in Table 4–15.

B. Lesions and Disorders Causing Hypoadduction

1. **Lesions that damage vagal nuclei within the brainstem** are called *intramedullary*. If a lesion occurs after the nerves leave

Table 4-15. Branches of the vagus, and the result of lesions.

Branch	***Result of Lesion***
Pharyngeal branch	The muscles of the velum (levator and levator veli palatini) are affected on one or both sides.
Superior laryngeal branch	The cricothyroid muscle is affected on one or both sides.
Recurrent laryngeal branch	All other intrinsic laryngeal muscles are affected either unilaterally or bilaterally resulting in the fixation of the folds in an abducted position.

the skull, it is *extracranial.* If the nerve is damaged before leaving the skull but outside the brain stem itself, the lesion is referred to as being *extramedullary.* All intra- and extramedullary and extracranial lesions occur before the vagus separates into its *pharyngeal, superior laryngeal,* and *recurrent branches.* This means that all the muscles they innervate will be paralyzed *on the same side* as the lesion. Symptoms of these lesions include paralysis or weakness of the muscles listed in Table 4-15.

a. **A brainstem lesion affecting the nuclei of the right and left vagus nerves results in bilateral paresis (weakness) or paralysis of the pharyngeal and laryngeal muscles, affects sensory functions, and is very serious.** When both folds are abducted and the velum is involved as well. the airway is without its usual protective defenses. Fortunately, unilateral lesions occur more frequently than bilateral ones. Symptoms of unilateral damage are usually less severe, but they are troublesome.

b. **Symptoms**

(1) Unilateral lesions result in the following symptoms:

(a) Unilateral vocal fold paralysis

(b) Breathiness and aphonia

(c) Tremorous vowel prolongations

(d) Reduced loudness

(e) Reduced endurance

(f) Lowered pitch

(g) Diplophonia (differences in size/mass of the folds may lead to "two-toned" pitch)

(h) Hypernasal resonance, particularly on vowels

(i) Distorted pressure consonants

(j) Nasal emission

(k) Weakened cough

(l) Swallowing problems

(2) **Bilateral lesions will result in the following symptoms:**

(a) Bilateral vocal fold paralysis

(b) Open glottis

(c) Almost total absence of vibration

(d) Marked hypernasality

(e) Distorted pressure consonants

(f) Absent or weak cough

(g) Absent or weak gag reflex

(h) Dysphagia (nasal regurgitation on swallowing)

2. **Lesions that damage the superior and recurrent laryngeal nerve** branches, but not the pharyngeal branch, do not create velar problems, but they do result in all of the laryngeal symptoms listed above. If the paralysis is complete (superior and recurrent) Sataloff and Spiegel (1993) suggest that intracranial studies be ordered by the physician.

3. **Lesions of the superior laryngeal nerve alone,** or extracranial lesions not involving the pharyngeal or recurrent laryngeal nerve, affect the cricothyroid muscle and impact on pitch capability. Sataloff and Spiegel (1993) note that superior laryngeal nerve paralysis is suspected when one fold lags in adduction and when the larynx is tilted. Symptoms include loss of high pitches and instability in the upper range as well as breathiness and weakness.

   a. **Bilateral paralysis may cause the following signs:**

      (1) The thyroid cartilage will not tilt on the cricoid cartilage during phonation.

      (2) The vocal folds appear short.

      (3) The vocal folds appear bowed.

      (4) The epiglottis overhangs the anterior part of the vocal folds.

      (5) Voice quality will be breathy or hoarse.

      (6) Loudness will be reduced.

      (7) The ability to alter pitch will be impaired.

      (8) Singing will be difficult.

   b. **In unilateral paralysis of the cricothyroid muscle,** the following symptoms occur:

      (1) The vocal folds appear to adduct during phonation.

      (2) The paralyzed fold appears to be shorter.

      (3) There is asymmetry of the epiglottis and anterior larynx.

      (4) Voice quality may be slightly hoarse or breathy.

      (5) The loudness is slightly reduced.

(6) There is some inability to change pitch.

(7) There are subtle difficulties in singing.

4. **Lesions of the inferior recurrent laryngeal nerve** result in paralysis of all intrinsic muscles of the larynx with the exception of the cricothyroid. The cricothyroid assumes a compensatory function and acts as an adductor. Thus, the folds may be positioned at the midline or paramedian position rather than in an abducted position as might be expected.

   a. **In bilateral involvement of the recurrent laryngeal nerve, the major concern is not with phonation. It is with maintenance of an airway.** The folds, approximated at the midline, will vibrate, and voice may sound almost normal. However, because the abductor muscles are paralyzed, serious respiratory distress may occur and there may be stridor during inhalation. This condition frequently requires a tracheotomy.

   b. **Unilateral paralysis may result in:**

      (1) Reduced airway

      (2) Weak cough

      (3) Reduced loudness

      (4) Diplophonia

      (5) Pitch breaks

      (6) Breathy, hoarse quality

5. **Myasthenia gravis** is a progressive neurological disease that, in some patients, manifests itself first in the muscles supplied by the vagus nerve. The disease is characterized by progressive, flaccid weakness or paralysis that is related to muscular effort. Thus, initially when a patient reads or speaks for a substantial period of time, there is a gradual decrease in control of the muscles of the velum and larynx which results in gradual deterioration in voice quality. In the early stages of

the disease, this gradual change from normal voice quality to hypernasal, breathy or hoarse quality results from myoneural junction problems in all branches of the vagus nerve and is diagnostic. However, other nerves may not be affected.

a. Bilateral muscle weakness resulting from lower motor neuron disease[4] creates:

(1) Incomplete adduction of the folds

(2) Bowing of the vocal folds

(3) Inhalatory stridor (as the condition worsens)

(4) Hypernasality

(5) Nasal emission

(6) Reduced loudness

(7) Restricted pitch range

(8) Breathy, hoarse quality

(9) Tremor on prolonged vowels

(10) Phonemic distortions

(11) Monopitch

(12) Weak cough

(13) Normal appearance of larynx during visualization of structures in early stages of disease

(14) One or more of the components of communication may be affected initially (e.g., consonant imprecision, plus weak voice)

Diagnosis of myasthenia gravis or myoneural junction disease is made by a neurologist and may involve admin-

[4] Diseases of the lower motor neuron include myasthenia gravis, amyotrophic lateral sclerosis, and Wallenberg syndrome.

istration of Tensilon intravenously. When the Tensilon injection results in a marked, though transient, improvement in speech and voice symptoms, the diagnosis is confirmed. This test is used to differentiate between conversion reactions and myasthenia gravis (Aronson, 1990).

b. Management techniques include:

(1) Corticosteroids

(2) Anticholinesterase drugs to improve the action of the neurotransmitter chemical acetylcholine

(3) Removal of the thymus gland

(4) Adrenocorticotropic hormone therapy

(5) Palatal lift prosthesis to compensate for velar inadequacy

(6) Voice therapy to increase hyperadduction is not usually recommended if problem is treated with medication

6. **Respiratory disorders may also coexist with flaccid dysphonia.** Lesions of the cervical, thoracic, or lumbar spinal nerves may result in weakness and atrophy of the speech muscles and flaccid dysarthria including dysphonia. Lesions may be the result of trauma, tumors, and myoneural junction disease. Weakness in the respiratory muscles results in reduced lung volume, reduced expiratory force, and limitations in subglottic air pressure. Although respiratory and laryngeal symptoms frequently coexist, this is not invariably the case. However, when both the laryngeal and respiratory muscles are impaired, communication is severely limited and mechanical ventilation may be necessary.

a. Voice related symptoms include:

(1) Increased number of breaths per minute

(2) Diminished tidal volume

(3) Breathiness because of weak vocal fold adductors

(4) Short breath groups

(5) Inhalatory stridor if abductors can't open glottis wide enough

(6) Decreased loudness because of hypofunctional laryngeal valving

(7) Dysphagia

(8) Minimal intonation, stress, loudness variation

b. Management strategies include:

(1) Postural changes and supports

(2) Family counselling

(3) Physical therapy

(4) Respiratory therapy

(5) Mechanical ventilation

(6) Palatal lift prosthesis if velopharyngeal inadequacy/ flaccidity

(7) Voice therapy to improve speech breathing and laryngeal adduction

(8) Alternative communication strategies

IX. DYSPHONIAS ASSOCIATED WITH INCREASED MUSCLE TONE AND HYPERADDUCTION, MIXED PATTERNS, AND TREMOR

Neurologic dysphonias may result from lesions within the central nervous system (CNS). However, they are seen infrequently; only 10% of all neurologically based voice disorders are caused by these lesions. There seems to be both contralateral and ipsilateral innervation of the vagus nerve from the upper motor neuron. This means that a unilateral lesion in the motor strip on either side of the cerebral cortex, or of the corticobulbar fibers, does not disrupt laryngeal function. Bilateral lesions of the corticobulbar tracts supplying the motor nuclei of the cranial nerves involved in speech production, however, cause spastic dysarthria.

A. Spastic Dysphonia

This disorder, which is not the same as the condition now known as spasmodic dysphonia, is frequently a component of a generalized dysarthria. Increased muscle tone (spasticity) occurs even in the presence of weakness and paralysis of muscles in disorders of the upper motor neuron.

1. Symptoms of spastic dysarthric dysphonia (pseudobulbar) include:

a. Harsh, strained, voice quality (hyperadduction of folds)

b. Abnormally low pitch

c. Lack of variability in pitch and loudness

d. Reduced loudness

e. Adduction of false (ventricular) folds

f. Vocal folds appear normal when visualized

g. Involuntary and incongruous laughing and crying

h. Slow rate of speech

i. Hyperactive gag reflex

j. Bilateral, velopharyngeal inadequacy/hypernasality

k. Slow, alternate motion rates for lips and tongue

l. Articulatory problems related to both weakness and spasticity in the articulators

m. Patients may be perceived as cognitively impaired or unstable, but this is not always an accurate perception.

It may also result from co-existing CVAs or multi-infarct dementia.

2. **Voice treatment** is tailored to the individual's situation but the condition is frequently unresponsive to treatment. Alternative communication systems may be suggested.

B. Amyotrophic Lateral Sclerosis (ALS)

ALS is a degenerative disease of bilateral corticobulbar tracts and lower motor neuron nuclei. Spastic and flaccid paralysis occur together. At different times and in different patients, various symptoms can be seen. Langmore and Lehman (1994) noted that, when dysarthria and dysphagia are seen as the initial signs, the patient is described as having bulbar manifestations of ALS. However, if the manifestations of the disease initially are seen only in the limbs it is described as nonbulbar, prebulbar, or spinal ALS suggesting damage to the anterior horn cells or lower motor neurons (and usually the corticospinal tract or upper motor neurons as well). Nevertheless, even if there is no initial evidence of bulbar involvement (e.g., dysarthria, dysphagia) as the disease progresses, bulbar involvement occurs. Langmore and Lehman (1994) described muscle weakness as the salient feature of this disorder. Reduced tongue strength was found even when patients were not yet perceived to be dysarthric. Hyperadduction of both the true and false folds and characteristics of spastic (pseudobulbar) dysphonia are seen. Additionally, hypoadduction and characteristics of flaccid dysphonia can be seen in this population. This is a mixed pattern.

1. **Symptoms may include:**

   a. Voice quality that is harsh, strained, yet also breathy

   b. Reduced loudness

   c. Audible inhalation

   d. Pooling of saliva in the pyriform sinuses causing a "wet" gurgling sound

   e. Infrequent swallowing

   f. Tremor on vowel prolongations

g. Atypical pitch characteristics

h. Articulatory disturbances

i. Velopharyngeal inadequacy

j. Abnormally slow rate

k. Hyperactive gag reflex

l. Inappropriate laughing and crying

m. Slow alternate motion rates (AMRs)

2. Depending on the stage of the disease, some degree of **disruption** will occur **in voice resonance, rate, and prosody.**

3. **Articulation** also deteriorates progressively so that intelligibility is completely impaired in the later stages of the disease.

4. **Management** includes emotional support, palatal lifts, and use of alternative communication systems.

C. Chorea

Dysphonia associated with **chorea** is said to be hyperkinetic dysarthria because movements are irregular and unpredictable. Huntington's chorea is an extrapyramidal hereditary disease caused by lesions in the basal ganglia. It is a genetic disorder afflicting approximately 30,000 Americans. Although the disease causes disorientation and memory lapses, patients are aware of their deterioration and suffer from depression during the 10- to 20-year decline preceding their death. The earliest sign of onset usually is an unsteady gait. Jerky movements of the respiratory and laryngeal muscles and uncontrolled movements of the articulators are observed as the disease progresses.

1. **Symptoms include:**

a. Sudden, forced breathing

b. Prolonged vowels

c. Harshness

d. Excessive variations in loudness

e. Reduced pitch variability

f. Abnormal prosody

g. Irregular aphonic episodes

h. Progressive dementia/intellectual impairment

2. **Management**

Depending on the stage of the disease, the voice clinician may assist with techniques to encourage improved phrasing (e.g., shorter phrases) and other maintenance strategies. The effects of depression on communication must also be addressed and family counselling is frequently implemented.

D. Hyperkinetic Dystonic Dysphonia

This form of dysphonia is characterized by slow, writhing movements of the speech and or vocal mechanisms. Nonvolitional spasms of the abductor and adductor laryngeal muscles may produce stridor, groaning, and strained, strangled, voice quality.

1. **Symptoms include:**

a. Vocal folds appear structurally normal when visualized.

b. Intermittent hyperadduction of folds

c. Abnormal prosody

d. Slow, continuous, voice changes

e. Strained, harsh, breathy quality

f. Abnormal rate, phrasing, and timing

g. Slow and irregular AMRs

h. Signs of dystonia may appear in other parts of body in addition to the larynx

i. Intellectual and behavioral impairment

j. Inappropriate variability

k. Imprecise articulation

2. **Management**

The goal of treatment in the early stages is to help maintain communication for as long as possible. Helping the patient's caretakers to simplify and structure interactions may be part of the support provided.

E. Parkinsonism

Parkinsonism is an extrapyramidal syndrome, characterized by hypokinetic dysphonia and caused by basal ganglia lesions. The early signs of this disease may be confused with functional dysphonia. Many patients experience improvement in their voices as a result of L-dopa drug therapy. Amplifiers and communication aids may be necessary for some severe cases. Complete aphonia may occur.

1. **Symptoms[5] include:**

a. Visualization of the larynx reveals normal, symmetrical folds

b. Incomplete vocal fold adduction may result in breathiness

c. AMRs sound rapid

d. Mask-like face

e. Rate, timing, and prosodic disturbances

f. Imprecise articulation

g. Reduced loudness (spontaneous speech)

[5] See Forrest, K., Weismer, G., and Turner, G. (1989). Kinematic, acoustic and perceptual analyses of connected speech produced by Parkinsonian and normal geriatric adults. *Journal of the Acoustical Society of America, 85,* 2608–2622.

h. Reduced pitch variability

i. Tremor in voice •

j. Hoarseness, roughness in quality

k. Rigidity of respiratory and laryngeal muscles

l. Diminished range of motion

m. Lack of loudness variability

n. Swallowing problems

2. Management

Medications used include levodopa, selegilene, dopamine agonists, anticholinergics, and amantadine. Some side effects may be noticed as well as behavioral benefits. Voice treatment techniques include increasing the depth of inhalations and practicing coordinating exhalation with voice onset. Increasing the strength of fold adduction by using reflexive cues (e.g., pushing, pulling, lifting) and increasing the duration of vowels and voiced continuant consonants help patients to maintain vibratory function over time. Exercises such as timing the prolongations of /z/ provide feedback and help patients become conscious of the need for sustained effort. Some clinicians suggest that encouraging patients to shout or move systematically further and further away from the listener helps the patient learn to monitor the feeling of increased effort and speech movement. Activities to improve rate, pitch, and loudness variability, phrasing, and articulatory precision are usually beneficial. "Thinking loud" and drills such as activities to increase adductory strength, and pitch glides, are used to address the vocal fold bowing and hypokinesia (Ramig, 1992). See Ramig (1991) for a discussion of treatment efficacy, patient characteristics and motivation during treatment, depression, and prognostic considerations associated with Parkinsonism.

F. Essential Tremor

Voice tremor may be a part of the syndrome known as (organic) **essential tremor.** It may be the only manifestation of the disorder or may be accompanied by tremor in the head, face, neck, or hands. Voice tremor occurs if there are alternating contractions of the adductors and abductors of equal magnitude acting on the vocal folds. The vocal fold tremors are unlike those associated with Parkinsonism, cerebellar disease, excessive thyroxin, or highly emotional states. No specific location for a lesion causing this type of tremor has been identified although a familial pattern has been observed.

1. **Symptoms**

   a. **Different patterns may be heard** in the vocal characteristics depending on whether the adductor or abductor movements predominate.

   b. **Voice arrests and breathy air release** may be heard depending on the pattern.

   c. **Symptoms may also include:**

      (1) Quavering voice[6]

      (2) Voice spasms

      (3) Voice breaks are less obvious on higher pitched vowel prolongations.

      (4) Synchronous tremor movements of the tongue may be seen during vowel prolongations.

      (5) Onset may follow a stressful event and cause misinterpretation as a psychogenic disorder.

      (6) Onset may be gradual or sudden.

      (7) Severity of tremor is greater during stress and fatigue.

      (8) Tremor can be heard during long, prolonged vowels.

      (9) Tremor is not present at rest.

[6] Case (1991) describes consistent rhythmic vibratolike alterations in pitch and loudness, ranging from 4 to 12 oscillations per second with a frequency of oscillation around 5–6 Hz and intensity variation of as much as 5 dB.

2. Management

Treatment should target a more even, clear, vibratory pattern by maximizing the contributions of other systems such as respiration, resonance, and articulation. Swallowing to relax the musculature (patients can be encouraged to take sips of water frequently) as well as firm versus breathy adduction exercises (e.g., prolongations with easy onsets) are beneficial to some patients. Varying the duration of the vowel sounds may also help. Chewing exercises, yawn-sigh, chanting, and emphasis on precise articulation to maximize intelligibility and focus attention on the facial area may be helpful. While voice therapy techniques are not very successful in significantly reducing tremor, they can eliminate compensatory behaviors that worsen the problem. Olson and Scherer (1991) note that pharmacological and surgical intervention may offer some relief of symptoms.

G. Gilles de la Tourette Syndrome

This syndrome is characterized by tics and involuntary vocalizations. Vocalizations include involuntary grunting, barking, coughing, swearing, and echolalia. Management includes use of the drug haloperidol. The exact cause of this syndrome is unknown. Voice therapy usually is not recommended, although speech pathologists may be helpful in referring school-age children with tics, because one tic, usually in the eye area, begins between 2 and 13 years of age. Occasionally, a mild, phonatory symptom, such as unpredictable, filled pauses, may be seen in the early stages of this condition. In such cases, it may sometimes be confused with paradoxical vocal fold motion or asthma.

H. Vocal Apraxia

Vocal apraxia (apraxia of phonation) may result from a lesion in Broca's area of the dominant cerebral hemisphere and therefore is a motor speech disorder. Apraxia of respiration for speech, and apraxia of speech, also may occur from a lesion in Broca's area. Patients are unable to produce sound or exhale or inhale on command, however they can breathe automatically and may cough spontaneously and reflexively. There is considerable variety in range of severity and it may also present with dysarthria.

1. **Symptoms include:**

   a. No articulatory movements or sound production

   b. Articulation with air only

   c. Articulatory movements without breathing out

   d. Phonetic problems

   e. Vocal folds appear normal when visualized

   f. Dysarthric and apraxic symptoms co-existing

2. **Management**

   The approach to treatment used by most clinicians is to shape phonation elicited reflexively. Repetitions of short coughs, prolongation of throat clearing, and humming initiated by throat clearing are useful techniques to initiate the sequence of training.

I. Deep Cerebral and Brain Stem Lesions

Dysphonia resulting from **diffuse, deep cerebral and brain stem lesions** can be caused by tumors, cerebrovascular accidents, metabolic diseases, subdural hematomas, and lack of oxygen (anoxia) for critical periods. These dysphonias are present in **akinetic mutism.** Symptoms may be mistaken for psychogenic disorders or vice versa.

1. **Behaviors include:**

   a. Immobility

   b. Open eyes but failure to maintain eye contact

   c. No movement except for eye movement

   d. Occasional reports of motor responses after long delay

   e. Few voluntary movements

f. Sucking movements

g. Trance-like behavior

h. Long latency before all responses

i. Disorder involving different degrees of speech inhibition

j. Typically produces no sound of any kind

k. Prognosis is guarded — mutism may come and go and be partial or complete.

2. Management

Voice therapy does not seem effective.

J. Frontal Lobe Lesions

Lesions in the frontal lobe may also result in dysphonia, aphonia, or mutism associated with apathy and emotional changes. Lesions of this type may be associated with brain tumors and traumatic brain injury.

K. Multiple Sclerosis (MS)

MS is a disease of the central nervous system that involves scarring or sclerosis of the white matter. Lesions may involve the cerebral cortex, the brain stem, cerebellum, or the spinal tracts. There is a loss of myelin on the affected neurons.

1. Voice symptoms include:

a. Abnormal control of loudness

b. Harsh quality or breathiness

c. Impaired articulation

d. Abnormal pitch control

e. Impaired breath support

f. Hypernasality

g. "Scanning" speech or prosodic impairment

h. Increased rate of breathing

i. Nasal emission

j. Dysarthria

2. **Management includes:**

a. Adrenal corticosteriods

b. Muscle relaxants

c. Physical therapy

d. Amplification

e. Counselling

f. Speech and voice therapy for dysarthric symptoms

X. VOICE THERAPY STRATEGIES FOR LARYNGEAL HYPOADDUCTION AND HYPERADDUCTION

A. Hypoadduction Techniques

Vocal fold adduction problems[7] may have various etiologies and range from complete lack of adduction through many glottal configurations.

1. **The major goal of voice therapy** is to improve adduction in order to obtain improved voicing.

2. **Stimulability approaches** include eliciting reflexive behaviors such as coughing, throat clearing, grunting, laughing,

[7] Glottic insufficiency has also been treated with injectable cross-linked bovine collagen (Ford & Bless, 1992) when other treatments have been unsuitable or have failed.

and so forth. Digital manipulation and pressure applied to the abdomen are frequently paired with stimulation of reflexes. By pressing on the external abdominal wall, the speech pathologist can increase subglottal air pressure. To increase adduction of the vocal folds, techniques such as pushing, pulling, and lifting are used as the patient phonates (see Table 4–16).

3. To compensate for laryngeal valving constraints, it is important to **improve** other **associated behaviors and systems.** Goals might include improving respiration behaviors, for example, using the techniques shown in Table 4–17.

B. Hyperadduction Reduction Techniques

These techniques are frequently needed by patients who suffer from upper-neuron system disorders and demonstrate spasticity

Table 4–16. Activities to improve vocal fold adduction.

Stimulability

1. Push down with hands on seat while phonating /i/.
2. Lift a chair while phonating /i/.
3. Push the walker slowly across the floor while prolonging /i/.
4. Push hands together in short spurts with repeated phonation of the vowel (and hard attack) /i/ /i/ /i/.
5. Push against the wall /a/ /a/ /a/.
6. Hit a punching bag with rapid punches, and punch out the /ʌ/ /ʌ//ʌ/.
7. Turn the head to one side in the direction of the normal fold (to increase tension on the paralyzed fold) and say /ʌ/ /ʌ/ /ʌ/.
8. Digital manipulation of the thyroid cartilage to help approximate the folds while repeating a series of different vowel sounds.
9. Producing a series of vowel sounds at high pitches to stimulate the adducting compensatory function of the cricothyroid. Begin with the tense vowels.
10. Use visual feedback to monitor intensity levels of the production (VisiPitch™, IBM Speech Viewer™, VU Meter, decibelloscope).

Table 4-17. Techniques to maximize associated behaviors in the presence of weak phonatory behavior.

Step I	Respiration (facilitating posture) erect head, neck, and thorax collaborate with physical therapy to obtain appropriate support devices
Step II	Respiration increase frequency of replenishing breaths initiate phonation at beginning of exhalation
Step III	increase level and duration of subglottal pressure
Step IV	increase consistency and strength of exhalation on /s/ and /z/ to coordinate airflow and voicing
Step V	monitor through visual feedback
Step VI	Resonance behaviors drop jaw open mouth decrease posterior tongue tension improve velopharyngeal closure (surgery or prosthesis)
Step VII	Articulation practice hard, sharp onsets increase precise contacts adjust rate and phrasing one word per breath if necessary
Step VIII	Cognition pretend to be shouting loudly

and hypertonicity. Hyperadduction patterns may also occur in extrapyramidal system diseases characterized by involuntary movements such as dystonia and chorea.

1. **Hyperadduction patterns** range in severity from the inability to phonate to disruptions in phonation that are moderate to mild and continuous or sporadic. Examples include:

   a. Strain, strangled/harsh

   b. Adduction of false folds (ventricular phonation)

   c. Reduced loudness

d. Pitch breaks and spasms

e. Pressed, tight phonation

f. Alternating hyper- and hypoadduction spasms

g. Intermittent voice arrest

h. Compensations for inadequate respiration

i. Extreme tension in upper body

j. compensations for velopharyngeal inadequacy

2. **Goals of therapy** are to reduce tension in vocal fold closure, relax laryngeal muscles, and initiate phonation with breathy onset.

3. **Strategies include:**

   a. Progressive relaxation

   b. Massage and direct muscle manipulation

   c. Yawn/sigh technique

   d. Chewing method

   e. Decreased airway resistance (rotate head backwards and initiate vowel at high lung volume)

   f. Raise pitch and hum

   g. Mental images of open throat space

   h. Panting rapidly followed by lip closure and slight hum

   i. Exaggerated repetitions of voiceless plosives /p/ and /t/ gradually adding vowel sounds

   j. Phonating while bending over from waist and other postural changes

4. **Facilitating Materials and Devices**

   Use of facilitating positions and devices (in consultation with a physical therapist) may help some patients improve consistency and duration of exhalation.

   a. Use **relaxed abdominal breathing** and encourage the patient to "breathe out the word." Sample words: "shoe," "shush," "hush" (should be prolonged and air flow felt on hand). The concept of breathing as a rhythmic, tidal process may be emphasized to avoid "locking" the mechanism.

   b. **Use of humming, facial buzz, vibrating** an index card placed on the lips, feeling the lips vibrate on the hand, and other techniques to encourage placement of the tone "in the mask" and distract attention from laryngeal effort.

   c. Use **gentle, articulatory movements and mouth opening** to encourage relaxed articulatory precision without build-up or overflow of tension. Facilitating words and phrases include: *Wh*ile, *wh*ite, *w*orms, *w*ent, *w*ading, *W*illy, *w*ept (blow out the /w/ with gentle lip protrusion and increased air flow).

5. **Therapy for unsteady vocalization patterns** such as tremor and roughness have included such techniques as:

   a. Vocalization on an inhalation to extinguish ventricular phonation

   b. Measurements of jitter and shimmer used as feedback

   c. Visual feedback (e.g., VisiPitch™), videoendoscopy, tape recorder, C-Speech®

   d. Changing pitch levels, or assuming a role as a pitch cue (e.g., one patient with essential tremor pretended she was the British Queen Mother with good results)

   e. Prolonging the vowels and voiced continuant consonants

   f. Using rhythmic, breathy phrases

g. Compensatory over-articulation to enhance intelligibility (e.g., older patients who have hearing impaired friends can thus aid lip reading)

6. **Therapy for disordered prosody** includes attention to rate, duration, rhythm, loudness and pitch variation, and intonation and stress patterns. Ataxic patients need to practice vowel prolongations and pausing tied to the meaning of the utterance. Melodic intonation therapy and accent therapy may be useful with some patients.

   a. Facilitating words and phrases to **cue durational increases** (e.g., "stretching" the word) are useful.

      A long jump.

      A worm crawled.

   b. **Tying the vocal pattern to the meaning** is a useful technique. In the following exercises, the patient must use stress in a contrastive way.

      A *blue* bottle. (the color is stressed)

      A *blue bottle.* (a creature's name)

   c. In the next examples, the pitch contour must **contrast a question and a statement.**

      It's yours?

      It's yours!

   d. Sentence is spoken four different ways **stressing a different word** during each rendition.

      "*He's* my best friend."

      "He's *my* best friend."

      "He's my *best* friend."

      "He's my best *friend.*"

e. **Visual feedback,** to monitor excessive variation in pitch and loudness, is also helpful. The VisiPitch™, IBM Speech Viewer™, a VU meter, and a video recorder can be employed.

7. **Patients may have difficulty with the voiced/voiceless contrast** by voicing the voiceless phonemes. For example, patients with spastic dysarthria may have this problem. Patients may be taught techniques for modifying vowel duration by producing phonemic pairs (see Table 4-18).

8. **Augmentative or alternative communication** may be necessary when voice therapy is unable to shape the oral communication skills sufficiently or medical management is not effective in improving communication. Some treatment options are:

   a. Amplifier on the telephone

   b. Portable amplifier (see Figures 4-7 and 4-8)

   c. Artificial larynx

   d. Communication boards

   e. Electronic devices/computer systems

   f. Sign language (if hand/eye coordination and cognitive abilities allow)

Voice therapy goals change if a condition worsens. Augmentative or alternative communication becomes necessary for patients when their spoken language is no longer intelligible. Counselling of nursing staff, family members and friends to maximize communication with the patient is an important part of the speech pathologist's role. The team approach to the treatment of neurologically based voice disorders involves

Table 4-18. Phonemic pairs.

neat	need	utter	udder	matter	madder
hat	had	time	dime	fat	fad
pat	bat	heat	heed	tell	dell

Figure 4-7. Voice amplifier that may be used to talk to groups of 50-100. (Available from Luminaud, Inc., 8688 Tyler Boulevard, Mentor, Ohio 44060. Telephone: [216] 225-9082.)

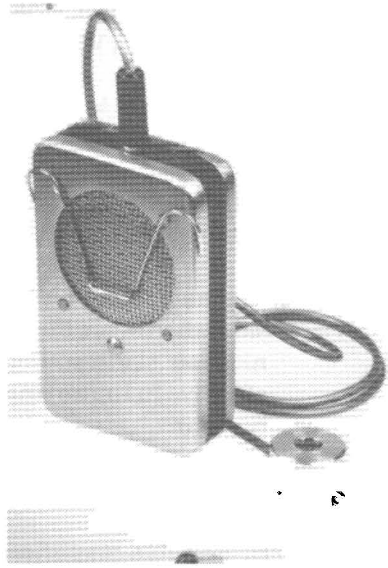


Figure 4-8. Pocket size voice amplifier used one-on-one or in small groups. Useful for persons with low-pitched or hoarse voices. (Available from Luminaud, Inc., 8688 Tyler Boulevard, Mentor, Ohio 44060. Telephone: [216] 225-9082.)

the neurologist, otolaryngologist, speech pathologist, patient, and family. The focus is on facilitating, compensating, and maintaining the best communicative interactions possible.

XI. DISORDERS OF UNCERTAIN ETIOLOGY: SPASMODIC DYSPHONIAS

Spasmodic dysphonia was, for many years, referred to as spastic dysphonia. It was first described by Traube in 1871 as a "spastic form of nervous hoarseness," and this phrase profoundly affected descriptions and treatment of the disorder for over a century because of his choice of adjectives. In recent years this condition has been referred to as laryngeal dystonia (Brin, Blitzer, Stewart, & Fahn, 1992) and most clinicians reject the hypothesis that it is psychogenic.

A. Characteristics of Spasmodic Dysphonia

It once was generally agreed that spastic dysphonia was a psychogenic problem that resulted in a cluster of perceptual symptoms, including a strained, choked, effortful, voice pattern similar to stuttering of the vocal folds. It was thought to result from hyperadduction of the true and false folds and was extremely resistant to treatment. Many treatments — voice therapy, hypnosis, biofeedback, acupuncture, respiration training, tranquilizers and muscle relaxants, electroshock therapy, and psychotherapy — were tried and reported in the literature. No treatment seemed effective.

1. In the 1970s, Aronson wrote about **variations in the symptom complex** and identified the following variations within the general group of spasmodic dysphonias. They were:

    a. Adductor spasmodic dysphonia (AD-SD)

    b. Abductor spasmodic dysphonia (AB-SD)

    c. Mixed type

    d. Essential voice tremor

2. Aronson (1985) and Aronson and DeSanto (1983) further described **three general etiologic categories,** and suggested that **psychogenically based** adductor spastic dysphonia could manifest itself as: (1) AD-SD of conversion reaction and (2) AD-SD of musculoskeletal tension. **Neurologically based** adductor spasmodic dysphonia could occur as: (1) AD-SD of organic or essential tremor or (2) AD-SD of dystonia. **Idiopathic** adductor spasmodic dysphonia of unknown origin was also a category in this etiologic categorization system.

3. With all types of spasmodic dysphonia, the **major problem** is loss of control of the voice. This causes patients to become very anxious and upset about their voice and causes occupational and social problems.

4. The **onset** of this disorder may begin in the third or fourth decade or earlier or later in the life span. Patients usually report that the onset was associated with one of the following:

a. An upper respiratory infection

b. Emotional stress

c. A time when they needed to rely on the voice

5. **Disease Course**

After the onset of the problem, it gradually worsens and deterioration occurs for about 2 years. Patients report that they have to make an effort to speak or that speaking is a struggle.

6. **Symptoms are usually *not* noted** under the following conditions:

a. Singing

b. Use of falsetto or vocal fry

c. Swallowing

d. Yawn/sigh

e. Coughing and throat clearing

f. Emotional outbursts (e.g., laughing, crying)

g. When angry

7. Although Aronson made it clear that an etiologic statement was helpful in describing the disorders characterized by adductor laryngospasm, he also noted that the frequency, severity, and type of symptoms must also be described.

B. Types of Spasmodic Dysphonia

1. Adductor Spasmodic Dysphonia

a. The **etiology** of adductor spasmodic dysphonia has been attributed to organic pathology of the central and peripheral nervous systems.

(1) The **psychogenic factors** associated with the disorder now are assumed by most writers not to be causal but coexistent or reactions to the stress of coping with the communicative distress.

(2) Finitzo and Freeman (1989) reported that over 80% of their AD-SD and AB-SD patients had documented evidence of **neurological pathology.**

(3) The following **hypotheses concerning the etiology** of adductor spasmodic dysphonia (AD-SD) have been reported:

(a) Myelinization abnormalities of the laryngeal nerve

(b) Abnormal brain stem responses indicative of variable cranial nerve involvement

(c) Extrapyramidal lesions in the central nervous system

(d) Manifestation of neurologic conditions (essential tremor, spasmodic torticollis, pseudobulbar palsy, or torsion dystonia)

b. **Symptoms** include strain and struggle and intermittent voice breaks during vowels or the consistent perception of an effortful, harsh voice. Voice onset may seem jerky. The patient may also have an intermittent voice tremor (4 to 5 Hz) and swallowing problems may be reported. Sometimes other focal dystonias are seen. Speech intelligibility is affected and some patients with severe problems may whisper to reduce the struggle to talk.

c. **Management**

(1) Approximately 60% of these patients are women and **voice therapy** does not seem to help chronic cases. Mild cases (experience voice breaks on vowels during every second or third sentence) may be helped by adopting a breathy voice (to keep the folds from touching) and other techniques (e.g., rate and phrasing changes) to shape and eliminate symptoms.

(2) Dedo (1976) reported significant voice improvement following **Xylocaine injection** to anesthetize the recurrent laryngeal nerve and mimic unilateral vocal fold paralysis. This procedure provided a way to assess the usefulness of permanent paralysis of the nerve which was then surgically induced in appropriate patients. Dedo believed the success he found in relieving patients' voice symptoms in this manner confirmed a neurogenic etiology of the disorder. The long-term results of this procedure, however, have been disappointing because of the incidence of deterioration in voice with time.

2. **Abductor spasmodic dysphonia** seems to be less common than the adductor type.

   a. **Symptoms.** Normal or strained voice is interspersed with breathy spasms. The spasms appear to be triggered by voiceless phonemes, particularly when they occur in the initial position in words. The phonetic characteristics of the reading materials used with these patients affects the severity of the symptoms. Patients sound worse when they read sentences loaded with voiceless consonants and best on sentences that contain all voiced sounds. Some patients produce voice only at the beginning of a sentence and cannot maintain any voice as they continue speaking. Fiberoptic nasolaryngoscopy reveals normal closure of the folds during coughing and throat clearing. The Valsalva maneuver (forceful exhalation with the glottis, nose, and mouth closed) is also normal. Yet intermittent, regularly occurring, vocal fold abduction may be noted. Onset is usually similar to AD-SD. Some patients complain about controlling breathing or loss of air when talking. Severe cases have a constantly breathy voice with strained effortful production. Severity of symptoms also is affected by stress.

   b. The **major diagnostic criteria** include:

      (1) Exclusion of neurological disorders such as parkinsonism and cerebellar disease.

      (2) Prolongation of voiceless consonants because of difficulty closing folds again after their production.

(3) Normal laryngeal closure during nonspeech maneuvers and reflexes.

(4) Consistent, strained, breathy quality when disorder is chronic

c. Aronson (1990) believes there may also be **psychogenic, neurogenic, and idiopathic types** of abductor spasmodic dysphonia.

d. Like adductor spasmodic dysphonia, the **onset** of abductor spasmodic dysphonia is gradual.

3. **Mixed abductor-adductor spasmodic dysphonia** is characterized by both abductor and adductor laryngospasms. Perceptually, there are aphonic, breathy periods as well as strained voice arrests. Connito and Johnson (1981) believe that there may be a continuum of spasmodic dysphonia rather than separate symptom entities. This hypothesis may explain the coexistence of different physiologic characteristics.

4. **Essential tremor** may manifest itself in voice tremor as the only evidence of the essential tremor syndrome. Additionally, voice tremor may coexist with tremors of the head, face, and hands.

a. **Three patterns** may occur in terms of the voice characteristics that have been reported:

(1) AD-SD of essential tremor

(2) AB-SD of essential tremor

(3) Mixed AD-SD and AB-SD of essential tremor.

b. **Symptoms are** regular modulations of voice intensity and frequency identified on prolonged vowels. Voice breaks and modulations can occur as a result of inconsistent overadduction or inconsistent abduction. This is an intentional tremor (i.e., it is not observed when the folds are visualized at rest). However, it may be noted during exhalation as well as during phonation.

c. The **onset** is usually in the sixth decade but may be seen in younger individuals. The condition worsens in the first

2 years following onset and then remains chronic. Patients are usually women (70–80%). It appears to be familial.

d. The **diagnostic challenge** is to differentiate it from parkinsonism, cerebellar disease dysphonia, and AB-SD and AD-SD. Patients are eager for treatment because speaking is so effortful, socially embarrassing, and frustrating. Voice therapy may help to maintain function in mild cases but usually is not successful with severe cases. Medications help some patients.

C. Current Treatment Approaches

Health professionals currently use the term "spasmodic" dysphonia to refer to the symptom complex just discussed. This is considered more descriptive than the old term "spastic" dysphonia. It also clearly differentiates between a different disorder (see section IX.A) associated with spastic pseudobulbar dysarthria. Approaches to treatment have involved a variety of medical and therapeutic strategies.

1. **Reduction of laryngospasms has been a primary thrust of management.** Especially in the case of hyperadduction of the folds, speech pathologists frequently have used techniques to help patients use a breathy, phonatory pattern. The aim was to avoid complete approximation of the folds, because it was thought this triggered more frequent spasms. Surgical procedures, such as the Dedo approach, also attempt to decrease hyperadduction through inducing unilateral paralysis of a vocal fold. A recent, most successful approach, of injecting botulinum-A toxin (Botox®), also creates vocal fold weakness and reduces laryngeal approximation. This injection, used previously for other dystonias, weakens the muscles that spasm. The most dramatic effects have been seen in reducing adductor spasms but relief of other symptoms has also been reported. Occasionally, there may be side effects of weakening the laryngeal sphincter, for example, patients may report aspiration problems. They are advised to sip instead of gulping liquids and to hold the breath while swallowing.

   a. **Methods of reducing glottic closure and constriction.**

(1) **Recurrent laryngeal nerve resection** reported by Dedo (1976) reduced symptoms of adductor spasmodic dysphonia for varying lengths of time post-operatively.

(2) Currently, however, the most successful treatment appears to be **Botox® (botulinum toxin) injections** into the thyroarytenoid muscle of patients with adductor spasmodic dysphonia. In cases of abductor spasmodic dysphonia, the injection targets the posterior cricoarytenoid muscle (Blitzer, Brin, Fahn, & Lovelace, 1988). Periodic reinjection is necessary to maintain benefits. Abductor or mixed SD patients and those with uncontrollable gag reflexes are more difficult to treat with Botox®, but some success has been reported. The use of EMG-guided injection percutaneously for patients with sensitive gag reflexes has been recommended by clinicians. See Brin, Blitzer, Stewart, and Fahn (1992) for a detailed description of the procedure and clinical trials.

(3) **Voice therapy** approaches involve direct symptom reduction, reduction of secondary characteristics and struggle behaviors, psychodynamic counselling, and reduction of musculo-skeletal tension. Counselling and help in adjusting to sequelae of recurrent laryngeal nerve resection and Botox® injection are also necessary following these procedures. Goals involve vocal re-education and use of smooth phonatory phrasing, elevated pitch levels, decreased loudness, and increased breathiness. Decreased expiratory drive and coordination of respiration, phonation, resonance, and articulation are helpful. Some patients react by pushing too hard to compensate for the change in laryngeal movements subsequent to injection. Voice therapy to aid the coordination of exhalation and voice onset is especially advantageous in such cases. Voice clinicians usually also are involved in encouraging patients to become associated with self-help groups and in family support activities.

(4) **Acoustic and aerodynamic analyses** assist in judging the severity of SD symptoms, making judgments

concerning treatment needs, and obtaining pre- and post-treatment data. Pretreatment vocal tremor is usually 4–5 Hz.

(a) **Mirror examinations** and **videostroboscopy** usually reveal normal structures and reflexes, although vocal fold bowing, asymmetry, and reduced range or speed of fold movement on one side may be seen in AB-SD cases. Because SD is a movement disorder and occurs in connected speech even more than on prolonged vowels, the visualization technique (e.g., mirror or rigid endoscope which allows visualization of vowel production only) affects what is seen. Flexible transnasal laryngoscopy may reveal more abnormal patterns during connected speech. For example, in essential voice tremor, there may be laryngeal bobbing or pharyngeal movements.

(b) Acoustic and aerodynamic measures yield useful data to **document progress with treatment.** Acoustic analysis may reveal a slightly higher fundamental frequency for AD-SD patients because of increased tension. Intensity values will vary from those of normal speakers. Maximum phonation times are shorter in all SD patients and are useful pre- and post-treatment measures.

(c) **Jitter and shimmer measures** taken during connected speech are usually higher in SD patients than in normals. **Signal-to-noise ratios** are lower.

(d) To maximize differences in most cases, when using these measures pre- and post-treatment, it is wise to use **connected speech** rather than only prolonged vowels.

(e) **Rate measures,** such as mean sentence time, are usually shorter following treatment. Prior to treatment, syllables (e.g., too) are elongated and sound bisyllabic as the voice breaks on the vowel.

(f) Because it is more difficult for AD-SD patients to initiate and sustain phonation smoothly, voice onset time and **other durational and timing measures** also can be used to determine the efficacy of treatment.

Aerodynamic measures, such as mean flow rates for vowels, might be expected to be higher for AB-SD patients. However, a great deal of variability is observed in SD patients, and it is not unusual to see normal flow rates (80–220 ml/sec).

XII. GERIATRIC VOICE DISORDERS

A. Overview of Voice Disorders Related to Aging

Individuals vary dramatically in both the manifestation of physical signs of aging and the psychological adaptations they make. However, advancing age inevitably produces changes in the larynx as well as in related systems that impinge on voice production. Deterioration of neuromuscular control, sensory abilities, and energy levels is reflected in vocal patterns. The presence of illness and disease (e.g., pulmonary, neurological, cardiovascular) as well as the effects of medication and psychological states also limit communicative abilities. Generally speaking, however, the voice usually reflects the overall level of health and vigor exhibited by an individual.

1. Disease Processes

Woo, Casper, Colton, and Brewer (1990) reviewed 151 dysphonic patients over the age of 60 to define aging-related voice disorders. They found that the dysphonia was due primarily to disease processes rather than to physiologic aging alone. The disease processes included the following:

a. **Central neurologic disorders** affecting laryngeal function (e.g., stroke, Parkinson's disease, essential tremor, Alzheimer's disease)

b. **Benign vocal fold lesions** (e.g., Reinke's edema, benign and dysplastic epithelial lesions)

c. **Inflammatory disorders** (e.g., laryngeal sicca [dryness], medication effects)

d. Laryngeal neoplasia

e. Laryngeal paralysis

Only 6 patients of the 151 studied exhibited vocal fold bowing and breathiness consistent with presbylarynges indicating that it is not a common condition.

2. Aging of the Vocal Mechanism

Although the majority of dramatic changes in elderly patients' voices are probably the result of disease processes that occur in association with aging, there are certainly perceptible changes that occur as a result of the aging of the mechanism itself (Kahane, 1981).

a. **Respiratory capacity and function** changes with age and contributes to a general decrease in vocal power.

b. There is a **decrease in pitch flexibility** and **changes in habitual pitch levels.**

c. **Ossification of cartilage** also occurs.

d. In some patients there may be **poor posterior glottic closure** which is due to limitation of arytenoid movement.

e. **Atrophy, edema, and increased presence of vocal fold sulci** also have been noted in the larynges of elderly patients.

f. **General physical condition,** as well as previous vocal training may help preserve vocal vigor into old age.

g. **Pitch changes** with aging. There is a tendency for women's voices to become lower in pitch with age, especially if they have been heavy smokers. Mysak (1959) reported on an increase in male pitch level related to aging. However, Hollein, Dew, and Philips (1971) found no age-related trend in their measures of phonational frequency range for either males or female. The means were 38 semitones and 37 semitones, respectively. Standard deviations were large with women's voices (N = 202 aged 18 to 75 years) ranging from 23 semitones to 50 semitones.

h. Voice problems may occur when patients attempt to compensate for these changes and adopt **inappropriate strategies.** They may habituate patterns that lead to vocal misuse.

i. Life stresses and anxiety may also contribute to the development of hyperfunctional patterns.

3. Case Study

Consider the case of Phyllis, a 72-year-old widow, who was referred for voice evaluation. She presented a hyperfunctional pattern characterized by hoarseness, strain, and intermittent aphonia. She was alternately weepy and angry during the interview, complaining about the otolaryngologist's referral and saying she was sure speech therapy "could not help." She described feeling depressed since the death of her husband a year before. She was talkative and expressed anger concerning how she felt her women friends, who had husbands, did not understand how lonely she felt all of the time. The clinician encouraged Phyllis to vent her feelings and made reflective statements and empathetic comments. Gradually, Phyllis shared her feelings concerning the funeral director who had arranged her husband's funeral. "I could tell he was attracted to me," she said. "He encouraged me to come and see him anytime and made me feel he was interested, you know, put his arms around me and hugged me every time I stopped by. My friends all said I was reading too much into it. They told me I was making a fool of myself going to the funeral home to see him all of the time. I didn't care, I needed the support. What do they know about being all alone anyway?" Phyllis broke down and sobbed when she explained how terrible she felt when she heard that the funeral director was planning to marry a much younger woman. When she recovered her composure, her voice had changed significantly and sounded normal in all respects. "I guess I needed to get it off my chest," she said, "but you know, I don't really need speech therapy, because my voice sounds pretty good now, don't you think?"

B. Clinical Issues in the Treatment of Geriatric Patients

1. Normal changes that occur in the larynx include increased rigidity of the cartilages and joints and loss of muscle tone.

Loss of muscle tone in other parts of the body also significantly affects voice production. Additionally, there are other physiological changes that, although normal and expected, result in perceptible vocal restrictions.

a. **Reduced muscle tone** occurs all over the body, and posture is usually affected. This, in itself, may change body alignment and limit thoracic movements. Changes in the abdominal wall; in the shape and position of the thorax; in the erectness of the head, neck, and thorax; and in the laryngeal muscles occur, and neuromuscular control is reduced. F_1 and F_2 may decrease in women because of lower laryngeal position in the neck. This may affect resonance. Additionally, the articulatory muscles may exhibit reduced strength and control, and repetitive oro-motor movements (e.g., reflexive chewing) may emerge.

b. **Changes in the vocal folds** may be noted and may affect vocal quality. For example:

   (1) **edema and thickening of the superficial layer of the lamina propria** (Hirano, 1990);

   (2) **atrophy and** loosening of the elastic fibers of the intermediate layer of the lamina propria causes **thinning** (seen in male larynges) (Hirano, 1990);

   (3) **thickening** of the collagen fibers in the deep layer of the lamina propria (seen in male larynges) (Hirano, 1990);

   (4) **atrophy of the thyroarytenoid and vocalis muscle fibers;**

   (5) **atrophy of the mucosa and changes in mucous secretions;**

   (6) **reduction in amount of nerve endings.**

c. **Life-style changes** may affect the integrity and level of function of communication-related systems. Many elderly people, because of circumstances, fears of falling, and physical limitations, do not have opportunities for exercise. A sedentary life style reduces pulmonary and cardiovascular efficiency and diminishes muscle strength and energy. Living arrangements may result in lack of social contact and little stimulation or opportunities for conversation. Some elderly individuals who live alone may not talk to anyone all day. On the other hand, some individuals who are robust and socially active may retain vibrant speaking and singing voices (although power and control diminish) into their seventh and even eighth decade of life. The wearing of dentures, reduced hearing sensitivity, the use of amplification, and changes in social and emotional states all impact voice use. The voice changes, to some extent, as a result of normal aging even in individuals who are free of serious or debilitating disease. Additionally, hearing and visual impairment can limit communicative interactions in otherwise physically able elderly persons. Some comment "I don't hear as well without my glasses." **Changes in communicative patterns** that may be minor or easily perceived include:

(1) **reduced respiratory support, loudness and pitch control;**

(2) **breathiness or hoarseness** (vocal fold bowing);

(3) **increased fundamental frequency** levels in males;

(4) **decreased fundamental frequency** in females;

(5) **decreased vocal endurance** and fatigue;

(6) **decreased control of vocal variation;**

(7) **tremor;**

(8) **inappropriate compensations.**

2. **Health problems affecting vocal behavior** include systemic diseases, disorders of the central nervous system, upper and lower motor neuron disorders, extrapyramidal disorders, and depression (see Appendix D).

   a. **Systemic diseases** may result in voice symptoms. For example, arthritis may cause changes in the joints, fixation of the folds, laryngeal pain, and dysphonia. Cardiovascular problems may result in arteriosclerotic changes in the blood vessels supplying the larynx, pressure on the vagus if the heart is enlarged, and edema related to circulatory problems. Renal disease also may result in edema. Obstructive pulmonary diseases restrict respiration, and many elderly individuals suffer from chronic bronchitis and coughing that irritates the folds. Dehydration of laryngeal tissues may occur in elderly patients because of restricted fluid intake, medications, mouth breathing, and reduced endocrine function. Additionally, patients receiving oxygen through nasal tubes experience dryness of the tract.

b. Disorders of the central nervous system, such as dementia, usually result in communicative deficits and patients may exhibit changes in respiration, voice quality, pitch and rate as well as in language and articulation. A few individuals with dementia may have thyroid or vitamin B_{12} deficiencies that can be treated with medication. The vast majority, however, exhibit a global deterioration of cerebral structures with irreversible and progressive cognitive dysfunction. In the early stages, reality therapy may be helpful, but patients are not responsive to treatment as the condition worsens. Some patients with dementia may also be dysarthric because of pathological conditions such as idiopathic Parkinson's disease, Pick's disease, Huntington's disease, Wilson's disease, or multi-infarct dementia.

(1) Communication deficits associated with dementia include:

(a) Difficulties initiating communication

(b) Inability to maintain interactions

(c) Disturbed rate

(d) Distorted prosody and rhythm

(e) High pitched voice

(f) Confused, inappropriate talking

(2) **Treatment approaches** such as music and rhythm activities may be used to provide communication stimulation and interactive enjoyment when other methods fail. Even patients who can no longer form a complete sentence may be able to sing a complete song. Some may retain the ability to use simple musical instruments or move in response to rhythmic stimuli. Thus, music may be an important aspect of treatment for some patients with dementia. Singing, music, and rhythmic activities also are useful with less involved patients to help normalize voice and prosody.

c. **Upper motor neuron disorders** such as pseudobulbar palsy and lower motor neuron disorders such as motor neuron disease may also be seen and present dysarthric communication patterns, postural, and swallowing difficulties.

d. **Extrapyramidal disorders** such as Parkinson's disease may be treated with medication to reduce symptoms.

(1) **Symptoms include:**

(a) Rigidity and difficulty with voluntary movements

(b) Resting tremor

(c) Postural and balance problems

(d) Hypokinetic dysarthria

(e) Dysphagia and drooling

(f) Quality deviations (e.g., breathy or aphonic)

(g) Restricted loudness and pitch variation

(h) Arrhythmic speech pattern

(i) Cognitive and emotional changes

(2) **Treatment** may involve surgery if tremors are severe. Voice therapy emphasizes functional communication, improvement of audibility (amplification may be an option), and an emphasis on phrasing, prosody, and pragmatic strategies.

C. Treatment Approaches

Treatment must be individualized as many elderly patients present with a complex set of health problems, all of which must be considered when treatment plans are implemented. Coordination of strategies of intervention by all team members is necessary.

1. Treatment of Voice Problems Related to Dysarthric Patterns

a. When a voice problem is related to a general dysarthric pattern, the speech pathologist will usually **stimulate reflexive laryngeal valving** (e.g., lifting, pushing) to improve hypoadduction of the folds and breathy voice onset in cases of hyperadduction of the folds (Wertz, 1978). Physical and occupational therapists may also be involved in these types of activities.

b. Other treatment **goals** might include:

(1) Improvement of stress and prosody

(2) Use of instrumental or biofeedback techniques

(3) Use of prostheses (e.g., pressure against abdominal muscles; palatal lift)

(4) Postural corrections and supports

(5) Using the arms to press down on a table

(6) Pursed lip breathing (Scott, Caird, & Williams, 1984). This is a method of expelling air as though blowing on hot coffee for 3 or 4 times. Subsequent inspiration will occur in a more relaxed manner.

2. Treatment of Depressed Geriatric Patients

a. It is not unusual for a patient to respond to **psychological trauma** (e.g., loss of a spouse, move to a nursing home) with complete withdrawal. This type of stress-related elective mutism is the result of a severe reactive depression. The patient may be unresponsive to family members, professionals, and staff as well as friends. Feelings of rage, loss of independence and control, anxiety about the future, and confusion concerning changes in living arrangements may occur.

(1) **Treatment approaches** involve a team effort with counselling for family members as well as provision of services for the patient. The patient's subsequent recovery will be related to the support available from family and professionals. The speech pathologist may be asked to assess the patient, counsel the family, and consult with nursing staff and other professionals.

(2) **Treatment goals** may include:

(a) **Maintenance of** patient's **dignity** through a personal "adult to adult" relationship to build trust;

(b) **Acknowledgment** of the emotional stress **and acceptance** of the negative feelings;

(c) **Discussion** with significant others about the avoidance of reprisals, blame, demands to respond, and so on during the patient's stages of grieving and adaptation;

(d) **Communication through touch and verbal comments** acknowledging the patient's feelings and expressing interest in the patient and family members;

(e) **Referrals for counselling,** arrangements for clergy or other visitors, or peer contacts and participation in organized activities when patient seems ready.

3. **Observations of potential for vocal communication** are sometimes necessary when the speech pathologist is asked to consult on a patient who is not communicating. Bedside evaluations may include elicitation of behaviors relevant to respiration, swallowing, and laryngeal competence (e.g., laryngeal diadochokinesis and production of a hard attack). Communicative competence may also be noted by such behaviors as paralinguistic communicative strategies (eye contact, facial expression, pitch and loudness variations).

a. Does the patient use vegetative vocalizations (e.g., coughing, crying, sighing, throat clearing)?

b. Can the patient pant, sniff, sustain a vowel, grunt, blow out air on demand?

c. Is the voice quality "wet" sounding?

d. Can the patient drink without leakage from mouth or nose?

e. Is there any sign of velopharyngeal inadequacy?

f. What are the results of the oro-motor function tests? Diadochokinetic rate?

g. Does stabilizing the jaw help articulatory movements?

h. Does pressure against the abdominal wall improve voicing? Digital manipulation of the larynx?

i. Does the patient follow directions, imitate, try to respond?

j. Is the posture inhibiting responses?

4. Counselling and Management

a. **Management** of geriatric patients usually involves an approach using a **systematic model.** This model is appropriate, because elderly patients frequently require supportive services from a group of people — all of whom interact with them, have influence on them, and are concerned about their problems.

b. **The speech pathologist's role.** The speech pathologist usually has goals similar to those listed below.

(1) Learn about the patient from everyone in the system. Ascertain, for example, pre-morbid personality, coping style, and achievements.

(2) Review history and previous intervention strategies.

(3) Talk to the patient about his or her perception of his or her needs.

(4) Assess the patient's functional communication, sensory abilities, potential for use of prostheses[8] or communication aids, psycho-social status, and need for referrals (e.g., better fitting dentures, hearing aids).

(5) Problem solve with other professionals and family members, and determine strategies to promote change.

(6) Use counselling techniques to empower patient and supportive significant others.

(7) Implement direct voice/speech treatment if it is appropriate.

(8) Document changes in the patient and in the environment, communicate evidence of change across time, refine and modify intervention strategies as needed.

(9) Strive to reinforce the patient's sense of self-worth and uniqueness during all interactions.

(10) Help the patient deal with life-stage issues such as a review of life accomplishments, improved communication with family and significant others, avenues for self-expression and stimulation, and protection of the right to adequate physical and emotional care.

XIII. SUMMARY

This chapter reviewed material on conditions that result in the onset of voice disorders during the adult and geriatric years. Discussion was confined to dysphonias that occur in physically mature individuals who previously enjoyed normal vocal function. Problems diagnosed during childhood and persisting through the adult years were not addressed (such as those associated with developmental delay). However, it is important to remember that some individuals do struggle with vocal deficits across their entire life span. Additionally, some Problems that occur during the adult years (e.g., hyperfunction) may have their roots in behavior problems that began during childhood.

[8] The Passy-Muir valve may be considered for patients with tracheostomy, for example.

A brief review of the anatomy and physiology pertinent to an understanding of the disorders described was integrated into the fabric of this discussion rather than assigned to a separate chapter. Because speech pathologists have studied this information previously, this review is not exhaustive. It was included to highlight the physiologic bases of many voice disorders and to describe how limitations in function affect treatment decisions. Disturbances of phonatory mechanics related to changes in the mass of the vocal folds, abnormal movement patterns of the folds, and behavioral and psycho-social adaptations, were noted. The effects of neurological insult and disease also were addressed. Each patient's unique developmental history must be carefully studied. This is just as important for end-stage geriatric patients as it is for the young children we treat. For some elderly patients, the maintenance of voice use is a very a high priority, because control over other areas of life lessens and physical vigor and independence wanes. Thus, it can be seen that many different causative factors, individually and in combination, may contribute to vocal distress. Some of these factors, such as occupational demands, are related to the predictable challenges of the individual's life stage. Additionally, voice disruption may be idiopathic, iatrogenic, related to accidental trauma, or the result of systemic health problems, aging, and degenerative disease. Usually the speech pathologist works closely with other specialists to design comprehensive, individualized treatment programs. With some patients, restoration of normal voice function is an achievable goal. With others, the maintenance of some form of functional communication for as long as possible is the only realistic alternative.

CHAPTER

5

Communication After Laryngectomy and Tracheotomy

I. CANCER OF THE LARYNX

Cancer of the larynx may be seen in patients of any age. However, it is seen infrequently in children and most commonly in older adults over 50 years of age. Males between 50 and 70 seem most vulnerable. Cancer of the larynx constitutes less than 2% of all cancers and 25% of head and neck cancers treated in the United States of America. Approximately 12,000 people in the United States each year develop squamous carcinoma of the larynx. The use of tobacco, especially when combined with heavy alcohol use, is thought to contribute to malignancies of the aerodigestive tracts. Additional risk factors include irradiation, inhaled pollutants, and leukoplakia and keratosis of the vocal folds. The American Cancer Society has been active in publicizing the symptoms of "throat cancer," and early detection enhances the probability of successful treatment. Prevention strategies are important also, because there is increasing evidence that cancer of the larynx may be a preventable disease. Laryngeal cancer may be treated using radical or conservative surgery and/or radiation therapy or adjuvant chemotherapy in conjunction with radiation therapy. The procedures chosen depend on the extent of the tumor; the site of the tumor; the preference and training of the surgeon and/or oncologist; the health status, age, and preferences of the patient; and accessibility of services.

A. Anatomic Considerations

1. Laryngeal Topography

The larynx is divided into a number of areas. These are bounded by cartilage or fibro-elastic ligaments which seem to slow the spread of the disease. There is resistance, for example, to tumors spreading from one side of the larynx to the other or from supraglottic to glottic areas. Topographically, we can describe the larynx in terms of three regions:

a. The **glottal region** consists of the true vocal folds that meet anteriorly at the midline at the anterior commissure. Posteriorly, the commissure region of the glottis encompasses the mucosa and the vocal processes of both arytenoids.

b. Immediately below the glottis is the **subglottis** consisting of the area beneath the vocal folds to the inferior border of the cricoid cartilage, traversing the cricothyroid membrane.

c. Immediately above the true vocal folds is the region known as the **supraglottis** that consists of the epiglottis, aryepiglottic folds, ventricular folds (false vocal folds), ventricles, and all of the arytenoid cartilages with the exception of their vocal processes.

2. Importance of Regions

The regions of the larynx tend to contain the spread of early cancers, and the regions or compartments of the larynx (divided by fibro-elastic ligaments and cartilages) are used as part of the classification of tumors.

B. Classification of Tumors

1. **Initially, a tumor is classified according to its location** and is noted to be **supraglottic, glottic, or subglottic.**

2. **Then, other characteristics** of the tumor are considered in order to **define the stage.** The American Joint Committee for Cancer Staging (1983) lists the current staging system used by physicians. Various characteristics of the primary tumor are delineated by use of a notation system.

   a. As shown in Table 5-1, tumors are classified according to a **notation system**[1] that involves abbreviated notations using capital letters (T = tumor; N = nodal involvement; M = metastasis) and numeral subscripts denote the location and pervasiveness (using the scale 1–4 with 1 = the tumor is confined to a region and 4 = massive, extended tumor).

   b. Terms Used in Tumor Classification

   (1) **Glottis** = space between the vocal folds

   (2) **Transglottic** = applied to a tumor crossing the ventricle and involving the glottis and supraglottis

   (3) **T** = tumor

   (4) **T_x** = primary tumor cannot be assessed

   (5) **T_0** = no evidence of primary tumor

   (6) **T_{is}** = carcinoma in situc

   (7) **N** = lymph node

   (8) **N_x** = regional lymph nodes cannot be assessed

   (9) **N_0** = no regional lymph node metastasis

   (10) **N_1** = metastasis in a single ipsilateral lymph node

[1] American Joint Committee for Cancer Staging and End-Results Reporting; *Manual for stages of cancer.* 1983. Philadelphia: J. B. Lippincott.

Table 5-1. Classification of laryngeal tumors.

Supraglottis	***Glottis***	***Subglottis***
T_1 Tumor limited to one subsite of supraglottis; normal fold mobility.	T_1 Tumor limited to vocal fold(s) but may involve the anterior or posterior commissures. Normal fold mobility.	T_1 Tumor limited to subglottis.
	T_{1a} Tumor limited to one vocal fold.	
	T_{1b} Tumor invades both vocal folds.	
T_2 Tumor invades more than one subsite; normal fold mobility.	T_2 Tumor invades supraglottis and/or subglottis, and/or restriction of vocal fold mobility.	T_2 Tumor extends to vocal fold (s) with normal or impaired mobility.
T_3 Tumor limited to larynx with fold fixation, and/or invades postcricoid area, medial wall of pyriform sinus, or pre-epiglottic tissues.	T_3 Tumor limited to the larynx but there is vocal fold fixation.	T_3 Tumor limited to larynx with vocal fold fixation.
T_4 Tumor invades thyroid cartilage, and/or extends to other tissues beyond the larynx (e.g., to oropharynx or soft tissue of neck).	T_4 Tumor goes through thyroid cartilage and/or extends to other tissues beyond the larynx (e.g., oropharynx or soft tissues of the neck).	T_4 Tumor invades the cricoid or thyroid cartilage, and/or extends to other tissues beyond the larynx (e.g., oropharynx or soft tissues of the neck).

Source: Adapted from the description of tumor staging system in the American Join Committee for Cancer Staging and End-Results Reporting; *Manual for stages of cancer,* 1983, Philadelphia: J. B. Lippincott.

(11) N_2 = metastasis in a single ipsilateral lymph node, more than 3 cm but not more than 6 cm in greatest dimension, or multiple ipsilateral lymph nodes, none more than 6 cm in greatest dimension, or bilateral or contralateral lymph nodes, none more than 6 cm in greatest dimension

(12) N_{2a} = metastasis in a single ipsilateral lymph node more than 3 cm but not more than 6 cm in greatest dimension

(13) N_{2b} = metastasis in multiple ipsilateral lymph nodes, none more than 6 cm in greatest dimension

(14) N_{2c} = metastasis in bilateral or contralateral lymph nodes, none more than 6 cm in greatest dimension

(15) N_3 = metastasis in a lymph node more than 6 cm in greatest dimension

(16) M_x = presence of distant metastasis cannot be assessed

(17) M_0 = no distant metastasis

(18) M_1 = distant metastasis

c. Tumor Location and Symptoms

Tumors may be supraglottal, glottal, or subglottal depending on their location above, on, or below the vocal folds. Naturally, the location of the tumor will affect the symptoms.

(1) **Tumors on or near the folds** will result in **hoarseness** almost immediately.

(2) As tumors increase in size, **disturbed breathing** (dyspnea) and **noise during inspiration** (stridor) may occur.

(3) **Supraglottal tumors** may result in the following symptoms:

(a) dysphagia

(b) swelling of the neck

(c) discharge

(d) pain (may be referred to ear)

(e) subglottal tumors may also cause pain and dyspnea.

d. Tumors may **spread** (metastasize) **from the primary site through the cervical lymph nodes** of the neck.

(1) When node involvement occurs on one or both sides, a procedure known as **radical neck dissection** is usually performed. This procedure removes underlying structures and leaves the neck looking noticeably changed.

(2) The following **structures may be sacrificed:**

(a) muscles

(i) sternocleidomastoid

(ii) omohyoid

(iii) all of the "strap" muscles

(b) blood vessels

(i) internal jugular vein

(ii) external carotid artery

(c) cranial nerves

(i) spinal accessory (XI)

(ii) vagus (X)

(iii) hypoglossal (XII)

(iv) lingual branch of the trigeminal (V)

C. Treatment Strategies

The medical/surgical treatment of laryngeal cancer is usually decided by a group of specialists including a surgeon, radiologist, oncologist, plastic surgeon, pathologist, and dentist who specialize in head and neck cancer.

1. The **factors that are considered include:**

   a. Site of tumor

   b. Extent of tumor

   c. Node involvement

   d. Metastasis

   e. Patient's age

   f. General health of patient

   g. Pulmonary status of patient

   h. Preservation of laryngeal functions (voice, respiration, deglutition)

2. **Carcinoma in situ** (the earliest of lesions) may be treated by **radiation therapy, endoscopic microsurgery,** and/or **laser excision** (CO_2 laser). Laser techniques are also frequently employed for vaporization of hyperkeratosis and premalignant lesions such as dysplasia and leukoplakia. They can also be used for some T_1 squamous cell carcinomas of the mid- to anterior-vocal-fold with intact fold mobility. Sometimes, the laser is also used to vaporize obstructing tumors prior to laryngectomy.

3. **Laryngectomy**

   A laryngectomy is an operation to remove the larynx ("ectomy" means "removal of"). A person who has had his or her larynx removed is referred to as a laryngectomee. Surgery may involve total or partial removal of the larynx and/or a radical neck dissection. In recent years, with the improvement of treatments such as radiation therapy and chemotherapy, surgeons have attempted to treat tumors without removing quite so much tissue. Prior to the development of the adjuvant treatments, it was necessary for surgeons to preserve a wider "margin of safety" when removing a malignant tumor.

a. Some tumors may be treated by **conservation surgical procedures.** Most patients can adapt to loss of a substantial portion of the larynx without loss of respiratory, voicing, and swallowing functions. Resection is performed in the vertical plane for glottic tumors, but supraglottic tumors are resected in the horizontal plane. Lesions most suitable for conservation surgery include those not readily accessible to irradiation and those small enough to avoid sacrifice of all structures.

(1) Patients best suited to conservation procedures include:

(a) Those without significant pulmonary disorders

(b) Those without significant neurologic disorders

(c) Those who are adaptable individuals (complications may include aspiration of food and saliva)

(d) Those aware that surgical exploration may reveal a tumor that requires total laryngectomy.

(2) The paramount concern in the decision-making process is that the **patient's chance for survival should not be compromised by the attempt to preserve laryngeal tissue and function.** Tracheotomy is usually an initial step in all laryngeal conservation procedures.

(3) Examples of conservation procedures include:

(a) Anterior frontal partial laryngectomy

(b) Extended frontolateral laryngectomy

(c) Supraglottic subtotal laryngectomy

(d) Extended supraglottic laryngectomy

(e) Subtotal laryngectomy.

b. Following less conservative surgical procedures, **reconstruction** may be possible in some instances to preserve function.

(1) **Reconstruction of posterior glottis and vestibule** (employ cartilage, muscle, skin and other tissue) to reduce postoperative aspiration following vertical hemilaryngectomy.

(2) **Following supraglottic laryngectomy:**

(a) Reconstruction of various portions of the hypopharynx and base of the tongue.

(b) The epiglottis may be reconstructed to help decrease aspiration.

(c) When an arytenoid is removed, the fold may be surgically fixed at the midline to maintain adequate glottic competence.

(d) Cricopharyngeal myotomy or laryngeal suspension may help deglutition.

(e) Glottic reconstruction after arytenoidectomy can also improve deglutition.

c. Surgery for Advanced Laryngeal Cancer

(1) Near-total laryngectomy is used if the posterior commissure, one arytenoid, and the ipsilateral ventricle are free of tumor. This allows the creation of a dynamic phonatory shunt to prevent aspiration and use of the airway (Pearson, 1986).

(2) Total laryngectomy

(3) Total laryngectomy with modified neck dissection

(4) Total laryngectomy with radical neck dissection. This is indicated whenever there are palpable lymph nodes and metastasis is suspected. Elective neck dissection is usually recommended for lesions that have a 20% or greater chance of occult cervical metastases. These include subglottic tumors, transglottic tumors, large glottic tumors, and subglottic tumors (paratracheal node dissection).

4. Radiation Therapy

a. Uses

(1) Irradiation and supraglottic laryngectomy are both highly successful modes of treatment for **early lesions.**

(2) **Lesions extending to the true vocal folds** are not suitable for supraglottic laryngectomy, but in favorable cases, they can be treated by radiation therapy. *The status of the neck may determine the selection of treatment of the primary tumor.*

(3) Radiation therapy is sometimes used alone but most **often is combined with surgery.** Patients with early-stage primary tumors but advanced neck disease, for example, may be irradiated for the primary tumor and have surgery for the neck.

(4) **Advanced supraglottic lesions,** including unfavorable T_3 and T_4 cancers, may require preoperative irradiation as well as surgery and postoperative irradiation.

b. Effects of irradiation may be edema and fluid build-up, skin redness, necrosis if deep biopsies are attempted, anatomic distortion, and post-treatment changes that cannot be distinguished from recurrent cancer.

c. Complications resulting from irradiation may include sore throat, loss of taste, xerostomia (dry mouth), dry desquamation of skin (shedding of the epidermis), increased risk of dental caries, and laryngeal edema (may necessitate a tracheostomy because of aspiration and airway compromise).

d. **Common side-effects** of radiation therapy include diminished taste, skin irritation, edema, and swallowing problems.

5. **The Rehabilitation Team**

A number of specialists are involved in the rehabilitation of the laryngectomee. Physicians, nurses, physical therapists, speech pathologists, social workers, and family members play important roles in helping the patient to recover from the surgical and medical treatments and adjust to his or her vastly changed circumstances. It is always helpful for a patient to meet at least one other person who has undergone a laryngectomy and developed successful communication and coping strategies. Many communities have a pool of speakers from self-help groups or American Cancer Society volunteers available to perform this important service. Pre- and post-operative visits with the patient and family members are usually made by the speech pathologist and a rehabilitated laryngectomee.

a. **Preoperative visits** should be brief, and the **main goal** of these visits **is the provision of reassurance and support.** Brief descriptions and written materials describing the surgery and the altered physiology may be given. Pamphlets may be obtained from the International Association of Laryngectomees (IAL) and the American Cancer Society (telephone: (404) 320-3333) for this purpose. It is essential to avoid too many detailed descriptions, however, because the patient is in a state of shock following the diagnosis and is not likely to absorb a great deal of detail. It is important to assure the patient and family members that various communication methods will be available to the patient following surgery. Demonstration of an artificial larynx may be advisable.

b. At both the pre-operative and post-operative visit, it will be necessary for the speech pathologist to **review the changed breathing mechanism** that results from laryngectomy. Diagrams, such as the one shown in Figure 5-1 are helpful. The fact that the trachea is connected to the base of the neck and the way air moves from the atmosphere through the stoma, via the trachea, to the lungs

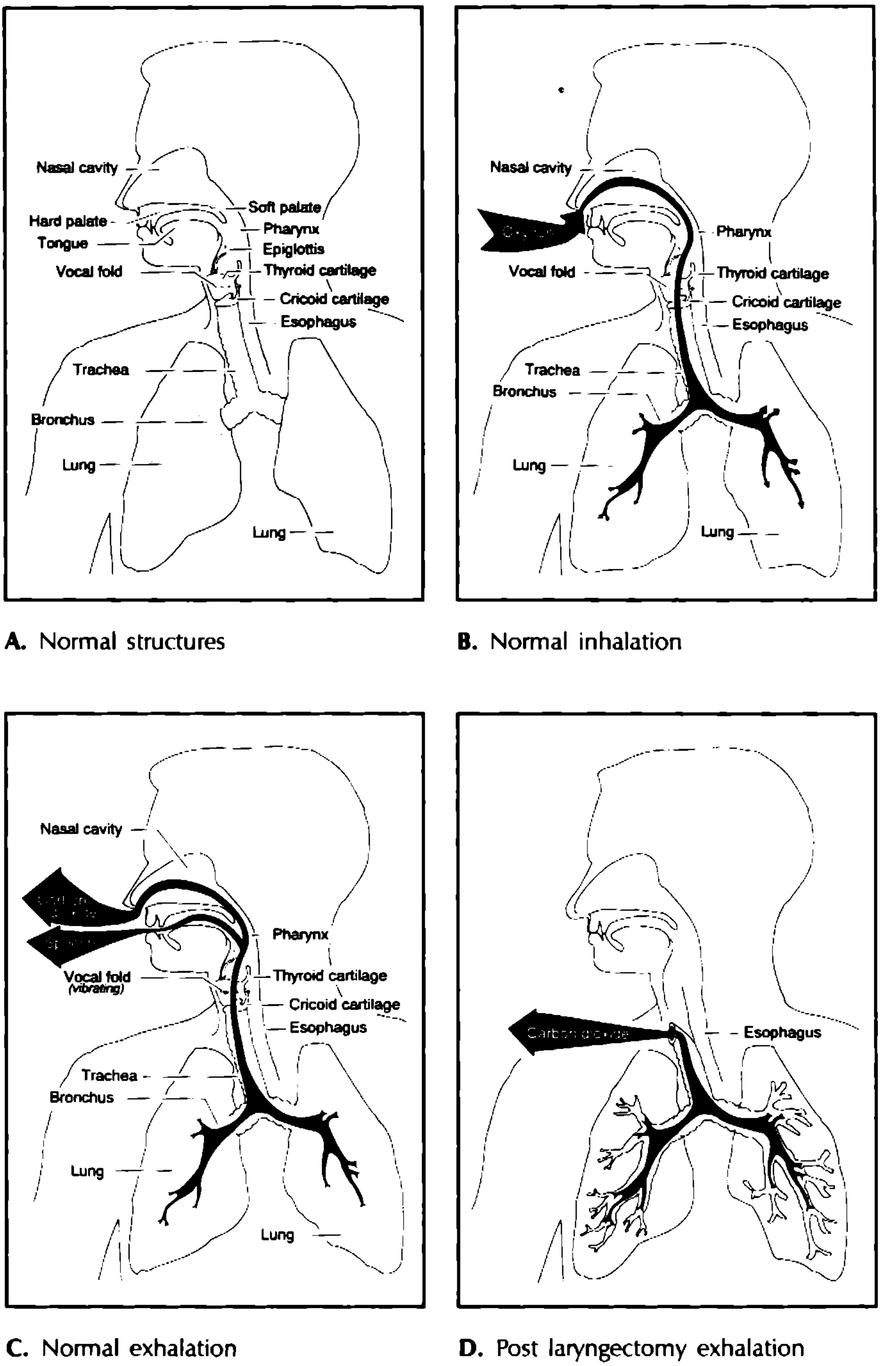
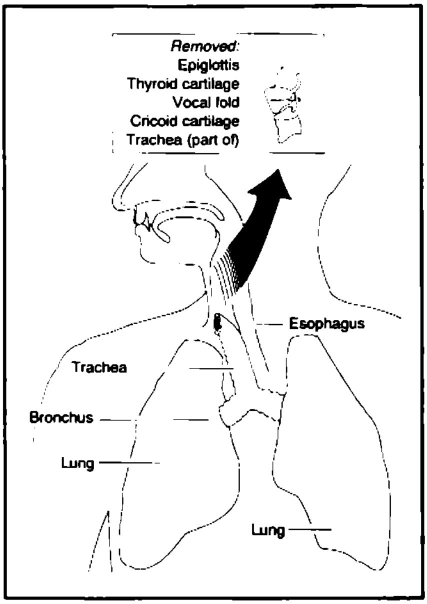
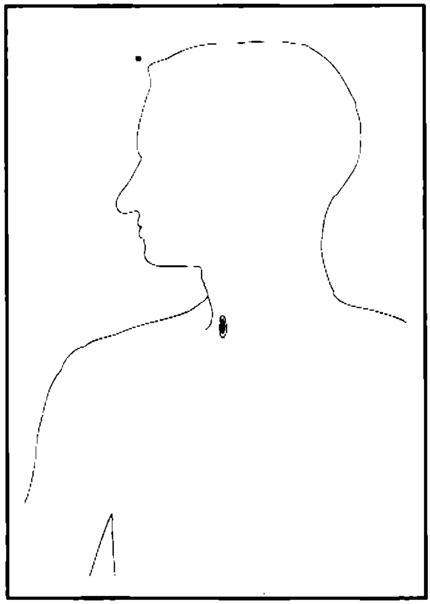


Figure 5-1. Physiology of the head and neck before and after total laryngectomy.



E. Post laryngectomy



F. Post laryngectomy

must be explained. It may need to be reiterated that there is no passage of air any longer from the mouth, nose, and pharynx into the lungs.

c. **Physical changes related to swallowing, smell, taste, and diet** will need to be addressed. The patient may be monitored by a dictician to ensure that nutritional needs are met. The extent of disturbance to the pharyngeal walls, hypopharynx, and upper esophagus by surgery and/or radiation must be considered.

d. The **physical therapist** plays an important role when patients have undergone radical neck dissection. Involvement of the accessory nerve and limitations in movement of neck and shoulder must be addressed through physical therapy.

e. Patients usually undergo a **grieving period** following disfiguring, cancer-related surgery. It is to be expected that the numbness and shock associated with the diagnosis and surgery gradually changes into depression and mourning for what has been lost. The postoperative recovery period is characterized by frustration, agonizing adjustments, inconveniences, and a loss of self-esteem and independence. Gardner (1971) and Blood and Blood (1982) discuss emotional reactions related to the physical and psychological changes and the need for open discussion of feelings and anxieties.

Cancer changes a person's view of themselves, their future, and their relationships. It affects not only the patient, but also the family, in profound ways. Many patients have to adjust to the loss of jobs, income, and status as a result of the disease and treatment. Marital difficulties are common and include sexual rejection, changes in the role within the family, and divorce. It is not unusual, for example, for a spouse to begin treating the patient as another child rather than as a partner.

f. **Hygiene concerns** for the laryngectomee must be addressed by nursing staff, physicians, and the speech pathologist. Care of the tracheostomy, cannula (the tube inserted into the stoma), and/or a stoma button will be explained by the medical and nursing staff but must be reinforced by the speech pathologist. The cannula is usually worn until the physician feels the patient can gradually decrease its use without the stoma decreasing in size. A stoma button may be used to keep the stoma from decreasing in size after the cannula is removed.

(1) **The stoma, cannula, and stoma button must be kept clean and free of mucus.** Soap, tissues, and cotton balls should not be used. Cotton washcloths, warm water, and water-soluble lubricants should be used to clean and lubricate the stoma at least once a day.

(2) **Stoma covers** (gauze, foam rubber, or decorative jewelry) may be worn as well as clothing that camouflages and protects the opening. Molded plastic may be used in the shower, but plastic that adheres or can be sucked into the opening must be avoided.

(3) **Excessive mucus** is a problem for laryngectomees. A cloth handkerchief should be used to cover the stoma during coughing, and humidification in the home should be increased. Mucus encrustations should be removed according to the physician's directions.

g. **Safety concerns** should be addressed to ensure that the laryngectomee is fully aware of hazards to neck breathers, and Medic-Alert identification should be worn in case emergency first aid is needed. Guidance concerning sensory deficits should be explained in relation to shaving and the avoidance of extreme temperatures. The dangers of participation in water sports, boating and fishing in precarious locations, should be noted in relation to the threat of drowning if water enters the stoma and lungs.

h. **The removal of the laryngeal valve and loss of the glottal closure reflex** pose additional problems for the laryngectomee. Because the air pressure can no longer be controlled, any activities that require bearing down, pushing, pulling, and lifting may be affected.

i. The most accurate **information concerning their condition** and news of interest should be always made available to patients. The International Association of Laryngectomees (IAL) publishes a newsletter and disseminates information. All laryngectomees should be encouraged to contact the IAL of the American Cancer Society, 1599 Clifton Road, NE, Atlanta, Georgia 30329.

II. ISSUES RELEVANT TO NONLARYNGEAL VOICE OPTIONS

Following laryngectomy, the patient has a drastically changed respiratory system as well as different aero-digestive tract relationships. The patient is no longer capable of normal laryngeal vibration to produce voice. In the absence of a larynx, other methods can be used by patients to produce alternative vibrating sound sources for speech production. However, a number of problems must be solved in order for such compensations to occur.

A. Changes in Respiration and Air Intake for Speech

Respiration and air intake for speech, and the changed relationship between those two functions, are the first major issues to address. A summary of pre- and post-operative changes in structures and behaviors relevant to respiration can be seen in Table 5-2.

1. **Prior to laryngectomy,** lung air was used for two purposes:

   a. **to sustain life** through oxygen exchange; and

   b. **to produce voice** via airflow through the larynx.

2. **Following laryngectomy,** unless additional secondary procedures are implemented (e.g., to shunt pulmonary air into the lower esophagus), **lung air is not involved in sound production *inside the body.***

Table 5-2. Pre- and post-operative changes in respiratory structures and behaviors.

Pre-operative	*Post-operative*
The patient could inhale into the lungs through the nose or the mouth or both.	The patient can take air into the lungs only through the stoma in the neck.
The patient could exhale air from the lungs through either the nose or the mouth or both.	The patient can exhale lung air only through the stoma in the neck.
The air inhaled through the nose was warmed, moistened, and filtered en route to the lungs.	The air taken into the stoma passes rapidly into the lungs without the benefit of passing through upper-respiratory tract passages.
The respiratory tract was continuous from the lungs through the bronchi, trachea, and larynx to the pharynx, mouth, and nose.	The tracheal stump is sutured to, and terminates, at the stoma. No communication exists between the mouth, nose, and pharynx and the trachea, bronchi, and lungs.
Pulmonary air was used for voice production, as needed, during exhalation.	Pulmonary air is exhaled directly through the stoma.

a. Lung air, exhaled through the stoma, may on occasion, be used to vibrate a reed in pneumatic artificial larynges *external to the body.* These devices will be described later.

b. When a *conventional laryngectomy* is performed as a primary procedure, and no secondary procedure is done, air intake for speech production will be entirely separate from the pulmonary system. In such cases, the communication options available to the patient include the use of an artificial larynx or esophageal speech. Conventional esophageal speech involves taking atmospheric air in through the mouth or nose and storing it briefly in the top of the esophagus. Thus, the top of the esophagus serves as a pseudo-lung for purposes of sound production.

B. Adapting the Mechanism for Nonlaryngeal Speech

1. **Successful air intake for esophageal speech is dependent on appropriate tension of the upper esophageal sphincter.** A critical wall tension must exist to permit airflow in and out. Both pharyngeal constrictor and cricopharyngeal spasm have been noted as inhibitors of esophageal speech acquisition because of air flow constraints. Blom, Singer, and Hamaker (1985) have been pioneers in drawing attention to the role of hypertonicity and spasm, as well as very low wall tension, on both efficient air intake and airflow. For example, they noted that elevated tension will trap air in the esophagus, but force it into the stomach rather than allowing it to be used to vibrate the pharyngo-esophageal segment (P-E segment) to produce voice as it is released. In cases of very high wall tensions, air cannot penetrate or be entrapped at all. Thus, air never enters the top of the esophagus. On the other hand, a patient with very low wall tension may have such minimal resistance during injection and release that he or she wastes air and needs to take air charges too frequently.

2. Blom, Singer, and Hamaker (1985) reported a diagnostic technique called the **Esophageal Insufflation Test** to evaluate the muscle response of patients at risk for voice failure. The procedure is described below.

a. Following a **brief explanation of the procedure,** the patient's nostril is lightly sprayed with a topical anesthetic and lubricant is applied to a 50-cm long, No. 14 F, French latex catheter imprinted with a 25-cm marker.

b. The catheter is then **introduced through the nose** until the 25-cm marker is at the nostril. This ensures that the tip is within the upper thoracic esophagus. It must not coil in the pharynx. The proximal end of the catheter may be connected to a syringe and a manometer (to supply air as described by Van den Berg and Moolenaar-Bijil, 1959, and Seeman, 1967). However, the catheter may also be attached to a circular tracheostomal housing that adheres to the skin of the patient's peristomal area. The patient then uses his own air.

c. On insufflation of the esophagus, audible sound will be heard when pressures reach 10 to 30 cm H_2O with gastric filling.

d. When there is no sound production, it is evidence that there is a hypertonicity or spasm problem.

e. Example. Blom, Singer, and Hamaker (1985) described their assessment of a patient who had undergone endoscopic voice restoration prior to the assessment. Following very light stoma occlusion with a finger, the patient attempted production of "ah" a minimum of five separate times for as long as possible. This was followed by five attempts to count continuously from 1 to 15.

f. Blom, Singer, and Hamaker (1985) note that **patients who are unable to comply should not be repeatedly insufflated to avoid build-up of air.** Anxiety may make the PE segment tense. Sometimes a repeat visit may be necessary to ensure valid results. The Blom-Singer air insufflation test is a very useful test and is commercially available.

g. Lewin, Baugh, and Baker (1987) have also proposed **preoperative recordings of intraesophageal peak pressure levels to predict the prognosis for postoperative speech success.**

h. When spasm or hypertonicity is suspected, a video barium swallow and/or pharyngeal plexus nerve block with lidocaine may also be performed to confirm that the PE segment is strongly resistant to airflow.

i. Patients in whom airflow induces pharyngeal constrictor spasm may show the following signs:

(1) Complete lack of sound

(2) brief, strained syllables

(3) sensation of retrosternal pressure

(4) inconsistent, labored sound

(5) inability to swallow food, such as steak.

j. **The insufflation test may be repeated** under standard fluoroscopy in the anterior-posterior or oblique projection to observe esophageal distention and the formation of the constrictor muscle mass. Also, an insufflation assessment may be repeated following pharyngeal plexus nerve block to observe changes after induced relaxation of the constrictor muscles.

3. Treatments for Patients Who Fail the Insufflation Test

a. **Secondary pharyngeal constrictor and cricopharyngeus myotomy** (Singer & Blom, 1981). Peripharyngeal nerve block is used first to determine the potential for airflow after relaxation of the muscles. Singer and Blom (1981) use needle placement against the cervical spine from the level of C-2 to C-4 and C-5. Then, the entire length of the pharyngeal constrictor muscles is incised vertically from the base of the tongue to the esophageal inlet, avoiding entering the lumen of the pharynx. Singer and Blom (1981) note that although muscle relaxants, anti-cholinergic drugs, and tranquilizers have been used, they do not produce sphincteric relaxation. The sphincter which produces too tight a closure for approximately 40% of esophageal speakers involves the inferior and medial constrictors as well as the cricopharyngeus muscle. Normally, the muscle action prevents gastroesophageal reflux into the larynx and airway. In a laryngectomee, this is not a problem following myotomy, because the larynx has been removed. Singer and Blom (1981) note that they found no cases of dysphagia in their patients following myotomy.

b. Singer, Blom, and Hamaker (1985) believe that a **pharyngeal plexus neurectomy** also is a very useful and uncomplicated technique done during the laryngectomy to eliminate any possible tonicity and spasms in the sphincter. Advantages of the neurectomy that they have observed include:

(1) less anatomic destruction;

(2) preservation of the vascular integrity of the pharyngeal wall;

(3) some residual pressure remains and contributes to a better tone in the pharyngoesophageal segment;

(4) it can be done easily during primary laryngectomy;

(5) as a secondary procedure, the nerve identification is more difficult because of previous scarring; and

(6) a low failure rate of 10%.

c. Because hypertonicity of the pharyngeal muscles is frequently a reason for conventional esophageal speech failure, tracheo-esophageal puncture (TEP) speech failure, and dysphagia, **other methods** have also been used to address the problem.

(1) Some success has been reported with **mechanical hypopharyngeal dilation.**

(2) Peterson et al. (1992) described the use of electromyographically (EMG) guided needle electrode **injection of botulinum neurotoxin A** (Botox®) into the pharyngeal musculature of patients subsequent to total laryngectomy as an alternative to dilation or myotomy.

C. Esophageal Speech Production

1. Air Intake Techniques Through the Mouth

Patients with the ability to take air into the top of the esophagus, trap the air and then release it, causing vibration of the P-E segment. This segment includes the cricopharyngeus muscle and the middle and inferior pharyngeal constrictor muscles. Those who use conventional esophageal speech take atmospheric air in through the mouth and the air is stored temporarily in the top of the esophagus. Thus, they use two different air supply mechanisms. They breathe in through the stoma to meet their oxygen requirements and through the mouth to produce speech. They may use the intake techniques noted below for speech production.

a. **Patients inject or move air by using the tongue** (tongue pumping or glossopharyngeal press). They close the lips and press the tongue against the teeth ridge. The blade of the tongue pushes the air upward, and the back of the tongue moves the air toward the esophagus. Sometimes, patients are helped by the advice to first open the mouth and then close it suddenly.

b. Patients use the **air produced naturally by consonants** such as plosives and fricatives. Rapid successive productions of sounds such as /p/, /t/, and /k/ in combination with a vowel are practiced first.

c. Usually, patients use a **combination of both methods** noted above. The movement of air into the esophagus using these methods is not synchronized with the taking of air into the stoma. However, stoma noise and audible klunking may be heard if too much force and effort is expended. These extraneous sounds should be eliminated by reducing effort and strain. They should not be allowed to become habituated, because they are distracting and reduce intelligibility.

d. Another method of air intake is the **inhalation method.** This method synchronizes the inhalation of air through the stoma and air intake into the top of the esophagus.

After the patient inhales quickly through the stoma, negative pressure in the thoracic cavity helps expand the diameter of the esophagus. Patients who use the inhalation method for air intake into the esophagus can be observed to "sniff" the air and often make head movements as they attempt air intake. It is not unusual for "inhalers" to also use injection techniques as well. Sometimes, this method is taught by asking the patient to pretend to throw peanuts into the mouth or use other images to assist in quick passage of the air into the esophagus.

2. Surgical or Prosthetic Methods

Another very successful method of introducing air into the esophagus to provide air flow through the P-E segment to produce vibration is achieved by **shunting the pulmonary air into the bottom of the esophagus.** This is accomplished by surgical/prosthetic procedures that are secondary to the primary laryngectomy. The advantage of using pulmonary air is that the air is available from below the P-E segment, thus eliminating the extra effort of attempting to take air in from above. This reduces the effort; avoids extraneous movements; and results in more natural head, mouth, and face postures. Additionally, the flow of available air is not limited to the amount of air that can be temporarily "stored" in the top of the esophagus. Thus, phrasing is more natural and smooth and speech is more fluent. The easy availability of air and the natural involvement of the thoracic musculature also contribute to easy, almost immediate, speech acquisition once the prosthesis is fitted. These tracheo-esophageal approaches will be discussed in the next section of this chapter. However, it is important to note here that the success of this technique is the direct result of shunting pulmonary air into the esophagus. Thus, tracheo-esophageal speech procedures allow, through prosthetic redirection of the exhalation, for lung air to be used to drive the "new" voice generator. The P-E segment substitutes for the larynx, but lung air is used, as it was before laryngectomy, to produce voice. There is a pseudo-larynx or neo-larynx (i.e., the vibrator is not a true larynx, but the respiratory system is responsible for the exhaled air flow).

3. Other Methods of Generating Sound

It should also be noted that there are two other sites where air is sometimes trapped by laryngectomees attempting nonlaryngeal communication. These air reservoirs are the mouth and the pharynx. Neither is an efficient place to store air, because both have other functions related to speech production. The speech pathologist must be alert to the signs of both buccal and pharyngeal speech development and immediately take steps to discourage these habits.

a. When a patient attempts conventional esophageal speech and is ineffective in forcing air into the esophagus, **sound** may be **produced in the mouth or buccal cavity** instead. This buccal form of speech is referred to as "Donald Duck" speech. It utilizes air trapped in the cheeks, and intelligibility is severely limited, because the articulators are involved in manipulation of air, production of voice, and speech sound production simultaneously.

b. **Pharyngeal speech** is produced when air is trapped in the oropharynx instead of being moved lower to allow the P-E segment to vibrate. The back of the tongue is used as the vibrator, and the resultant sound is "gargly" in quality and limited in intelligibility. Phrasing is short, because so little air can be trapped in this space behind the back of the tongue. To observe whether the patient is producing pharyngeal voice, the speech pathologist can ask the patient to produce "ah" with the tongue protruded or pulled forward with gloved fingers. Because the back of the tongue is the sound generator during pharyngeal speech, voicing will not be possible without tongue retraction.

D. Surgical and Prosthetic Options

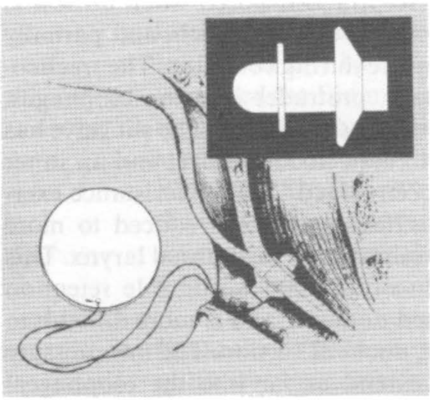
1. Historical Perspective

Since the 1970s, significant progress has been made in the use of surgical and prosthetic methods to improve voice restoration following laryngectomy. Prior to Singer and Blom's introduction of their tracheo-esophageal puncture technique and duckbill voice prosthesis, conventional esophageal speech was the method of choice. Yet, the failure rate for esophageal speech acquisition was between 25% to 45%, and Gates, Ryan, and Cooper (1982) suggested even this was a conservative estimate. They found that only 26% of their laryngectomized subjects actually used esophageal speech at all. Fluent and intelligible speech was acquired spontaneously with little speech therapy by 80% to 90% of the initial series of patients who used the Blom-Singer tracheo-esophageal puncture and voice prosthesis (1985). Ninety-five percent of the patients studied, reported that they would recommend the procedure. Blom and Singer (1990) provide an historical perspective on the way their procedure followed a long sequence of previous attempts to achieve voicing using tracheo-esophageal fistulas and shunts.

Since the 19th century, attempts had been made to shunt pulmonary air into the lower esophagus using a variety of reconstructive and prosthetic methods. All had been confounded by persistent problems of leakage of esophageal contents into the trachea or by the difficulties experienced by patients having to undergo complicated secondary surgical procedures to construct and/or repair the shunts. The simplicity and effectiveness of the Blom-Singer technique, which used only a small puncture to establish tracheo-esophageal communication, marked a major milestone in the evolution of voice restoration techniques of this type. Additionally, the design of their original silicone prosthesis, which fitted snugly into the puncture, capitalized on an uncomplicated "duckbill" type slit, one-way valve that significantly reduced the danger of aspiration. The endoscopic midline puncture is situated 3 to 5 mm inferior to the mucocutaneous junction of the stoma at the superior aspect. It crosses the membranous wall of the trachea to provide access to the esophagus at a point that is inferior to the pharyngeal constrictors and Killian's inlet. The puncture is stented (with an 18 French catheter) prior to insertion of the prosthesis and at other times when the prosthesis is not in place to avoid spontaneous closure of the puncture. If a patient chooses not to continue using this approach to rehabilitation, the puncture will close spontaneously.

a. Advantages of the **Blom-Singer prosthesis** have become increasingly apparent as it has evolved since the 1970s. Additional refinements of the prosthesis have occurred, and patients who used the earlier form and had to occlude the stoma manually may now use a specially designed tracheostoma valve (Blom, Singer, & Hamaker, 1982). The valve is open during respiration, closed when airflow is diverted into the prosthesis during speech, and partially averted to release pressure during coughing. The tracheo-esophageal valve, which protrudes into the esophagus, has also been redesigned and improved. The slit valve has been replaced by a circular, hooded valve, and an inner retention collar has been added. Airflow resistance exerted by the voice prosthesis has been reduced to more closely resemble the resistance of the normal larynx. This low pressure valve, incorporating the flexible retention collar, has an increased diameter and is more difficult to insert than the earlier, duckbill version. The low pressure valve also does not extend as far into the esophageal lumen as did the duckbill. Valve aspiration into the airway has also been addressed by modification of the inserter. Miller (1990) describes selection of patients and fitting for the tracheostoma valve. Prostheses may be left in place longer than was advisable using the earlier versions. In 1988, Blom described how use of a high volume ultra-low resistance valve may not be required if optimal pharyngo-esophageal relaxation occurs. In some patients, he noted that the normal negative pressure drop in the esophagus during each pulmonary inhalation can be sufficient to open a low resistance valve and draw in air causing gastric filling. The standard duckbill valve is more appropriate for such patients. Blom also notes that Candida albicans occurs in some patients, indicating that silicone may not be the best material to use for the prosthesis. He foresees the development of a long-term, indwelling metal valve to diminish tissue trauma (e.g., focal granulations). Frequent removal and reinsertion of the prosthesis contributes to inflammation and thickening of tissue, necessitates scrupulous hygiene, commitment, hand/eye coordination on the part of the patient, as well as increased stress and expense. The goal is to develop an extended-wear prosthesis that solves these problems.

b. Panje (1981) developed a **Voice Button prosthesis** also using tracheo-esophageal fistula to shunt air between the trachea and esophagus without the problems of aspiration (see Figure 5–2, which shows this prosthesis). Like the Blom-Singer TEP procedure, this technique can also be performed on an outpatient basis. A small vertical inci-



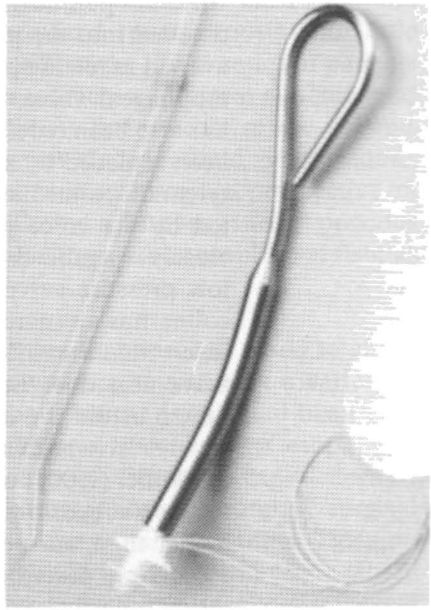


Figure 5-2. The Panje Voice Prosthesis is a biflanged silicone tube with a one-way valve designed to restore speech in laryngectomized patients. It is distributed by Hood Laboratories, 575 Washington St., Pembroke, MA 02359. Phone: (800) 942-5227.

sion is made in the tracheo-esophageal wall inferior to the site in the Blom-Singer puncture. A catheter is placed in this incision, and following healing, the Voice Button prosthesis is inserted into the fistula. The patient must remove the prosthesis daily for cleaning.

(1) **Advantages** of the procedure, as described by Panje, include the simplicity of the outpatient procedure, the self-contained nature of the prosthesis, the fact that it cannot be dislodged, and the lack of any need for sizing.

(2) **Disadvantages.** The prosthesis and inserter are difficult for some patients to manipulate. Like the Blom-Singer prosthesis, the Panje Voice Button is not advisable for patients with arthritis, impaired vision, other problems that preclude commitment, observance of hygiene principles, and adequate hand/eye coordination.

c. The **speech pathologist's role in assisting patients' use of tracheo-esophageal speech** is vastly different from the role assumed when teaching conventional esophageal speech.

(1) Speech pathologists need to have **specialized training in TE prostheses fitting and trouble-shooting.** Continuing education workshops with hands-on experience related to the evaluation of appropriate candidates for this approach, air insufflation testing, and prosthesis fitting and maintenance are available.

(2) The speech pathologist functions as **part of a team** which includes the surgeon, family, and in optimal situations a social worker skilled in cancer-related counselling.

(3) **Patients must be fully recovered** from the original surgery as well as postsurgical treatments, such as radiation therapy, prior to fitting of a T-E prosthesis. Some surgeons insist on the need for time to elapse between the primary laryngectomy and the secondary tracheo-esophageal procedure for voice restoration. Other surgeons, however, prefer to create the tracheo-esophageal communication at the time of the laryngectomy. Whether the T-E communication is accomplished as a primary or secondary procedure, a catheter stent is always inserted and remains in place until the prosthesis is fitted.

(4) **Choice of a particular type of TE prosthesis** usually depends on the training and preference of the surgeon.

(5) **Information on available prostheses** may be obtained from the following manufacturers:

(a) Inhealth Technologies, Santa Barbara, CA (800) 477-5969

(b) Bivona, Gary, IN (800) 348-6064

(c) American V Mueller, Chicago, IL

(d) Hood Laboratories, Pembroke, MA (800) 942-5227

(6) **Criteria for determining whether a patient would benefit from a prosthesis** to allow the development of tracheo-esophageal speech have been described by Singer, Blom, and Hamaker (1989) and Panje, Van Demark, and McCabe (1981). Patient characteristics include:

(a) **Psychological and lifestyle factors** such as stability, motivation, eagerness to communicate, knowledge concerning pros and cons of the method, ability to follow directions, and commitment to hygiene and self-care.

(b) **Physiological and medical factors** such as stoma size of 1 cm in the greatest diameter; freedom from pharyngeo-esophageal spasm; lack of significant pulmonary disease, diabetes, vision or coordination problems, or alcoholism; and full recovery from the primary surgery and from postsurgical radiation treatments (6 to 12 weeks).

(c) **Availability of a speech pathologist** experienced in the treatment of patients with surgical/prosthetic voice restoration who works closely with an experienced surgeon.

d. **Goals for the speech pathologist** working with tracheoesophageal puncture (TEP) patients are summarized below:

(1) **Education.** Provide clear explanations and demonstrations of the physiology, mechanics, fitting, cleaning, and maintenance of the prosthesis.

(a) Insist on and practice exemplary standards of hygiene and safety (see Appendix E).

(b) Provide repeated practice sessions to ensure the patient is comfortable with insertion, removal, and cleaning strategies.

(2) **Fitting the prosthesis.** Measure to ensure the appropriate prosthesis length. Kits are available for this purpose and can be obtained from manufacturers (e.g., Bivona) of prostheses that require sizing.

(a) Emphasize the need to maintain patency of the puncture at all times either by using the catheter or the prosthesis.

(b) Demonstrate catheter removal, placement of the prosthesis on the inserter, holding of the prosthesis strap, and prosthesis insertion.

(c) Discuss the pressure felt as the end of the prosthesis is pushed through the puncture in the TE wall. Note the action of the retention collar locking in place.

(d) Demonstrate removal of the inserter and the holding of the prosthesis strap against the patient's skin as the inserter is twisted free. Secure the strap with tape. Stress relaxation to discourage coughing.

(3) **Voice production.** Manually occlude the stoma so air from the trachea can enter the prosthesis through a hole on the underside of the portion that is in the trachea. Instruct the patient to inhale and open his or her mouth as if saying "ah." Practice numerous trials, removing the thumb from stoma for inhalation. Ask the patient to occlude his or her stoma during practice of "ah," other vowels, and automatic utterances.

(4) **Observation of patient skills.** Encourage the patient to remove and insert the prosthesis without help. Note the following behaviors:

(a) catheter removal

(b) inhibition of swallowing during short periods when the puncture is free of the catheter or prosthesis

(c) appropriate use of the inserter and appropriate insertion of the prosthesis

(d) removal of the prosthesis

(e) cleaning of the prosthesis (catheter must be in place)

(f) appropriate cognitive strategies (e.g., question asking)

(5) **Tracheostomal valve.** Demonstrate and describe the use and steps involved in application, following the instructions available in the tracheostomal valve kits. Have a large mirror available. Evaluate the appropriateness of valve use for each individual patient (Miller, 1990).

III. SOUND SOURCES EXTERNAL TO THE BODY: ARTIFICIAL LARYNGES

A number of devices are available that enable sound to be generated outside the body. These devices are referred to as artificial larynges.

A. Types of Artificial Larynges

1. **Electronic devices** are battery-operated sound generators.

2. **Pneumatic devices** utilize pulmonary air to vibrate a reed to generate sound. Vibrations from these devices are directed into the body so that the speech articulators can shape the artificially produced voice into speech.

3. When the vibrations are sent into the mouth via a tube, the device is known as an **intraoral device.** Both electronic and pneumatically produced sound may enter the mouth intraorally.

4. When sound is communicated into the body by holding the head of an artificial larynx against the tissues of the neck, the device is referred to as a **"neck-type" instrument.** Electronic devices are usually "neck-type," although some have flexible tubes to deliver sounds intraorally. See Figure 5-3 for an illustration of an electronic device.

B. Intraoral Devices

1. The **Tokyo artificial larynx** is a pneumatic device. One end of a tube is placed over the stoma, and during exhalation,

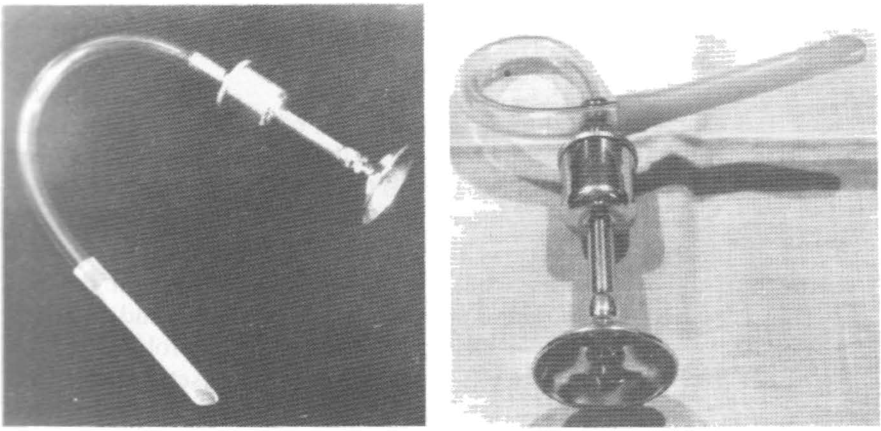


Figure 5-3. Two views of the Tokyo pneumatic artificial larynx. The chrome-plate brass end fits over the stoma and the rubber tube inserts into the mouth. (Available from Artificial Speech Aids, 2027 Read Street, #53, Omaha, NE 68112.)

pulmonary air passes through a rubber membrane, similar to a reed, which vibrates. The vibrations are then delivered via a flexible tube into the side of the mouth to be resonated and articulated. This device must be held in place, thus it has the disadvantage of requiring hand involvement. It also is visible to those observing the speaker. As with all intraoral devices, the Tokyo's tube in the mouth may collect saliva and interfere with articulation. However, Weinberg and Reikena (1973) reported on the characteristics of the Tokyo device and noted exceptionally high intelligibility.

2. **The Cooper-Rand electronic larynx** also is an intraoral device. It is used frequently by patients immediately after surgery or when there is soreness, scar tissue, or swelling on the neck which precludes the use of a neck-type device. The Cooper-Rand generator and battery case are made to fit in a shirt pocket. They are connected to a hand-held generator that produces the sound. Special adaptations of the Cooper-Rand allow for hands-free use. The tone may be activated by the lift of an eyebrow, the turn of a wrist or a puff of mouth air. Patients with limited physical strength, as well as non-laryngectomized patients with debilitating disease such as Gullian Barré and poliomyelitis, also can then use this device. Intraoral devices require the patient to adapt to the

presence of the tube in the mouth, but practice with a speech-language pathologist helps appropriate positioning and coordination of voice and articulation.

3. A recent development in the area of artificial voice simulation is a system known as **Ultra Voice** (Available from Health Concepts, Inc., 279-B Great Valley Parkway, Malvern, Pennsylvania 19355, [800] 673-7881 or [215] 889-7363).

   a. There are three basic components of this system: the oral unit (with a loud speaker, a control circuit and small rechargeable batteries); the hand-held control unit which allows the user to remotely control onset, volume and pitch; the charging unit which recharges the batteries in both the oral unit and the hand-held control unit. See Figures 5-4 and 5-5 which illustrate these components.

   b. **The following steps,** to obtain satisfaction with this product, **are recommended for all patients:**

      (1) Contact a speech pathologist and a physician. The physician must provide a prescription.

Figure 5-4. Picture of the Cooper-Rand intraoral artificial larynx which can also be adapted for use by wheelchair-bound patients or patients with the need for hands-free activation. (Available from Luminaud, Inc., 8688 Tyler Blvd., Mentor, OH 44060. Phone: [216] 255-9082.)

Figure 5-5. Picture of Ultra Voice device showing components mounted into an upper denture and hand held remote control unit with chargers. (Available from Health Concepts, Inc., 279-B Great Valley Parkway, Malvern, PA 19355. Phone [800] 673-7881.)

(2) Obtain the device from Health Concepts and provide the company with names and addresses of the patient's speech pathologist, physician, and dentist.

(3) Visit a dentist to have an impression made for a denture or retainer.

(4) Have the Ultra Voice dental laboratory build a denture or retainer with the oral unit installed for use in the mouth cavity.

(5) Have the oral unit sent to the patient's dentist who will fit the appliance.

(6) Engage in therapy with the speech-language pathologist to learn how to use the device.

B. Nonoral Electrolarynges

The Western Electric 5C neck-type electrolarynx is probably the most commonly used artificial device. The patient experiments with placement of the head which vibrates against the neck until appropriate transfer of sound occurs. Salmon and Goldstein (1978) provide information on how this device can be adapted for intraoral use. The Servox Speech Aid, the Aurex Neovox, and the Romet are also electronic, neck-type instruments. These are more expensive than the Western Electric, but they produce excellent quality. Some variation in pitch and loudness is possible with some electronic devices. Figures 5-6 and 5-7 pictures popular electronic models.

C. Choosing an Artificial Larynx

The speech pathologist has an important role in helping patients choose artificial larynges and maximizing their use. Speech therapy is helpful in improving the intelligibility and acceptability of this type of artificial voice.

1. Patient Choices

Some patients choose an instrument as their only means of communication. Others use a device, on occasion, in addition to using conventional esophageal speech. They find it helpful to use the device when they are tired or in a noisy environment, for example. Other patients may rely on a device initially, to communicate while they are in the hospital, before they are well enough to pursue other communicative options. The artificial larynx is a valuable tool which extends the range of options available for patients following laryngectomy.

Figure 5-6. Picture of Servox Inton artificial larynx which is held against the neck. (Available from Siemens, 10 Constitution Ave., Piscataway, New Jersey 08855-1397. Phone [800] 955-4327.)

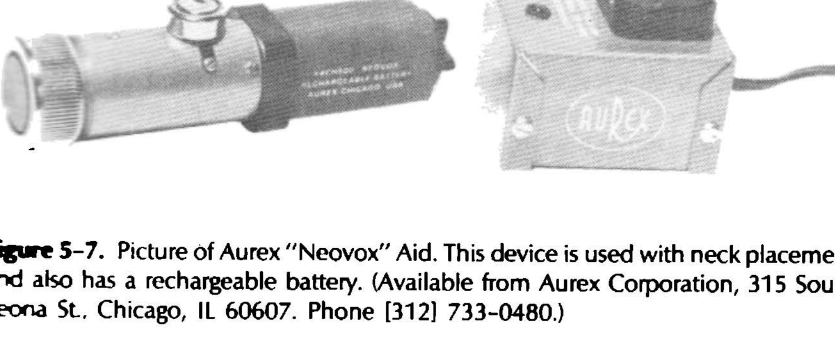


Figure 5-7. Picture of Aurex "Neovox" Aid. This device is used with neck placement and also has a rechargeable battery. (Available from Aurex Corporation, 315 South Peoria St., Chicago, IL 60607. Phone [312] 733-0480.)

2. Goals for the Speech Pathologist

a. Acquaint patients with the availability of various types of artificial larynges. Demonstrate the use of these devices. Allow patients to experiment with them.

b. Teach patients to coordinate hand and mouth movements to synchronize sound source and articulatory onset and termination.

c. Encourage mouth opening to improve resonance and more pronounced articulation than was necessary prior to laryngectomy. These strategies improve intelligibility.

d. Stress the importance of finding the best placement on the neck and maintaining a good seal.

e. Reduce competing stoma noise through relaxation and increased understanding that lung air is not used for speech anymore. Demonstrate differences between breathing out forcefully while speaking, not breathing out, breathing gently, mouthing only, and other techniques to create increased awareness on the part of the patient.

f. Practice normal phrasing and rate and conversation with appropriate facial expression.

g. Teach patients to use nonverbal signs to supplement the sound (e.g., placing the device against neck signals something will be said; touching the listener to gain full attention prior to initiating speech creates an expectation).

h. Rate changes provide variability, as do pauses, and help offset the mechanical effect.

i. Suggest to patients that they always explain what the device is when they encounter strangers. As with all handicaps, alaryngeal speech becomes less distracting if it is acknowledged and explained at the outset.

j. Be accepting of the patient's decisions concerning when, how, and if artificial larynges are used as part of an overall communicative repertoire/strategy.

IV. COUNSELLING AND MANAGEMENT ISSUES

A. The Need for Counselling

Voice is a critical component of each individual's identity, and loss of voice severely affects feelings of self-worth, day-to-day living, independence, employment opportunities, status, and social and family interactions. Thus, loss of a larynx, completely disrupts the patient's life, and it will never be completely the same again. Any type of cancer causes profound changes in any patient. The added devastation for the laryngectomee is that the ability to talk about the changes and feelings that occur is also gone. Because of the global effects of laryngectomy, an holistic approach to rehabilitation is absolutely essential. In Head and Neck Associates practice in Indianapolis, where Dr. Eric Blom is the speech pathologist, a full-time social worker, who is also a laryngectomee, is part of the management team and works closely with team members, patients, and their families. In many other clinical settings, counselling services are also readily available. When it is difficult to find appropriate counselling services, other members of the team must assume added responsibility in helping patients work through issues related to emotional health, self-esteem, and social and economic challenges. Underlying fears, anxieties, and loss of self-esteem undoubtedly influence patients' motivation and adaptive abilities during the rehabilitative process. It is essential that psychodynamic issues are recognized and directly addressed.

B. The Need for Immediate Communication

Provision of some communicative channel as soon as possible after surgery is of critical importance. It is inevitable that patients will experience fear, embarrassment, and depression; and these feelings are exacerbated by the social and emotional isolation experienced by complete loss of voice. The speech pathologist must work with the nursing staff and the family to provide as many avenues as possible for the patient to make his or her needs, feelings, and thoughts known. Usually, writing implements and intraoral artificial larynges are used initially. Care in choosing efficient instruments (e.g., a large, easily manipulated pen or pencil and stable pad) is essential. Instruction in how to maximize use of the artificial larynx is also needed. Communication boards are also made for some patients whose health, literacy, or sensory problems restrict use of other methods. Some patients are unable to read and write; and for these patients, it is helpful to have access to television, radio, and/or other listening devices. Patients without visitors or supportive family members need to be provided with sources of stimulation during the hospitalization period.

C. Other Physical Needs

The effect of other physical and sensory difficulties must also be addressed. Because the majority of laryngectomees are over 50, hearing sensitivity should be assessed, and patients with glasses should be encouraged to wear them. The speech pathologist should discuss possible effects on swallowing, digestion, and diet and coordinate efforts with the physician and nutritionist. Gastrointestinal symptoms (e.g., stomach rumbling, distention, and flatulence) may be troublesome and should be openly discussed. The speech pathologist should also check that the patient has well-fitting dentures if necessary. The physical therapist should be consulted if the patient has undergone radical neck dissection (e.g., shoulder drop and sensory deficits). Many laryngectomees may have addictive personalities, and it is important to recognize the possible influence of alcohol problems. Chronic smoking also may have affected pulmonary status (e.g., emphysema) which will also affect decisions made concerning rehabilitative strategies. For example, tracheo-esophageal speech may not be an option in the presence of chronic pulmonary disease.

D. Family Support

The support the patient receives from family and friends will affect speech acquisition. The family environment, together with the patient's own personality type, exerts a powerful influence on progress. Family dynamics inevitably are altered, and the spouse and entire family experience stress and must make adjustments. It is usually advantageous to provide information and reading materials to interested family members. Reading materials can be particularly helpful, because they can be re-read, shared, discussed, and thought about over time. Issues that family members may need to think about include:

1. **Changes in status and dependency.** It is essential that the patient is not inadvertently treated as a child. In areas involving decision-making, the patient should not be excluded or allowed to feel incompetent. Strategies to strengthen feelings of competence should be consciously identified and used.

2. **Restricted opportunities for stimulation and socialization.** The patient's embarrassment and fear about social contact and the family's protectiveness can limit opportunities for learning how to adjust to and compensate for the changed circumstances. Overt recognition of this, open discussion with the patient about goals and strategies to address this aspect of rehabilitation, and sensitivity about not pushing the patient beyond comfortable levels too quickly are important. Immediate contact with other laryngectomees (e.g., support groups) should be made.

3. **Changed attitudes and behaviors** on the part of the patient are to be expected.

   a. **Frank recognition and discussion** of depression, irritability, sexual problems, emotional lability, resentment, reassignment of family chores, and anticipated rejection can help patients and their families realize that these reactions are not unique to them. Reading materials, spouse support groups, and contact with other laryngectomees can assist in this aspect of counselling and management. Again, specification of what is to be expected, how others have developed coping strategies, and identification of ways the patient may plan to deal with troublesome aspects helps put negative attitudes in perspective. The major goal is to develop an awareness that dealing with feelings is part of the overall relearning program.

   b. **Phases in adjustment to disability** (Shontz, 1975) may be identified so that progress through the phases can be noted and reinforced by the speech pathologist. These phases are:

      (1) shock

      (2) realization

      (3) defensive retreat

      (4) acknowledgment

      (5) adaptation

4. **Each laryngectomee**, while having much in common with others, is unique. Factors such as life experiences, personal-

ity, family support, and economic and educational levels will affect the patient's ability to adjust and cope during the rehabilitative process. Patients are entitled to all information that they need to progress and for self-determination. However, the speech pathologist must be alert to signs of serious psychological problems, prolonged depression, withdrawal, and serious deteriorations in family relationships. When problems of this magnitude occur, referral for specialized psychiatric consultation should be made.

E. Reports

Reports of progress provide a comprehensive summary of an individual's progress across time. They also remind us of the variety of different aspects addressed by speech-language pathologists. Sample reports based on a typical laryngectomee are shown in Figures 5–8 and 5–9.

V. VENTILATOR-DEPENDENT PATIENTS

Ventilator dependence is a condition that results when a patient requires use of a ventilator at least 6 hours per day. Chronic respiratory failure (CRF) exists when the patient has used mechanical ventilation for 28 or more consecutive days while in a hospital, nursing home, or family home care with supportive services provided in lieu of institutionalization. Longterm ventilatory support may be necessary in cases of high-level spinal cord injury, neuromuscular disease, and respiratory failure characterized by abnormalities in gas exchange. Multidisciplinary team management is necessary.

A. Respiratory Failure

Roussos (1985) subdivides respiratory failure into two types described as lung failure or pump failure.

1. Patients with **acute respiratory failure** typically suffer from physiologic alterations of gas exchange in the lungs. Examples of acute lung failure are hyaline membrane disease in newborns and adult respiratory distress syndrome. The typical alterations of gas exchange in lung failure are hypoxemia (insufficient oxygenation of the blood).

Patient Name: Joseph Eagle **Medical Record No.:** 3325280

Date of Birth: 10/22/1930

Physician: Dr. I. Surgeon **Date of Admission:** 6/29/92

Diagnosis: Cancer of the larynx

Evaluation Date: 6/29/92

History: At the time of dictation, the medical history was not available. The patient will be undergoing total laryngectomy on 6/30/92. Today's meeting with Mr. Eagle was to provide a preoperative consult. The patient was accompanied by his daughter, Joan Rogers. During the session, the patient did not ask any direct questions. The daughter, however, asked a number of excellent questions and appeared to be supportive.

Description of Preoperative Consult: The patient presented visible signs of depression. He had difficulty concentrating on the brief descriptions of what to expect following surgery and the communication support that will be available. Printed materials and diagrams were provided, and Ms. Rogers took charge of them. The Cooper-Rand and Romet speech aids were shown and demonstrated to Mr. Eagle and his daughter. Mr. Eagle practiced using the Cooper-Rand, which he preferred and will use this device after his surgery. Because Mr. Eagle's surgeon plans to do a TEP at the time of the laryngectomy. Mr. Eagle will be visited by a TE speaker this afternoon. Mr. Eagle was compliant and seemed to understand the explanations.

Recommendations: Patient will be followed by speech-language pathology during his inpatient stay at our hospital. He will be seen at least twice daily and instructed in the use of the Cooper-Rand. The following goals are proposed:

1. Order a Cooper-Rand for Mr. Eagle to take home when he is discharged.
2. Continue to present oral and written information of physiological changes and the rehabilitative procedures available.
3. Show the video demonstrating the Blom-Singer TEP Voice Restoration Approach to Mr. Eagle and his family.
4. Arrange additional visits by laryngectomees during patient's hospital stay.
5. Continue to establish functional use of the Cooper-Rand speech aid (e.g., exchanges between patient and nursing staff, telephoning, etc.).

Figure 5-8. Report of preoperative consult.

Patient Name: Joseph Eagle **Medical Record No.:** 3325280

Date of Birth: 10/22/1930 **Date of Admission:** 6/29/92

Physician: Dr. I. Surgeon **Date of Report:** 7/27/92

Diagnosis: Laryngeal Cancer/Laryngectomy

Medical History: Joseph Eagle, a 62-year-old white male diagnosed with laryngeal tumor, underwent total laryngectomy on 6/30/92 at this hospital. He experienced hoarseness approximately 6 weeks prior to surgery. He was a heavy user of cigarettes and alcohol and has emphysema. Patient was seen for preoperative consult on 6/29/92 and twice daily for speech therapy during hospitalization. He was in the acute area until 7/15/92, in the skilled area from 7/15/92 through 7/18/92, and then in acute care from 7/20/92 through 7/24/92. Mr. Eagle has experienced wheezing, vomiting, aspiration with the catheter in place, and erythema of stoma site since the surgery.

Speech/Language: Patient was seen for his first outpatient visit on 7/27/92. During his hospital stay, he was fitted with a Blom-Singer TEP prosthesis. Initially, a 2.2 low pressure prosthesis was used, but the patient experienced difficulty with mucus plugging the prosthesis. A 2.2 duckbill prosthesis was substituted, and he had better success in keeping this device clean. Patient is able to do own self-care at this point. He follows instructions well, can remove the prosthesis, insert the stent device, and insert the clean prosthesis appropriately. He is also still using the Cooper-Rand at times. He is intelligible 50–70% of the time when topics are unknown in a quiet environment.

Oral/Motor and Swallowing: Patient demonstrated functional labial and lingual strength and range of motion. He refused to wear his dentures. A follow-up cookie swallow indicated that he should remain on soft foods. Although no aspiration was observed, there is some spilling over the tongue base prior to initiating swallow. He receives nutritional liquid supplements 4–5 times daily at home.

Recommendations: Speech therapy is recommended 1–2 times weekly, then on a p.r.n. basis. The following goals should be addressed:

1. Increase intelligibility of speech using the duckbill prosthesis under varied environmental conditions and with unfamiliar listeners.
2. Increase intelligibility of speech using the Cooper-Rand device.
3. Continue monitoring self-care of stoma and prosthesis.

(continued)

Figure 6-9. Report describing a laryngectomee's progress in treatment.

4. Continue counselling of patient and family in the following areas:
   a. diet and denture use;
   b. management of prosthesis and sequelae of surgery;
   c. emotional reactions and social relationships;
   d. alcohol use.
5. Consult with physician concerning fitting of a stoma cover button when patient is ready.
6. Encourage contacts with rehabilitated laryngectomees.

Date of Note: 9/1/92

Attendance: Mr. Eagle attended 5 out of 5 treatment sessions during August 1992.

Speech/Language: The patient has been successful in caring for his prosthesis at home. There has been only one incident when his prosthesis came out, and he called the speech pathologist. Family members were able to insert the stent into the puncture site. Family appears to be knowledgeable and supportive. During the last few visits, attention has been directed toward the fitting and use of the tracheal stoma valve. Several combinations were tried, and most success was achieved with a large housing. Patient is sensitive to liquid adhesives. Patient can now manipulate breath control for speech with moderate success.

Oral/Motor and Swallowing: Patient still wears dentures inconsistently. He denies any difficulties with present diet of soft, cohesive foods. Still using liquid supplements.

Recommendations: Continue speech therapy once per week and on a p.r.n. basis to address the following goals:

1. Increase speech acceptability and intelligibility.
2. Explore alternatives to alleviate loosening of housing of stoma valve. Try regular tape disk rather than liquid adhesives.
3. Continue counselling patient and family, moving them through phases of recovery and increasing patient's independence and social interactions.

2. Patients with **chronic respiratory failure** typically suffer from a disorder affecting the respiratory pump. There is hypercapnia (increased carbon dioxide in the blood). These disorders include brainstem, spinal cord, or peripheral nervous system disease or injury which affects the control of respiratory ac-

tion. Conditions that inhibit muscle efficiency or affect the thorax itself also usually affect pump function. Virtually all cases of CRF represent pump failures. It may be due to inadequate controller function from brainstem, spinal cord, or peripheral nervous system disease. It could also be due to inadequate force generation due to intrinsic muscle disease, chest wall defects affecting muscle efficiency or muscle fatigue resulting from respiratory load associated with pulmonary disease.

3. **Respiratory muscle fatigue** occurs as a result of both disorders of the lung and the pump. Grassino and Macklem (1984) note that fatigue results in an inability to generate sufficient pleural and airway pressures for adequate alveolar ventilation.

   a. **Treatment**, including ventilatory assistance, attempts to rest and repair the respiratory muscles.

   b. **Goals of treatment are:**

      (1) support oxygenation and carbon dioxide elimination

      (2) reduce demands on the system

      (3) restore respiratory pump and lung function

      (4) optimize physical state (e.g., hemoglobin, oxygenation, cardiac output, nutrition)

B. Mechanical Ventilators

Mechanical ventilators are classified as either **volume-limited** or **pressure-limited**. The respiratory therapist is in charge of monitoring this equipment. When very high inspiratory pressures are required because a patient has markedly decreased lung compliance or increased airway resistance (e.g., obstruction), a volume-limited ventilator may be necessary. They do not compensate for leaks in the system (e.g., around the endotracheal tube) but do provide a constant tidal volume in patients with changing lung mechanics. Pressure-limited ventilators inflate the patient's lungs to a certain preset pressure. When that pressure is reached, there is no further lung inflation. The inspiratory pressures may be held constant or expiration may begin. Most patients may be adequately ventilated with either a pressure-limited or a volume-limited ventilator.

All mechanical ventilation systems need an apparatus for humidification, warning devices, and safety pressure popoffs. The different modes of mechanical ventilation are listed below.

1. **Controlled ventilation** regulates both the rate and depth of ventilation, and the patient is unable to take spontaneous breaths in between.

2. **Assist controlled ventilation** is triggered by the onset of the patient's own respiratory effort and then delivers a full preset tidal volume or inspiratory pressure. Thereafter, the patient has control of the rate of ventilation but not the depth. Thus, the coordination of patient and ventilator effort is more efficient, but hyperventilation may occur.

3. **Intermittent mandatory ventilation (IMV)** describes a system where the ventilator is set to deliver a prescribed rate and depth of mandatory breaths. However, the patient may take spontaneous breaths, of any rate or depth, between the mandatory ones. Some ventilators have synchronized IMV so that the mandatory breaths are initiated at the time the patient makes an inspiratory effort. However, the spontaneous onset of inspiration must occur within the time frame prescribed for the mandatory breaths. This type of apparatus can be adjusted to gradually decrease the rate of the mandatory breaths so that spontaneous ventilation is increased.

4. **Positive end-expiratory pressure (PEEP)** helps minimize alveolar volume loss during expiratory pauses. This type of pressure can be sustained through the expiratory period when patients are utilizing any of the aforementioned mechanical ventilation modes.

5. **Continuous positive airway pressure (CPAP)** refers to the delivery of a relatively constant positive airway pressure. No mandatory tidal volumes are mechanically delivered. Nasal prongs, a nasopharyngeal tube, or a face mask can be used instead of an endotracheal tube to deliver the positive airway pressure.

6. **Negative pressure ventilation** avoids the complications of endotracheal intubation by using some modern version of an iron lung.

7. **Oxygen therapy** is the name given to the administration of oxygen to treat acute arterial anoxia. This may result from pneumonia, pulmonary edema, or obstruction to breathing. It is also used to treat patients with congestive heart failure and coronary thrombosis, and postoperatively. The oxygen may be administered via nasal catheter, mask (nasal or oronasal), funnel or cone, oxygen tent, or special oxygen chamber, usually in a concentration of 70 to 100%.

C. Intubation

Endotracheal tubes are used to provide an airway through the trachea and are usually considered a relatively temporary procedure. **Cuffed tubes** are used to minimize the aspiration of foreign material into the bronchus. An inflated cuff surrounds the tube and is not inflated until after the tube has been placed in the trachea. Tubes are made of inert polyvinyl chloride. The correct tube size is that which comfortably passes the vocal folds and the cricoid cartilage. A cuffed tube is indicated if there are excessive upper airway secretions or hemorrhage to prevent entry of material into the lungs. However, it will not prevent the spread of infection. Cuffs also minimize air and pressure leaks around the tube when very high pressures are needed for ventilation. When a patient is intubated, the endotracheal tube is securely fastened in place. Various methods are used to fasten both oral and nasotracheal tubes (e.g., a piece of tape that encircles the head). Any air delivered through an endotracheal tube should be cleaned, warmed, and humidified.

1. The **major complications** are:

   a. tube obstruction or displacement; and

   b. local tissue damage due to infection or pressure necrosis in the nose, oral cavity, larynx, or subglottic trachea.

2. To **minimize complications**, the following practices should be implemented:

a. frequent tube suctioning;

b. optimal mouth care;

c. secure fixation of tube;

d. maintaining a neutral position where the tube emerges from mouth or nose to avoid unnecessary pressure on tissues;

e. cuffs should be inflated with no more than minimum pressure and only when necessary.

D. Long-term Ventilation

For patients requiring long-term ventilation, a tracheostomy tube is surgically implanted. A tracheotomy (to place a tracheostomy tube) is the operation of incising the skin over the trachea and making a surgical wound in order to create an airway. Optimally, it is performed over a previously placed endotracheal tube, preferably in an operating room. Occasionally, however, tracheotomy must be performed as an urgent, life-saving procedure. Cuffed tracheostomy tubes must be inflated if the patient is on a positive-pressure ventilator unless otherwise ordered by a physician.

1. Interference with Swallowing

While tracheostomy tubes secure a patent (open) airway, they can also interfere with swallowing. When normal swallowing occurs, the larynx is lifted in an anterosuperior direction to protect the laryngeal inlet from invasion by foreign matter. A tracheostomy tube may anchor the larynx and hamper this preventative movement. Additionally, an exhalation normally follows a swallow and helps clear out the airway. When a tracheostomy tube is in place, the pulmonary air exits via the tube instead. To ensure that air passes upward to clear the larynx of possible obstruction, the tracheostoma must be covered or plugged. A finger, a full closure plug (tapered and fitted to ensure safety), or a one-way valve (e.g., Kistner valve that opens on inhalation and closes on exhalation) may be used. This allows for airflow through the larynx and coughing to clear the airway. Care should be taken to ensure that the diameter of the tracheostomy tube is not too large or it will impede the progress of air even when the tracheostoma is occluded. Fenestrated tracheostomy tubes are also sometimes used if there are not excessive secretions to plug the opening. It is frequently unwise to use cuffed tubes, that are inflated, with patients who have swallowing difficulties (Groher, 1984). Cuffed tubes may also contribute to infection, tracheal stenosis, esophageal erosion, and innominate artery fistulization.

2. Vocalization and Communication

With a tracheostomy tube in place, a patient may vocalize (if the larynx is intact) by occluding the tracheostoma and shunting the pulmonary air upwards. Occlusion must be coordinated with the expiration and the stoma must be open during inspiration. The physician and speech pathologist select a method of communication that is appropriate for the patient's needs and abilities. The method chosen will depend on the patient's status and physical, motor, and cognitive skills.

a. **Nonvocal methods of communication** for the nonparalyzed patient include writing, sign language, communication boards, and mouthing.

b. **Vocal methods of communication** include specially designed tracheostomy tubes ("talking trach" tubes) that enable air to flow through the larynx without compromising the patient's ventilation. A separate unit delivers air to the trachea for phonation. Thus, the ventilation of the lungs is separate from the air supply for speech. Both freestanding and wheelchair-based systems may be used. Levine, Koester, and Kett (1987) describe systems that allow quadriplegic patients to control their talking independently. They note two basic designs to allow independent voice control.

   (1) The use of an **electro-mechanical solenoid** to control flow from a compressed air source.

   (2) The use of an **air compressor** that can be turned on and off to supply regulated air to the "talking" tracheostomy tube.

(3) Levine et al. (1987) list several **considerations relevant to the choice** between a compressed air tank and an air compressor as a source. Their advice includes the following:

(a) Storage tanks must be refilled when empty. This can be done by the respiratory therapist if the patient is an inpatient.

(b) Portable air compressors eliminate the problem of refilling but create additional noise.

(c) The availability of rehabilitative engineers is an important consideration.

(d) Brief instructions should be placed on or near the equipment indicating appropriate procedures and maintenance.

(e) Nursing staff and family members should be familiar with the procedures, and there should be adequate documentation in patients' charts.

E. Communication Options

1. **Artificial larynges**, developed primarily for use with laryngectomees, **may be used by some ventilator-dependent patients**. They are frequently difficult to manipulate against the neck. Intraoral devices may be problematic because of difficulties with articulation (tube in mouth) and forehead switches. Electrolarynges may be suitable for some patients with vocal fold paralysis resulting from pre-existing conditions, trauma associated with intubation, or laryngeal muscle atrophy resulting from prolonged lack of phonation who are not candidates for talking trach tubes because of laryngeal deficits. Oral-motor skills and cognitive abilities, as well as motivation and hand coordination, must be evaluated to ascertain if this mode of communication is feasible.

2. **Assessment** of ventilator-dependent patients includes consideration of the following:

a. Posture (body, head, face) and positioning

b. Oral-peripheral examination

c. Dentition and swallowing

d. Primitive oral reflexes

e. Laryngeal function (MPT, quality, volume, cough, throat clearing, ability to impound air)

f. Behavior (alert, cooperative, confused)

g. Ability to follow directions; language and speech skills

h. Palatal function (VP closure, nasal emission, mouth breathing, gag reflex)

i. Hand/eye coordination

j. Cognitive abilities

k. Medical status

l. Airflow rate through the glottis if the use of a "talking" tracheostomy tube is to be used. Leder (1991) suggested 8 to 10 l/min., is an appropriate airflow rate with a possible range of 2 or 3 l/min. to 12 to 15 l/min.

m. Resource and support availability and the attitudes and motivation of patient, staff, and family members.

3. **Talking or speaking tracheostomy tubes** are specially designed tubes to assist ventilatordependent patients to communicate (see Figure 5-10). During inspiration, air passes through the inner cannula to the lungs. Air for speech enters the trachea through a separate channel above the inner cannula and is directed through the larynx. There is an independent air source for phonation provided by a storage unit and this is attached to the speaking connector tube. Sparker, Robbins, Nevlud, Watkins, and Jahrsdoerfer (1987) reported on a study of 23 patients ranging in age from 14 years to 78 years with an average age of 45 years. Eligibility for insertion of a

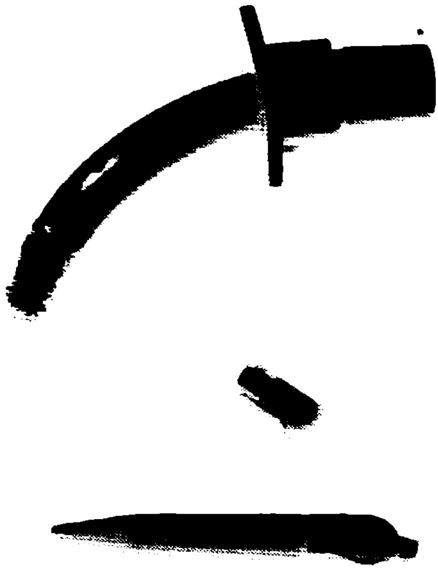


Figure 5-10. The proximal end of this COMMUNItrach I™ tube contains a 15 mm universal adapter to fit most connecting hardware of standard ventilator or anesthesia equipment. Independent air channels, one for breathing and one for speech, are formed by seals between the inner and outer cannulae at both distal and the proximal ends of the tube. Air for breathing travels through the inner cannula only. Air for speaking comes via the speaking air supply connector and then travels between the walls of the inner and outer cannulae. It exits through eight air vent ports and is directed towards the larynx. Note the cuff on the distal end of the tube.

speaking tracheostomy tube was determined by the speech pathologist's assessment of intact cognitive and articulatory function and otolaryngologic assessment including bedside laryngoscopy using a flexible pharyngoscope to determine vocal fold mobility, intact mucosa, and absence of other pathology. After insertion of the tubes in 19 of the subjects, instruction was provided for all professionals and family involved in the care. The speech pathologist provided treatment to encourage use and improve function. The **Assessment of Intelligibility of Dysarthric Speakers** (AIDS) was administered to test intelligibility with and without the tube. Fifteen of the patients used the device effectively. The main reason for failure in five subjects was excessive secretions collecting above the cuff. This occluded the air vents and caused coughing as secretions were propelled into the larynx and pharynx. Inadequate air seal, cuff breakage, and inadequate occlusion of the trachea by an intact cuff were often problems that had to be rectified. Loudness of voice varied as a function of the debility of the patients. Most patients were loud enough to be heard over the ambient noise of the ventilator. Although the listener was required to control the flow of air into the inner cannula to allow the patient to speak, this was readily accomplished in this study. Cues from the patient (to initiate and interrupt the air flow) were easily recognized. Both the Portex™ and COMMUNItrach™ tubes were used in this study. Careful screening of patients, suctioning of secretions, correction of connector tube kinking and air leaks around the cuff were needed. It was noted that, in most cases, gentle pressure had to be applied on the trach tube itself to prevent escape of air around the stoma site. The weight of the ventilator connectors tended to pull the tube away from the stoma.

4. Patients with spinal cord trauma, neuromuscular diseases, COPD, and ARDS are **candidates for speaking tracheostomy** tubes if they can produce intensity levels to compensate for ambient room noise. If a patient must maintain cuff inflation at all times for ventilation, then a talking tracheostomy tube is the device of choice. Leder (1990, 1991) demonstrated that speech intelligibility was adequate at airflow rates of 5 l/minute with careful listening, however, 10 to 15 l/minute of airflow was optimal. He found that patients took an average of 5–6 days following insertion of the COMMUNItrach I™ to learn to use it appropriately. Speech airflow is dispersed through eight fenestrations in this tube. Other tubes discussed by Leder (1990, 1991) are the Portex™ and Pitt™. Both of these tubes use a single opening, however, they are no longer available commercially. COMMUNItrach I™ is available from Spectrum Medical of California (telephone: [800] 328-0925). Leder and Traquina (1989) list prolonged prior endotracheal intubation resulting in poor adduction of folds (e.g., trauma, prolonged abduction, nonuse of folds) as a cause of delay in learning to adapt to a talking trach tube.

   a. **Voice therapy daily** following insertion of the tube was necessary to:

(1) stimulate vocal fold adduction;

(2) synchronize airflow through the speaking tube with adduction of folds;

(3) improve speech articulation;

(4) promote coordination between speech production and ventilator support for breathing;

(5) train patients (when possible) in self-use of the airflow line for speech; and

(6) eliminate anxiety.

b. The following **techniques** were used by Leder and Traquina (1989) and Leder (1990):

(1) A cough or throat clearing maneuver is used to stimulate fold adduction.

(2) The reflexive sound is shaped into a sustained vowel.

(3) Vowels are gradually shaped into connected speech.

(4) Light finger pressure is placed on the ventilator hose attached to the hub of the tracheostomy tube. This positions the tube optimally to eliminate any air leak at the tracheostomy tube-skin interface.

(5) The patient is trained to occlude the airflow line and speak only during the expiration phase of ventilation. (The unlimited airflow supply theoretically allows for continuous speaking. However, patients seem to be unable to speak during the inspiratory phase of ventilation.)

(6) Provide 50 cm of extra airflow tubing to make it easier to locate and occlude the line.

(7) Maintain the perpendicular insertion of the airflow line where it enters the tracheostomy tube, to avoid kinking.

(8) If problems occur, check the following:

(a) Is the patient able to adduct the folds?

(b) Are the fenestrations clogged with secretions?

(c) Are the neck straps too loose? (This causes anterior protrusion of the tube.)

(d) Are the ventilator hoses rotating the tube causing the fenestrations to be blocked by the tracheal wall?

(e) Is there air leakage because of inadequate locking of the inner and outer cannulas at the hub?

(f) Is there kinking of the airflow line tubing just before it enters the tracheostomy tube?

5. Patients with tracheostomas who are on ventilators but *are able to maintain appropriate ventilation in the presence of cuff deflation or removal* should be considered as possible **candidates for a speaking valve**. A one-way valve redirects exhaled air around the tracheostomy tube and upwards through the larynx. These valves fit on the end of the standard 15 mm hub of a tracheostomy tube and allow for laryngeal voicing to be used by the patient. Mason (1993, p. 363) describes some types of tracheostomy speaking valves. They include the Olympic Trach Talk, the Montgomery Speaking Valve, and the Passy-Muir Speaking Valve. The Passy-Muir positive closure speaking valve (see Figures 5–11 and 5–12) is the only valve that is FDA registered for inline use with ventilator-dependent patients (Mason, 1993)[2].

a. Differences between speaking valves and voice prostheses. It is important for the voice clinician to distinguish between these tracheostomy speaking valves and the voice prostheses (e.g., Blom-Singer, Panje) that are used with laryngectomees. Tracheostomy speaking valves are quite different and cannot be used with laryngec-

[2] See Mason, M. F. (1993). *Speech Pathology for Tracheostomized and Ventilator-Dependent Patients*. This book is available from *Voicing!*, 3857 Birch, Suite 194, Newport Beach, California 92660.

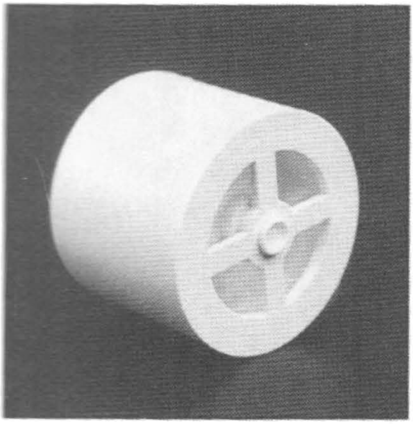


Figure 5-11. Passy-Muir Speaking Tracheostomy Valve.

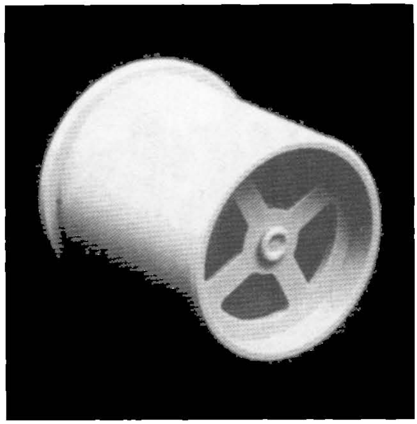


Figure 5-12. Passy-Muir Speaking Tracheostomy Valve.

tomees or patients with severe airway obstruction. They also cannot be used with foam-cuffed tracheostomy tubes or with inflated cuffs. They also may not be an appropriate option for some patients with severe obstructive pulmonary disease, which limits exhalation capacity.

b. Careful **assessment** is crucial before a decision to try a valve is recommended. Assessment issues include:

(1) pulmonary status/medical stability

(2) status of upper airway

(3) laryngeal function

(4) cognitive abilities

(5) thickness of secretions

(6) physician/respiratory therapist support

(7) staff and family education

c. Passy-Muir Speaking Tracheostomy Valve (see Figures 5-13, 5-14)

Figure 5-13. Patient using a Passy-Muir Speaking Tracheostomy Valve on-line with a ventilator.

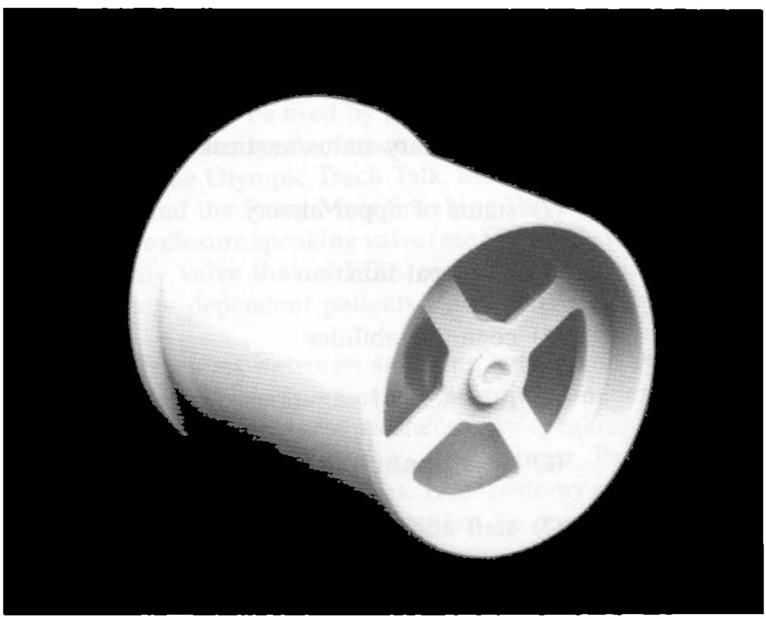


Figure 5-14. Passy-Muir Speaking Tracheostomy Valve.

Figure 5-15. Patient using a Passy-Muir Speaking Tracheostomy Valve.

(1) The Passy-Muir Speaking Tracheostomy Valve (PMSTV) has been used in **patients with the following conditions**:

(a) bilateral vocal fold paralysis

(b) sleep apnea

(c) neuromuscular diseases

(d) COPD

(e) head trauma

(f) quadriplegia

(g) amyotrophic lateral sclerosis

(2) **Benefits** that have been noted include:

(a) easy vocalization in sentences

(b) fewer infections than with finger occlusion

(c) assists weaning from the ventilator

(d) improves patient morale and relationships

(e) increased olfaction

(f) can be used for varied periods of time

(g) decreases oral and nasal secretions

(h) lightweight, hygienic plastic valves

(i) better swallowing and eating

(j) patients have more energy

(k) easily cleaned

(l) only needs replacement every 2 months

(m) can be used with young infants and children to normalize communication development

(n) Two versions of the valve are available so that patients may use a valve whether or not they are mechanically ventilated.

(3) The respiratory therapist will make the necessary **adjustments to the ventilator** when the patient uses the valve while still using the ventilator. (Some patients will wear it also when not on ventilators.) However, it is important to remember that safety alarms on a ventilator (e.g., low pressure disconnect alarms, parameter alarms, high pressure obstruction alarms) are still active. The respiratory therapist will work with the voice clinician and change settings as needed. Information concerning ventilator adjustments,

contraindications for use of the valve, variations in tolerance of valve and trouble-shooting are available from Passy-Muir, Inc., 4521 Campus Drive, Suite 273, Irvine, California 92715. Additionally, videotapes for educational inservice programs and information about clinician training are available.

F. Use of Mechanical Ventilation in Children

In the last decade, more children with CRF have survived. These patients may be cared for in special care units or at home. Mallory and Stillwell (1991) state that current technology for the provision of mechanical ventilation allows for patients' lives to be prolonged. However, the quality of life may be severely limited. For example, the presence of a tracheostomy tube results in restriction of mobility, and chronic ventilator dependence inevitably distorts body image and perceptions of self. There are also psychosocial effects and constraints imposed on interpersonal interactions, because of communication difficulties. Additionally, in children, there are concerns about both academic and social and emotional learning as well as physical growth and development issues to be addressed.

1. Prognosis

Sauve and Singhal (1985) report in excess of 90% survival rates and long-term excellent prognosis for infants with broncho-pulmonary dysplasia. Even children with neurologic or muscle disorders have a fair to good prognosis if individually tailored rehabilitation programs are implemented. Physical, occupational, and voice therapy is essential with careful assessment and provision of appropriate communicative stimulation. With a stable airway, minimal intrinsic lung disease, and well-trained caregivers, stability of ventilatory function may be predicted. Problems that do occur are often related to underlying cognitive deficits or deterioration of neuromuscular handicaps.

2. **Treatment goals for children** include:

   a. Increase muscle strength and endurance;

   b. Increase attention and cognitive development;

c. Increase chest wall movements;

d. Improve assisted cough;

e. Increase diaphragmatic breathing;

f. Stimulate communication development receptively;

g. Assess/monitor/improve swallowing;

h. Introduce/teach an appropriate method of expressive communication suited to individual's needs;

i. Train and support caregivers;

j. For some young patients with congenital disorders of the airway or chest wall, improvement with growth and development may lead to less dependence on mechanical ventilation. This raises the important issue of continual reassessment of every patient.

G. Use of Mechanical Ventilation with Adults

1. Speech Production

Hoit, Shea, and Banzett (1994) describe research findings concerning adults with tracheostomies who were mechanically ventilated. Their study reported the first in-depth research-based description of speech production. Recordings were made of chest wall motions, neck muscle activity, tracheal pressure, air flow at the nose and mouth, estimated blood-gas levels, and the acoustic speech signal during performance of a variety of speech tasks. However, their adult subjects did not use talking trach tubes or valves previously described. Each subject had a cannula which fit tightly into a tracheal stoma forming a seal. However, the cannula did not form a seal inside the trachea, so this allowed some of the gas from the ventilator to flow through the larynx and upper airway. This is sometimes referred to as "leak" speech and usually limits the length of utterances.

It was found that these subjects spoke, not only during inspiratory flow as might be expected, but also during end-inspiratory pause and early expiration. Subjects did not initiate speech at the exact onset of the ventilator's inspiratory flow (approximately 0.3 to 0.7 secs after inspiration onset). Also they usually terminated speech after the offset of the ventilator's inspiratory flow (0.7–1.1 secs). Maximal speech durations ranged from 2.0 to 3.1 secs. These maximal durations are shorter than normal speech durations (4.0–5.0 secs) calculated from reading samples by Hoit and Hixon (1987) and Hoit, Hixon, Altman, and Morgan (1989). The average F_0 for sustained vowels produced under all loudness conditions was within the normal range for each subject's age and sex. There were no consistent differences between the subjects with spinal cord lesions and the subjects with muscular dystrophy when F_0 and intensity were compared.

Hoit et al. (1994) noted that it appeared that most of their subjects may have used inspiratory muscular effort during speech. They also observed that these patients did not seem to find it difficult to speak and also meet gas exchange requirements simultaneously. However, they did not always take advantage of the entire speaking time that was available. The researchers also emphasized that most individuals with neuromuscular disease can be successfully ventilated with uncuffed tracheostomy tubes. The use of uncuffed (or deflated cuffs) and a fenestrated trach (which allows for laryngeal voicing) was noted as a way of enhancing speech. The authors also suggest the need to explore ventilator adjustments to improve speech. They believe that patients can also maximize speech duration by learning to continue speaking as far into the expiratory portion of the cycle as possible. This and other suggestions for speech training and clinical intervention are presented in detail in their report.

2. **Voice and speech therapy techniques** depend on the type of communication option that is implemented. For example, daily sessions with the speech pathologist are necessary to teach and reinforce proper use of a talking tracheostomy tube or valve. The following speech pathology treatment goals will usually be implemented.

   a. **Consultation and team intervention** with physician, rehabilitative engineer, respiratory therapist, nurses (suctioning of mucus as well as other roles), and other professionals as deemed necessary.

b. Full **explanations and demonstrations** of equipment and strategies to patient and concerned others.

c. **Direct therapeutic techniques** to maximize acceptance. practice of skills, and intelligibility.

d. **Encouragement, support, maintenance,** and **problem-solving** related to the use of systems and aids. See Figure 5-16 which provides a vivid narrative of the feelings of a patient and his perspectives on the treatment he received.

e. **Counselling and reinforcing** the patient to promote decreased emotional dependency, effective communicative interactions, and feelings of self-worth and accomplishment.

f. **Consultation** with social service agencies to ensure appropriate supportive services as an in or outpatient.

g. **Frequent reassessment** especially of patients with progressive neurologic disease. Communication options change as conditions worsen (e.g., ALS patients).

VI. SUMMARY

In this chapter we have discussed cancer of the larynx and the various approaches to treatment and communicative rehabilitation that may be implemented. The discussion of the factors to be considered during assessment and treatment emphasizes the need for careful individualized planning for patients who must communicate without a larynx. Significant advances have occurred in the last 20 years in the area of tracheoesophageal speech. This has resulted in great benefits for many patients who may not have been candidates for conventional esophageal speech in the past. Singer and Blom (1990), who developed endoscopic tracheo-esophageal puncture for voice restoration, also pioneered work in the area of air insufflation testing which has led to improved methods for treating cricopharyngeal spasm. Finally, in the last decade, ventilator-dependent patients have benefited from technological advances, such as the development of the Passy-Muir valve, that have improved options for communication in the presence of chronic respiratory difficulties. With the improvements in technology and prosthetic devices to aid communication, the role of the speech pathologist has changed and will continue to change as new advances occur.

COMMUNICATION BREAKDOWN

Caring for a conscious patient on a ventilator and allowing him to participate as much as possible in his own care is a demanding task. Howard Parker speaks from personal experience of being on a ventilator and suggests how communication breakdowns can be avoided.

"I had never heard of Guillain-Barré syndrome until I became a victim. I now borrow the "Tony Benn had it, remember?" explanation with which doctors soothed me. A disease of the Left? No. It seems to strike young and old of both sexes and all political persuasions similarly. Neurologists do not know a great deal about it and I now hold in the highest esteem those medics who do not pretend they do.

"The syndrome was picked out of the mystery bunch of nerve inflammations by two Frenchmen who defined its onset, main characteristics and generally favorable prognosis. The severity of the illness and associated paralysis on Guillain-Barré varies. Tony Benn was in the "lucky" majority who get it mildly. I am afraid I got about as heavy a dose as you can without joining the 20% plus mortality rate.

"In my case the onset of the syndrome was fairly rapid and from being fully fit to being ventilated in a regional neurology unit took only four days of decline. I arrived at the medical ward of the unit via a general hospital. The usual neurological tests, lumbar punctures and respiratory function monitoring had been done and a diagnosis of Guillain-Barré syndrome was confirmed shortly after I arrived at the unit. Hence I was ventilated in the knowledge that the prognosis was good if the acute stage of the illness could be managed, mainly with intensive nursing care and physiotherapy.

"Though paralyzed, I remained fully conscious and alert throughout my illness. This had its advantages but also meant I was always apprehensive or frightened. Little short of panic set in when the anaesthetists started talking about cutting a hole in the wind pipe — a tracheostomy — "to help you breath better on your own you might need a bit of help from a machine, a ventilator."

"Everyone except me knew very well I could be on the "vent" for several weeks and might not come off it alive. The the rabbit punch: "It's up to you old chap, but really it would be better if we did this with a local anaesthetic. It might be — well, er — a bit dodgy with a general in your state."

"And so to the first of several moments when death seemed to me to be a strong possibility. I was wheeled down to the cold slab to have a hole cut in my

(continued)

Figure 5-16. Report by a patient about his experiences on a ventilator and some suggestions for caregivers. Reproduced by kind permission of *Nursing Times*. From Parker, H. "Communication Breakdown", 1984 (pp. 37-39). *Nursing Mirror*, 158.

throat. ("Any last requests before we stop your voice working?") The "intellectual" fear is swamped by your whole body going into trauma. The smell of flesh being cauterized is soon blocked out by the total conviction that your heart, which is crashing and pounding louder than you can believe, will burst and that will be it. Yet you cannot speak — you mouth "Heart, heart" moronically. "Everything's fine, just relax," smiles a disinterested surgeon. My perceptions were totally different.

Technology time

"Here was the first point where I really needed my hand held, though back on the ward I realize it is technology time. A ventilator waited silently by my side. The special care trolley had been stocked up with dressings for the trachi, suction catheters and so on. Up went the intravenous infusions, down went the nasogastric tube, on went the heart monitor leads. Life has changed totally, it is no longer mine.

"I was reluctant to be attached to the ventilator and rejected the contrast of its slow deep action against my own shallow panting until I was actually too weak to resist. Looking back on this period it was managed fairly well, but a few aspects, in terms of my well-being, could have been improved.

"First (and it may not have been possible because of staffing difficulties) it would have been a great help to have had only two or three nurses "specialling" me during a 24-hour period instead of the half dozen. This would have helped some nonverbal rapport to develop and improved the chances of a communication system developing. Second it would have been useful to have worked out some system of communication with me before the tracheotomy, while I could still talk. Third, I was nursed in a four-bedded room for the first few days on the ventilator. Clearly it was the acute room and two people died dramatically right next to me during this time — a process which would really upset most people even if they were not ill at all, let alone fighting for their own lives.

"In fairness to the ward sisters, they responded to my unhappiness at being nursed "in the mortuary" by moving me into a single room. This improved my emotional well-being enormously, but those early days of intensive care still haunt me slightly and wherever possible I would hope such additional exposure to crisis and death for a dangerously ill patient would be purposefully considered and avoided.

"I was most impressed with the day and night intensive nursing care I received. The endless programme of observations, tube feedings, drugs, toileting, being turned, and ventilator maintenance punctuated by the mutli-professional daytime presence for blood tests, chest X-rays, blood gases, swabs for predicting

Figure 5-16 *(continued)*

nfection were carried out religiously — even if it meant I rarely got more than half an hour's sleep at a time.

Clearly some nurses enjoyed the "specialling" role and two or three third-year SRN students spent several hours a day with me for nearly three weeks. I developed a close bond and quite sophisticated rapport with these nurses. My difficulty came when the nurses left or went on breaks or off shift and a major criticism must be that the communication system (I had a chart for stroke patients by now!) broke down, often totally, on these occasions.

"For the conscious "vent" patient this is not a trivial matter. It means he cannot exert any control over his care, perhaps cannot get the new carer to understand he is in pain, needs to pass water or that the ventilator is not functioning properly, as was often the case with the humidifier on the vent.

"It also meant that rapport and therefore avoidance of boredom and frustration could not be achieved for either party. I know the theory — this should not happen, reports deal with these issues, nurses are trained not to leave a vent patient without proper changeover procedure. However, it did happen, and routinely, and on a ward which was very professional in many other respects. In the same way night staff did leave me unattended because they thought I was asleep, again probably for good reason, but in terms of the patient's well-being these practices were inappropriate.

Panic

"Having the tracheotomy under a local was not the only moment of panic. On three other occasions I thought it was curtains. All the incidents related to the ventilator and the standby oxygen cylinder. (There was only one piped oxygen outlet in my room which fed into my ventilator.)

"One incident occurred during chest physiotherapy. A registrar anaesthetist proceeded to disconnect me from the ventilator and "bag" me while the physiotherapist and nurse set about clearing my lungs. The standby cylinder feeding the bag was in fact empty.

"This late night team, blissfully unaware of the fact, was totally indifferent to my facial protests and I was saved from a fair degree of oxygen starvation only by the entry of my beloved night sister, who knew immediately from the look in my eyes that all was not well and insisted I was put back on the ventilator immediately.

"The junior anaesthetist's other little piece of subversion was to leave the oxygen cylinder on after routine "bagging." This happened because they were concentrating on getting me back onto the ventilator and checking its function. They consequently forgot to turn off the cylinder valve and could not hear the gas

(continued)

escaping because of the noise of the ventilator. Within a few minutes the reassuring sight of the cylinder in the corner was a cruel illusion.

"It was a fine spring morning, so they told me. All was calm. My special nurse of the month had just about got to know me and was chatting about her love life, when suddenly the ventilator's alarm went off. It was a good few seconds before I agreed with the machine, but then I accepted its diagnosis — it was not working.

"The nurse pressed the emergency bell and half the staff in the ward came crashing into my room. "Let's bag him" "Call the technician" — "Get the oxygen cylinder over here."

"You guessed. Empty. I knew by now that a backup cylinder should be full and standing in the stairway between mine and the next ward. Someone went to get it. As I suffocated, I thought that it would be just my luck if it was also empty or not there. A minute of terror was resolved. It was there. It was full.

"After these incidents I insisted, with all the means at my disposal, that a spare cylinder was kept by my bed and turned around so that I could see the gauge. Securing this practice became a major daily exercise. For a while there were two cylinders in the room.

"When about a fortnight later all the pipes, without warning, decided to fall off their connections on the ventilator, I was relatively calm (which is more than could be said for the poor relief nurse who viewed the control display of the ventilator as if it contained the buttons to let off Cruise missiles) because I knew the oxygen cylinder was half full.

"The checking of emergency equipment must in the end fall on the specialling nurse. It may well be the anaesthetist's fault, or the porter's who did not tighten some valve, that the standby cylinder is empty, but it is the nurse who must, in practice, correct these errors, check the cylinder and always have the pressure gauge in sight. Ironically the nurses least likely to do this are the ones who sit in for an hour while a colleague goes for a break.

"This relief nurse is less likely to be able to communicate well with the patient, less likely to be an expert with the ventilator, and less able to anticipate a respiratory crisis. Therefore she is all the more likely to require a working standby oxygen system.

"In conclusion, the "vent care" I received was very good and the willingness of staff to go to considerable lengths to look after my emotional and physical well-being was impressive. To pay attention to the whole patient and allow him as much participation as possible in his own care is a demanding task.

Figure 5-16 *(continued)*

Looking back through my medical notes with my consultant, it was gratifying to see how often I had been taken seriously when asking for the trach cuff to be changed, for vent pipes to be replaced or for extra chest physiotherapy. Yet while my carers coped well with the respiratory emergencies when the ventilator broke down or the standby cylinder failed, they could and should have been better prepared. Similarly, both sisters and specialling nurses failed to place sufficient emphasis on establishing and providing continuity with a communication system tailored to my needs and abilities. I have devised a chart which would have helped me and my carers very considerably and which I hope readers might find useful.

Communication

So for me, the patient, the three Cs of *communication, control,* and *crisis* were major interrelated issues. I was allowed some control over my care by the most astute nurses who facilitated communication; this helped us to avert or prepare for crisis. The corollary of this is that, without a communication system, the conscious aware patient is deprived of any participation in the care programme, and the prevention or preparation for ventilator incidents are undermined. Not all patients will be able to develop extensive communication systems or want to exert control over their care, but the nurse will never know if she does not try.

These charts may be helpful in setting up a communication system when nursing patients on a ventilator."

EMERGENCY
I cannot breathe properly.
I am in pain.
Something else — please let me try to explain.

MESSAGE
Pen and paper, please.
Please write a note for me using the alphabet.

THE VENTILATOR
I don't feel the vent's working properly.
The pipes to my throat are not right.
Too hard to breathe on the set rate.
Something else — please let me try to explain.

SUCTION
Please suck out my mouth.
Please suck out my trach/throat.

TOILET
Can I use a bottle/bedpan to pass water?

(continued)

I want to open my bowels please.
Can you attend to my catheter please?
Something else — please let me try to explain.

COMFORT
Turn — Can you turn me please?
Backrest — raised/lowered please.
Light — on/off.
I am too hot.
I am too cold.
Mouth — problem.
Eyes — problem.
Feeding tube — problem.

A	B	C	D		
E	F	G	H		
I	J	K	L	M	N
O	P	Q	R	S	T
U	V	W	X	Y	Z

1. **Establishing communication**
   Check the new patient understands the card. Agree on a cue or sign which the patient can use to indicate he wants to use the card. Always put the card high on a wall where the patient can nod or point toward it. Try to establish a set pattern of communicating and record this for the next nurse or shift. It is a form of neglect to leave the patient to be cared for by a colleague who does not know the system.

2. **Using the alphabet**
   As with the main chart use a thin pointer. Make sure the patient can see the whole alphabet clearly. Are glasses required? Write down each letter and always return to "A" between letters. If the patient is alert enough, speed things up by asking which line the letter is on.

Figure 5-16 *(continued)*

3. Acting as interpreter

Try to be present when doctors or physiotherapists, who are not familiar with the routine, are present. You may be able to help a great deal with communication.

Patient ______________________________

Cue to use chart is ______________________________

For "yes" the patients indicates by ______________________________

For "no" the patient indicates by ______________________________

CHAPTER

6

Voice and Psychosocial Dynamics

I. VOICE PROBLEMS RELATED TO ROLE IN FAMILY AND SOCIETY

Fifty-five percent of the emotional meaning of an oral message is communicated visually through gesture, posture, and facial expression; and 38% is transmitted through the voice. The actual words that are spoken communicate only 7% of the emotional content (Mehrabian, 1968, 1987). Paralinguistic aspects of communication contribute significantly to the success or failure of interpersonal relationships. Learning to interpret and use paralinguistic cues effectively is a critical aspect of each child's speech and language development. Most children acquire and refine these skills initially through observation and trial and error within the family. Thus, the family's communicative style and pattern of interpersonal interactions exert a powerful early influence. This influence may persist throughout an individual's life, especially if an individual is not exposed to other models or does not develop an awareness of the subtleties and diversity of interpersonal dynamics. Some children appear to have extreme difficulty learning the rules of nonverbal communication, including the encoding and decoding of salient vocal attributes. Nowicki and Duke (1992) believe that a nonverbal social communication deficit, or a difficulty in using nonverbal signs or signals, may be described as *dyssemia*. Dyssemia may be expressive, receptive, or both. Difficulties in adapting to varied communicative styles may also occur because of faulty learning that results from an isolated or deprived childhood experience, learning disability, or emotional disturbance.

A mismatch of vocal signals frequently occurs when any person first encounters groups with markedly different regional, cultural, ethnic, educational characteristics or social status. Although some of the difficulties with learning to interpret and use vocal signals are developmental, others are acquired as the result of experiencing the onset of a voice disorder. When a person's ability to use the voice is restricted in some way, listeners react differently, and some disruption in social interactions also affects the person's self-esteem and sense of competency and control. Thus, every voice disorder, regardless of etiology, has a psychosocial component. The interpersonal significance of vocal attributes and other nonverbal markers of meaning and feeling must be addressed during treatment.

A. Clinical Issues

To address the psychosocial dimensions of a voice disorder, the speech pathologist must see the patient as a unique individual who is also part of a family and cultural system. The role the patient plays within the family and the social and cultural manifestations inherent in communicative strategies always must be considered.

1. Family Systems

The dynamics within the family, the way the patient uses the voice to meet basic needs, solve problems, and maintain family or group equilibrium affect the treatment approach.

a. The **role the patient adopts** and the way vocal behaviors impact on that role directly influence prognosis for change.

b. **Use of a systemic model** involves the following strategies:

(1) Obtaining comprehensive **information about the family and/or life stage** of the patient.

(2) Considering how the **patient's aspirations** are related to life cycle stage, rôle and responsibility within the family, and stressors.

(3) **Observing** interactional patterns, social and cultural influences, patient's ego strength, and compliance.

(4) **Communicating** with family members, co-workers, other professionals.

(5) Using **counselling techniques** to help the patient explore the precipitating and maintaining factors and develop problem-solving and action-planning skills.

(6) Providing **support and practice opportunities** to empower the patient to habituate new vocal patterns.

Consider the following counselling exchange between a 45-year-old woman, Claudia, with a hyperfunctional voice disorder. Note the way in which the speech pathologist communicates empathy and respect for the woman's feelings while using reflecting statements to help her clarify her feelings concerning the problem.

c. Case Study: Claudia M.

Claudia: My husband never does a thing around the house. He never even takes out the trash or anything.

SLP: It's upsetting you that he doesn't do his share of the chores.

Claudia: He always lets everything go and then I have to do it. I have to do everything.

SLP: You feel he takes advantage of you.

Claudia: I suppose he thinks women should do all the work around the house. I mean, wouldn't that make you mad with him? He just watches T.V. — doesn't lift a finger to help me. But, I suppose women have to put up with this sort of thing — always have had to, I guess.

SLP: You sound pretty hopeless about any chance of changing the way he is?

Claudia: That doesn't mean I like it, you know. I really can't stand being made to work all the time while he does nothing to help. Doesn't even seem to notice anything that needs to be done — it's like he's blind or paralyzed or something.

Note that at this point in the exchange the speech pathologist makes a confronting statement.

SLP: You haven't mentioned anything about talking to your husband about how you feel about his lack of help around the house.

Claudia: I shouldn't have to talk to him about it! He's supposed to see what needs to be done. He's not blind is he? He should want to help me. I don't think I should have to ask him when he's my husband and it's his house as well as mine. After all, husbands are supposed to help their wives. They should want to help ... if they care.

SLP: I guess you're annoyed that you may have to ask him to do his share.

Claudia: Of course. Why should I be the one who has to nag? I'm tired of it all. He should change his ways and be more considerate. Maybe he will someday. I wish he would.

SLP: Maybe you hope he'll come to his senses on his own, but from what you've said, it sounds as if you really feel very unhappy with the way things are, and maybe he'll never change unless you actually tell him what you've just told me.

Note that the speech pathologist allows Claudia to talk about her situation in detail and to restate her feelings as she explores her problem without making suggestions or giving advice too early in the process. This allows Claudia to understand her feelings better before the speech pathologist confronts her with a more challenging statement. The speech pathologist communicated attentiveness and respect both verbally and nonverbally through: reflecting statements; tone of voice; eye contact; posture and gestures (relaxed and open); closing the distance between them (e.g., leaning towards Claudia).

Claudia's vocal problem was related to her habit of swallowing her resentment instead of asking for help or describing her needs. Her reluctance to express her feelings directly to her husband also may have been related to her perception of her role as the long-suffering wife who wouldn't nag. Her view of her traditional role in the marriage intersected with her feelings of frustration and anger because her "expectations" concerning his behavior were not realized. In this case, the speech pathologist acts as a consultant, facilitator, and counsellor to shape attitudes relevant to subsequent behavioral change and the unlocking of hyperfunctional muscular tension.

2. Personality and Voice Image

Cooper (1984) stated that "a misinformed society inculcates voice stereotypes: the individual consciously or unconsciously adopts one of these voice types which becomes rooted in the psyche as a personal voice image; the individual outwardly projects and thus fulfills the general characteristics of his or her voice type" (p. 79).

Many individuals select a voice type because of familial expectations ("he's the clown in our family") or because of vocational aspirations ("a woman Vice President must sound authoritative") or because of relationship demands ("my husband hates bossy females"). Extroverted individuals may feel they must always be talkative and entertaining to maintain listeners' attention and avoid being thought of as "boring." Introverts may become more reticent in noisy or competitive talking environments and feel overwhelmed or manipulated by colleagues who shower them with enthusiastic feedback or personal questions. The personality of the patient, and his or her vocal image, will affect motivation to change the vocal behavior as well as the reactions to changes that occur in treatment.

a. **A treatment plan must be tailored to the personal and lifestyle characteristics of the patient**. For example, many cheerleaders are terrified that the speech pathologist will "make" them change their entire personality because they have vocal nodules. Consider too the very telling reaction of a militant, politically active woman professor who consulted a speech pathologist because of repeated episodes of chronic, nonspecific laryngitis. The speech pathologist began providing suggestions about how vocal strain could be reduced if laryngeal tension was eliminated and a more breathy quality was used to avoid irritating the swollen folds. The professor became agitated at the thought of using, even for a short while, what appeared to her to be a weak, ineffectual, vocal style. "But," she said, "you don't understand. I have to sound aggressive or my colleagues will walk all over me." Clearly, her view of herself and her vocal style involved a combativeness that she could not easily relinquish, even temporarily.

b. To **ascertain an underlying vocal image**, the speech pathologist must facilitate self-exploration on the part of the patient and respond with empathy, respect, and specificity. If too many questions are asked, it creates a formal clinical atmosphere rather than a fruitful interaction. A few leading questions, with prompts to foster elaboration and self-disclosure, are preferable to a long series of questions. Open-ended questions ("How," "What," "When," or "Where") are preferable to "Why" or yes/no questions.

   Consider the case of Tomas W. who sought a voice evaluation because of a "high-pitched voice that no one took seriously on the phone."

c. **Case Study: Tomas W.**

   Tomas was a 30-year-old male proprietor of a small clothing store in a midwestern college town. He complained that when he talked on the telephone to business contacts in New York City, he felt that they didn't take him seriously. "It's my voice," he said. "It always sounds like a young kid's voice, not the voice of the owner of the business. I'm not trying to hide my sexual orientation. I'm gay and proud of it. I just want to be taken seriously." Tomas' voice quality was lacking in resonance, he habitually used a conversational pitch level that was appropriate, but his inflection pattern was exaggerated and tentative at the ends of utterances. He used a soft, breathy quality, and his voice also faded at the ends of utterances. The speech pathologist asked Tomas what he thought an authoritative voice sounded like and which voices he particularly admired. Tomas' response was somewhat surprising. He said he really wanted to sound just like Walter Cronkite. The speech pathologist also engaged Tomas in an exploration of his feelings concerning what he hoped to achieve through voice therapy. He talked at length about his plans for his business, his frustrations concerning interactions with employees, and his lack of capital. He mentioned several times that, if he could learn to talk like Walter Cronkite, all of his problems would be solved. The speech pathologist asked him to describe exactly what it was about Walter Cronkite's voice that he particularly admired. Was it the inflectional pattern, for example? "Oh no," said Tomas. "I like my inflections much better than his. I'd just like to use the words, the vocabulary, he does. It would really make people listen to me." The speech pathologist probed further asking about his earlier reference to his voice sounding "like a young kid's." "Oh, I'd sound older too, if my vocabulary was better," he said.

The example of Tomas reminds us how unpredictable some client's expectations can be and how easy it is to jump to the wrong conclusions. The speech pathologist's analysis of Tomas' voice and needs and Tomas' own analysis were vastly different. If the clinician had not allowed him sufficient time to disclose what his goals were, his real reason for seeking treatment might not have emerged.

3. Cultural Stereotypes

Cooper (1973) notes that certain vocal parameters are associated with specific attributes in our culture. Consider, for example:

low pitch (males) — strength, control, assurance, authority, security, knowledgeability, relaxation, naturalness, sexuality

low pitch (females) — grace, charm, gentleness, softness, nurturance

Stereotypical responses to communication styles, especially in reaction to first impressions, in our culture also include:

Spanish accent — emotional

British accent — educated, sophisticated

African-American accent — animated, confrontational

Tannen (1992) believes that masculine and feminine styles of communication are characterized by differences in communicative intent (pp. 76–77). For example, males use more "report talk" and females use more "rapport talk."

males — report talk (vying for status by exhibiting knowledge and skill)

females — rapport talk (making connections and negotiating relationships)

Cross-cultural studies of communication suggest that North American speakers are characterized as loud and fast talkers. Edward T. Hall (1990) describes speakers as:

low context speakers — tell listeners too much; talk down. Reaction — "Do you think I'm dumb?"

high context speakers — assume listeners know details so don't elaborate. *Reaction*—"I'm mystified."

Cultural differences in dealing with time, power, competitiveness, structure, formality of interactions, space, and collaboration impact on communicative patterns. Expectations and stereotypes prevent the establishment of open communication between people of diverse experience and backgrounds. During classroom discussions, it has been found (Eder, 1992) that different techniques elicit different amounts of participation by college students. For example:

critique-based (oppositional mode) — males participate more than females

students pose questions, in advance, based on readings — enhanced participation by all students

"Pros and Cons" — males and females contribute with equal frequency

a. Rating scales may be used during treatment to **elicit patients' self-perceptions** of their voice and speech patterns. Additionally, questions, like the ones shown in Tables 6-1 and 6-2, can be used to elicit information concerning patient's preferred styles.

Table 6-1. Scale for patients to rate aspects of preferred voice.

My voice is . . . or I would like my voice to be . . .				
Very musical 1	2	3	4	not musical 4
very tense 1	2	3	4	not tense 4
very authoritative 1	2	3	4	not authoritative 5
strongly accented 1	2	3	4	not accented 5
very expressive 1	2	3	4	not expressive 5
very unusual 1	2	3	4	not unusual 5
very combative 1	2	3	4	not combative 5
very pleasing 1	2	3	4	not pleasing 5
very masculine 1	2	3	4	not masculine 5

Table 6-2. Patient's response form to identify preferred voice style/patterns.

Voice/Style Pattern

A person I would like to sound like is: ____________________
A person I wouldn't like to sound like is: ____________________
I'd describe my mother's voice as: ____________________
I'd describe my father's voice as: ____________________
The best aspect of my voice is: ____________________
The worst aspect of my voice is: ____________________
People's first impression of my voice is: ____________________
People would stereotype my voice as: ____________________

Describe specific aspects to target during treatment:

pitch: ____________________
loudness: ____________________
rate: ____________________
expressiveness/variability: ____________________
accent/dialect: ____________________
cultural markers: ____________________
gender markers: ____________________
social interactions. ____________________
public speaking: ____________________
performing: ____________________
authority level: ____________________
tension level: ____________________
confidence level: ____________________
smoothness/steadiness: ____________________
telephoning: ____________________
annoying habits: ____________________

b. Treatment strategies must mesh with the patient's preferred voice goals. Dismissal criteria may also be specified to ensure that both the speech pathologist and the patient have a clear and similar understanding of the goals to be addressed. Unless expectations are clearly defined and operationalized, it is difficult to document progress in a satisfying, explicit manner. Patients with voices and vocal styles that exhibit regionalisms and racial, cultural, or status markers must be helped to identify and discuss the specific attributes they wish to change and those they are not willing to relinquish. Unless the specific, personalized variations in vocal style are brought to conscious awareness, the speech pathologist may not fully understand what it is that the patient wishes to achieve in therapy (see Table 6–3).

4. Self-concept and Voice

Feelings about the self are communicated by paralinguistic aspects of communication. Stance, gesture, eye contact, and vocal behaviors signal the level of comfort, anxiety, confidence, knowledge, and mastery of ideas. When strong emotions accompany a vocal message, it is almost impossible to prevent the emotion from being displayed. The breathing characteristics change, the rate and flow of the words alter, and the voice itself may be tremulous or otherwise reflect the attendant deep feelings. On the other hand, minor changes in feeling states, such as nervousness when beginning a presentation, may be successfully hidden in most instances. It is the degree of the emotionality that determines whether it will be perceived by listeners and observers. Transitory situational emotionality, such as that engendered by mild stage fright, sometimes enhances a performance because of increased adrenaline. Severe, paralyzing, stage fright (see Appendix F) or chronic problems of self-esteem, obviously, are inhibitors of natural voice use both during performances and in interpersonal interactions. Children and adults with low self-esteem and preoccupying anxieties concerning life stressors may exhibit a range of vocal markers of their emotional disequilibrium.

Table 6–3. Sample goals negotiated by speech pathologists and patients.

I wish to use general American (like the newscasters on the national news).
I do not wish to lose the speech/voice characteristics that signal my ethnic origin.
I want to use a more formal voice and speech without straining.
I want to reduce feminine gender intonation patterns when I am chairing meetings.

a. The **laryngeal sphincter** may respond to severe emotional states by assuming either **"flight" or "fight" postures**. Fear and anxiety, for example, may result in an internalized desire to escape from a situation, relationship, or conflict. The laryngeal sphincter opens widely to allow maximal respiratory flow which is a prerequisite for running away. Thus, voicing is weak, breathy, discontinuous, and secondary to the primary need for increased air. This pattern may be temporary or may be perpetuated over time. If feelings of powerlessness or worthlessness overwhelm an individual and retreat becomes the response of choice or the way to avoid conflict, aphonia may occur. Conversely, an individual who decides to stand his ground or "fight" may lock the laryngeal sphincter for combat, consciously or unconsciously. Thus, voicing is accomplished with overadduction, constriction of the acoustic tube, effort, and strain.

b. General bodily tension, or specific tension in the intrinsic and extrinsic laryngeal musculature, may result from life stressors or relational and attitudinal conflicts. Globus (the sensation of a ball or lump in the throat) is experienced by some individuals (see Appendix F). Sometimes a patient with globus hystericus may be referred for voice treatment. The emotional strategy of "soldiering on" or bearing the burdens, without ventilation of feelings, causes crushing pain or guilt to be manifest in hyperfunctional muscle tone. People whose ethical or belief structure strongly influences them to avoid complaining and makes them repeatedly "turn the other cheek" with sublimation of their own needs and rights are at risk. Typical family stressors, as well as nontypical events, together with an unassertive personality and low self-esteem may be noted. Lack of regular physical exercise and heavy work schedules that preclude relaxation and energy release through recreational activities may also be implicated. Table 6–4 summarizes stressors.

c. Compensations

Some individuals use a loud vocal style to shore up their feelings of inadequacy. A loud, bullying voice may mask a fragile self-esteem. Others retreat and become reticent.

Table 6–4. Stressful events and when they occur.

	Inside the Family	**Outside the Family**
Typical Stressful Events	Birth of a child	Work/family balance
	A handicapped child	Poor economy
	Death of a spouse	Weather changes
	Retirement of self or spouse	Neighborhood crime
	Divorce/remarriage	Conflicts at work
	Blended family	Trouble with friends
	Moving/changing jobs	Accidents
	Problems with family	Community disputes
	Financial difficulties	Loss of job
	Aging parents needing care	Legal problems
Other Stressful Events	Serious or chronic illness	Unemployment
	disabiity	Natural disasters
	Alcoholism/drug abuse	Racism and prejudice
	Accidental death in family	Loss of investments or income
	Loss of home	
	Rape or domestic violence	Lack of health insurance
	Runaway child	Sexual harassment

Loudness level is affected by many factors (e.g., hearing sensitivity, environment, culture, and awareness of listener's reactions), and many extremely assured individuals speak quite softly and yet exude authority. However, the way in which a speaker varies loudness in response to noise levels, situational and relational constraints, and intent is frequently indicative of emotional equilibrium and communicative competence.

d. Pitch variability, or lack of variability, may also signal psychosocial distress. Severely depressed patients show little affect and limited variability in all vocal parameters. Their voices are monotone, and the rate (also frequently influenced by medication) is slow. Adolescents with conflicted or ambivalent feelings about growing up and/or identification with parents of the same sex may exhibit mutational falsetto which is characterized by immature pitch level and pitch variation. Extreme tension and constriction of the laryngeal structures may also result in elevation of the larynx and abnormally high-pitched voice. Inappropriate pitch levels may be adopted by individuals seeking to project an image of themselves, through the voice, that is not consistent with their laryngeal physiology. Thus, a male who is anxious about his masculinity may try to adopt an inappropriately low pitch which is stressful to the mechanism.

B. Management of the Psychosocial Dimensions of Voice Problems

All voice disorders have a psychosocial dimension. Satisfying human interactions are fundamental to emotional well-being. When a person's voice does not sound "normal," that person feels less like him- or herself, less in control, and less competent. Self-esteem is affected, and social relationships are altered. The more severe the symptoms are, the longer the disorder persists, and the amount of ego investment the person has in being a "good voice user," the greater the damage that is sustained psychologically and socially. Sometimes, a psychosocial disruption is a trigger that causes a voice disorder. Voice is withheld or altered because of an unconscious or conscious attempt to solve a problem, and secondary gains, of one kind or another, accrue. However, whether psychosocial factors contribute to, maintain, or result from the voice disorder, they must be addressed during treatment. They can be addressed directly or indirectly as part of the voice treatment program or by mental health professionals working in tandem with the speech pathologist, through consultation, or referral, or through individual, group, or family counselling.

1. Counselling and the Speech Pathologist's Role

Many speech pathologists are reluctant to incorporate explicit counselling goals into their treatment programs. Yet, speech pathologists are well trained, and most do, in fact, work on the enhancement of self-esteem, social interactions, and increased self-determination for their patients. The speech pathologist's ability to help patients integrate new insights about their feelings and relationships into their communicative strategies is significant. Mental health counsellors can help patients understand the psychosocial dynamics of voice problems, but only speech pathologists can help patients produce and habituate more appropriate vocal behaviors.

a. When patients exhibit **severe emotional problems**, the treatment plan should involve a team approach with a mental health professional counselling the patient.

b. In **less severe cases**, the counselling goals can be addressed by the speech pathologist as part of the voice treatment program with consultation with mental health professionals as needed and referral if the situation changes. The major thrust of the psychosocial aspects of treatment is to identify and understand factors that impinge on vocal behavior. In other words, the goal is not to find out why the patient hates her mother. Rather, it is to understand how her feelings about her mother may be affecting the way she uses her voice. This may be addressed indirectly through role-playing situations the patient finds difficult and then analyzing the interactions. For example, the voice use is analyzed, and as a result, the underlying conflicts are identified and discussed. Alternatively, the possibility that interpersonal conflicts may underlie the voice problem may be addressed directly and discussed prior to any attempt to deal with the vocal behaviors themselves.

2. **Counselling and Voice Patients**

Patients who are not comfortable seeking counselling may frequently feel more comfortable consulting a speech pathologist because it is less threatening to them. These patients may start out wanting "voice exercises," but as their trust and confidence grows, they will divulge their anxieties and feelings quite openly. It is important that the speech pathologist allow these patients opportunities to volunteer critical information of this kind.

3. The **balance of time devoted to voice practice and symptom reduction versus counselling and insight development** changes across time and a speech pathologist should not feel guilty about deviating from a session plan if the patient signals that she or he has concerns to share.

4. It is always sensible to have at least one general **psychosocial goal** in every treatment program. Some examples of these goals are as follows:

a. The patient will **describe** her **feelings** about her voice problem and its effect on her significant relationships.

b. The patient will discuss ways in which her voice helps or hinders the satisfaction of her basic needs.

c. The patient will write a **brief statement** concerning how she wishes her interactions were different and update it periodically during treatment.

d. The patient will **keep a log** describing daily events and interactions and note significant voice changes and triggers.

e. The patient will **read and discuss printed materials** relevant to her voice problem.

5. The **use of written materials** is a helpful technique. When the speech pathologist asks a patient to write down her feelings about a certain event and bring it to the next session, it focuses the patient's attention, heightens awareness, and provides a helpful basis for discussion. The following excerpt was written by Ruth; a young music teacher who had vocal nodules. She was asked to describe how she felt when she first discovered her problem.

Panic led me to see a specialist. He said, "You have permanently damaged your vocal cords. You can't sing." It was as if the doctor's office was a hollow echoing cave. No matter how strong I thought I was, or how much I wanted to believe he was wrong, I couldn't. He was a doctor, a specialist. I'd come to him for help. I was to sing at my best friend's wedding one week from that day. My voice was gone.

The shock didn't wear off until we left the building. Once in the car, I began to tell my mother about the interview and examination. I repeated his words, and my entire world crumbled around me. I had spent most of my life learning and loving to sing.

Years of education and money seemed totally wasted. My mother kept questioning me. "Remember his exact words," she said. "Did you ask about surgery or therapy?" "What about medicine?" The more Mom talked the more hysterical I became. It was like I was having a nervous breakdown. The next two hours seem vague in my mind. I became angry and resentful with almost anything Mom would say. No one (so I thought) could possibly understand how I felt. I didn't want her to make me talk about *IT*.

On the second day I began to remember other words the doctor spoke. "Don't sing, don't talk; don't clear your throat, therapy . . ."

How could I do this? I'm a teacher. I need my job. I have bills to pay. How can I return to a job that has ruined my life? Resentment! I can't be a good teacher if I can't sing. I have to be good at my job. I have to see results. Get another opinion!

I went to another doctor who said I could sing if I was careful! He said I could teach if I had voice therapy to help. I made a list of things to do to save my voice at school — resign from coaching basketball, use student leaders in class, use instruments and rhythm patterns, order films, record instructions on tape recorder, develop hand signals... Frustrations come and go. Trying to get friends to understand is difficult and makes me weary. Feelings are hurt on both sides. Sometimes, I wonder if their friendship is worth having if they can't adapt. But, then I realize life moves at a very swift pace. I must keep control and keep trying. At least the second doctor gave me hope that I can get through this...

Written stories of this type are invaluable when a patient is comfortable with the technique. Ruth was verbal and analytical, and her written statements throughout therapy provided many helpful insights for her and for the speech pathologist. Throughout the stories of patients learning to adjust to fairly minor problems such as Ruth's (although it is clear *no* problem is minor to the person who has to deal with it!), as well as those faced with devastating illness and loss, are discernible themes.

6. Crisis Evolution

a. A typical crisis has four stages:

(1) The **situation is defined.**

(2) An **action or event produces change** that results in uncertainty, shock, stress, tension, and anxiety.

(3) The crisis culminates in a peak of tension.

(4) A solution is reached.

b. Factors impinging on **how the crisis affects a person** are:

(1) **perception** of the meaning it has

(2) actual **degree of stress**

(3) the person's **defense mechanisms and problem-solving skills**

(4) **support systems**

c. **Typical coping behaviors** include:

(1) seeking more information

(2) denying the problem

(3) talking with others

(4) laughing it off

(5) trying to forget it

(6) substance abuse

(7) withdrawal

(8) bargaining

(9) atonement

(10) stoicism

(11) seeking many other opinions/treatments

(12) acceptance

7. **Counselling patients who must deal with irreversible loss** of health and function as well as diminished communicative competence is particularly important and challenging.

a. Most patients with degenerative neurological diseases and cancer must work through the following **issues**:

(1) **threat** of death

(2) **uncertainty** about the future

(3) **pain management**

(4) **mourning** for loss of function

(5) **loss** of meaningful work, activity/income

(6) **dependency**/loss of control

(7) **costly** medical care

(8) **alienation** from others

(9) **depersonalization** (due to regulations and institutions)

b. **Impact** of serious loss of communication **on the family**:

(1) disrupts family system

(2) changes family roles

(3) instigates family guilt

(4) elicits overprotectiveness

(5) depletes family members' energy

c. **Intervention** involves the following:

(1) **Problem clarification** — exploring the meaning of the psychosocial changes with the person and family.

(2) **Feelings clarification** — allowing feelings to be brought to an awareness level and accepted in a nonjudgmental way.

(3) **Concept correction** — problems and their implications are discussed realistically and put into perspective.

(4) **Skill inventory** — problem-solving and coping strategies are explored.

(5) **Mobilization of support and services** — resources are found, services are coordinated, and communication aids are employed.

8. Counselling Family Members

Family members usually experience many of the emotions experienced by patients who undergo serious illness, surgery, and loss. Their reactions to the crisis and the treatment frequently have a direct bearing on the patient's ability to cope and maintain a sense of dignity. Because of this symbiotic relationship, it is essential to give time and attention to family members and their emotions. They feel guilty when they lose patience or express anger. Their roles change. They are at risk for overprotectiveness as well as burnout. The integrity of the family system is affected.

9. Working as Part of a Team

The speech-language pathologist in a rehabilitative setting works closely with other professionals who also are involved in counselling the patient and the family. For example, close collaboration with physical and occupational therapists enhances the effectiveness of the intervention program.

a. **Physical therapists (PTs)** use physical modalities such as heat, cold, ultrasound, electrical stimulation, hydrotherapy, exercise, and gait training. They seek to improve a patient's functional mobility, wound healing, relaxation, and edema control. Postural aids, breathing exercises, and pain management techniques may also be implemented. The voice clinician can provide information relevant to the patient's communication status and gain beneficial insights and assistance from the PT

b. **Occupational therapists (OTs)** use goal-oriented activities necessary to help patients perform self-care tasks. They also address homemaking skills, function of arm and hand, cognitive skills, visual perception skills, the use of adaptive equipment, and the modification of environments. Both the OT and the voice clinician are concerned about finding the best method of functional communication for the patient and the family.

Speech-language pathologists, physical therapists, and occupational therapists usually work together to help patients in rehabilitative programs. The team's goals are complimentary and all share an awareness of the psychosocial dimensions of the process of rehabilitation.

II. GENDER PRESENTATION

"Male" and "female" are biological categories with membership assigned on the basis of criteria such as chromosomal pattern and genitalia. "Masculinity" and "femininity" are gender terms descriptive of qualities and characteristics that are based on conventions prevalent in a particular society or culture. It is generally believed that biological males may demonstrate "feminine" qualities, and biological females may exhibit "masculine" traits. Sexual preference or orientation is another construct and is not necessarily aligned with an individual's biological makeup or gender expression (Money, 1988). Some writers believe there are three different continua, and individuals may be at different points on all three.

Biological Continuum

Male ⟵⟶ Female

Gender Continuum

Masculinity ⟵⟶ Femininity

Sexual Preference Continuum

Heterosexual ⟵⟶ Homosexual

In most western societies, being a man and demonstrating masculine attributes and qualities is more highly valued than being a woman and displaying femininity. In some non-western societies, however, it is considered quite commonplace for males to present as women and vice versa. There are, of course, many historical examples of cross-dressing, gender shift, and long-term masquerades of the other sex. Shakespeare (Garber, 1992) used the strategy of cross-dressing in many of his plays. "Twelfth Night," for example, includes double cross-dressing to underscore the theme that things are not always as they seem. The theatrical tradition of cross-dressing is also seen in Noh and Kabuki theater and in English burlesque. This theatrical device is seen by Garber (1992) as deeply rooted in our Anglo-American culture, and she suggests that "gender blending" is also demonstrated in modern popular culture. A performer, such as Michael Jackson, illustrates gender diversity within an ethnic minority. Bullough and Bullough (1993) note that in earlier periods of history, before western women enjoyed the freedom of movement they have today, women dressed as men in order to travel safely. Although males often burlesqued women and gave comic impressions of them, they rarely attempted day-to-day or nontheatrical cross-dressing until the twentieth century. (See Bullough and Bullough [pp. 104–105] for examples of some well-known individuals during the 17th and 18th centuries who did cross-dress day to day.)

A. Terminology

It is important for helping professionals (such as speech pathologists, physicians, social workers, educators, and counselors) to be familiar with terminology used to describe variations in gender expression. There is no current, universally accepted terminology, but the following definitions seem to be widely used. It should be noted that the American Psychiatric Association's (1994) *Diagnostic Statistical Manual* (DSM-IV) lists variations in gender presentation as gender identity disorders.

1. The term "**transvestite**" is felt by many to be dated and seems to be replaced by many within the TV/TS community (these initials are still commonly used, however) by the term "**cross-dresser**." This term refers to both males dressing as females and females dressing as males.

2. "**Gender expression**" refers to males expressing their femininity and females expressing their masculinity. **Gender presentation** refers to a strategy such as cross-dressing or use of gender props (Stevens, 1990). Stevens also notes that "dysphoria" means unhappy or uncomfortable. Thus, **gender dysphoria** connotes discomfort with one's socially and culturally assigned gender role, whereas "**sexual dysphoria**" means discomfort with one's biological make-up or sex. Stevens (1990) goes on to explain that

   > An understanding of these terms is especially important when it comes to deciding whether or not someone is a proper candidate for sexual reassignment surgery. Being unhappy with one's gender role is one thing. Being unhappy with one's sex is something completely different, and usually decides a person's identity, whether or not a person is just going to be a recreational cross-dresser, live as a transgenderist, or change sex. (pp. 4–5)

3. Chevalier Charles D'Eon was a celebrated 18th century French transvestite who convinced people that he was a

woman. Only after his death in 1810 was it discovered that he biologically was a man. Thus, "**eonism**" was a term used by Havelock Ellis to describe men who wore women's clothing. Dr. Mangus Hirschfield coined the term "**transvestite**" in 1910. It implies a relationship between erotic desire and dressing, whereas "**cross-dresser**" describes gender presentation. The modern preference for "cross-dresser" results from its inclusiveness (i.e., it is used to refer to anyone who cross-dresses for whatever reason and is considered nonjudgmental). It is estimated that 3 to 5% of heterosexual men in our society engage in cross-dressing activities of some kind. Adolescents who cross-dress may be at risk for suicide, since they do not reveal their habit for fear of retribution and lacking support and understanding, imagine that they are bizarre or "crazy."

Stevens (1990) notes that the term "**drag**" may have been coined by Shakespeare when female roles in plays were routinely played by men. Drag is an acronym for "dressed as a girl." It is predominantly a theatrical term and suggests a showy, camp, exotic, or high glamour image. It is like a costume and does not signal a person's sexual preference or inclination for full-time cross-dressing. "**Drag-Queen**" is a term which is usually identified with the gay community. A "**she-male**" is usually a gay male who lives full time as a woman or, in other words, a gay transgenderist. "**Female impersonators or impressionists**" are professional entertainers who perform "in drag." Presently they prefer to dissociate themselves from the "drag-queen" image and emphasize the term "impressionist" instead. Stevens (1990) summarizes by saying that there was a time when "drag" and "cross-dressing" meant virtually the same thing. However, nowadays cross-dressers do not consider themselves to be in costume. Most writers suggest that the habit of cross-dressing has to do only with gender presentation. Therefore, cross-dressing does not communicate other information such as sexual preference.

4. The term "**transgenderist**" has come to mean a person of one sex living full-time in an another gender role (cross-living).

5. The term "**transsexual**"[1] denotes someone who feels that their

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The American Educational Gender Information Service (AEGIS) in their quarterly publication *Chrysalis* (Volume 1, No. 4, 1992, p. 43), issued a policy statement on terminology. The statement reminds readers that those with transsexualism are not "transsexuals." Rather they should be referred to as persons who have transsexualism. Thus, transsexualism is merely one characteristic of an individual and not a total definition of a person.

gender identity is fundamentally and irrevocably incompatible with their sexual or biological make-up. They may or may not be on a path that leads to hormone therapy (Kirk, 1991). living full-time in the preferred gender role, or surgery (Walters & Ross, 1986). These individuals usually have experienced feelings of discomfort about their gender identity since early childhood (Steiner & Blanchard, 1990).

6. **The term "Androgyne"** derives from the Greek *andro,* meaning man, and *gyne,* meaning woman. It is a sociological term meaning harmonious balance between the expression of both masculine and feminine qualities within the same individual. Cross-dressing may be used as the tool to express this gender blending. **Hermaphrodite**, on the other hand, is a biological term indicating that physical characteristics of both sexes are present in one individual.

B. The Continuum of Behaviors Along the Path Toward Total Transsexualism

Speech pathologists will be consulted, primarily, by males who wish to learn feminine speech and voice patterns. Females, moving along the path to male gender identity, rarely consult speech pathologists. This is because hormone therapy achieves the desired result of increasing the bulk of the vocal folds, thus virilization is achieved chemically. Therefore, in this section, the process of the male to female transition will be described so that the speech pathologist is familiar with the various stages. It is important to remember that "passing in public," or "gender attribution," is usually the reason individuals consult a speech pathologist. It is important also to ascertain the point in the continuum or "path" from male to female the individual has reached to date. Some clients merely wish to cross-dress occasionally, others wish to live full-time in the preferred gender role, and some will wish to embark on hormone therapy and surgery. Physicians require that individuals who desire surgery undergo extensive testing and preparation, including living for at least a year, and preferably 2 years, in the desired gender role.

Individuals in the "T" community (the initial "T" standing for "transvestite" is acceptable and widely used even though "cross-dresser" has superseded the term) or para-culture share many common experiences. Most "purge," at some time, throwing away clothing in an attempt to reform their behavior. Many also feel various degrees of guilt about their behavior, though contact with other Ts is helpful in increasing understanding and acceptance. Many Ts are supported by spouses and SOs (significant others), but some Ts prefer to keep their crossdressing secret from family members.

1. **Dressing under clothes.** Beginning in childhood, many Ts dress in their mother's or sister's clothing. This may involve wearing feminine articles of clothing "in the closet" or under their masculine outer garments.

2. **Dressing out of the closet.** Wearing feminine clothing around the house only.

3. **Dressing in full feminine garb and going out in public.** This may be accomplished by dressing as a woman for a Halloween party or costume event.

4. **Attending events dressed in feminine apparel.** Group activities, such as conventions, where one can "try out" dressing with group support and without the need to pass.

5. **Attempting to pass as a woman.** The individual, either alone or with an SO, actually goes out in public for a short trial period (e.g., going to dinner or shopping).

6. **Employing techniques that can be reversed.** Shaving body hair, removing hair from arms and legs, and perming and/or growing hair on the head.

7. **Beginning electrolysis.** This is a long and expensive process and is reversible if not continued for long. It is mainly used to remove facial hair.

8. **Taking hormones.** Hormones may be obtained from a physician which is advisable, since medical monitoring is necessary. However, some Ts obtain hormones by other means. Hormones can stimulate some growth of the breasts and decrease hair growth on the body.

9. **Obtaining breast implants.** When larger breasts than can be achieved through hormone therapy are desired, implants

may be obtained. There are, however, health risks associated with this procedure.

10. **Having sex reassignment surgery**. This procedure is not reversible. Very few Ts proceed to this step. It involves economic, legal (see Stuart, 1992), and social adjustments that require serious commitment (Denny & Schaffer, 1992). For example, married Ts must divorce before having this surgery, and the surgery is expensive. Strict screening procedures must be undergone.

11. **Vocal fold surgery**. There is a surgical procedure which a few Ts may ask about to improve their voices. The folds are surgically reduced in length. However, the procedure does not produce an optimal result. There is, however, a small reduction in the protrusion of the thyroid eminence or "Adam's apple." "Shaving" of the "Adam's Apple" is also possible, through plastic surgery, if it is particularly obvious. Laryngeal surgery to increase pitch is not recommended by speech pathologists experienced in this area.

C. Voice Treatment

When the speech pathologist is consulted by individuals concerned about communication changes related to cross-gender behaviors, the approach adopted is usually an holistic one. The different cognitive and linguistic processes characteristic of both genders are considered. This is an essential part of treatment and contributes to the development of a more natural voice and speech pattern. An affected or phoney sounding style can be avoided most easily when the differences in the ways men and women think about and use communication strategies in our culture are specified. There are many excellent books on this topic (Brownmiller, 1980; Tannen, 1992; Lakoff, 1975); and discussions, reading, and role-playing may be used to bring an awareness of gender differences into conscious awareness. It is usually fruitful to address the issue of stereotyping in relation to communication styles.

Some speech pathologists may feel uncomfortable teaching traditional or stereotypical speech and language patterns, because nowadays, there is movement toward avoidance of locking either men or women into specific roles or stereotyped behavior patterns. However, when the main goal of an individual is to "pass" in a new gender role, it is certainly sensible to maximize traditional gender markers and behavior patterns.

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Before beginning treatment, it is wise for the clinician to elicit information concerning the client's situation and goals. The following examples of interview questions are appropriate to ask.

How long have you been in transition?

Have you had electrolysis? How long?

Are you working full time in the role?

Are you taking hormones?

What kind of social experiences are you having? (e.g., 60% in the feminine role and 40% in the masculine role)

How supportive are family, friends, and associates?

Have you had, or are you planning to have, sexual reassignment surgery?

What have you tried to change about your voice/speech already?

What would you like to focus on now?

Describe your priorities for communication training.

Consider the case of Max who was preparing for the final phase of his journey which would culminate in surgery to become a woman. Prior to undergoing surgery, it was necessary to undergo extensive counselling, obtain a divorce from his wife, and ensure continued employment. He wrote

> Separating from my wife is by far the hardest and most painful aspect of my journey. While our marriage has not been a good one, my identity crisis not withstanding, I never wanted to hurt her. It saddens me to know that Marian is going to suffer financially from the divorce also. Women almost always lose financially in divorce. I'll pay her as much alimony as I possibly can, but she is not employed and can't seem to find a job. Also, let's be realistic — transsexuals are often fired from their workplace. While I'm hopeful of transitioning on the job, if I lose out, so does Marian. The transition from man to woman is a frightening journey. Despite my fear, I'm hopeful for my future. Ever since I was a small child, I have felt trapped in the wrong body. I must, now I am nearly 30, become at last the woman I feel myself to be whether society approves or not. I will live as Maxine for two years before having the surgery. It will help prove that I can cope and is recommended as a final test of suitability for surgery. I must refine my gestures and my voice and speech and learn to do a zillion daily tasks differently.

Some of the program goals devised for Max/Maxine are illustrated below. The program is typical of treatment approaches designed for men wishing to acquire feminine speech and language characteristics.

D. Pitch Characteristics

Although many transsexuals and crossdressers will suggest that changing their pitch level is their most important goal, the pitch level is actually less important as a feminine speech marker than is pitch variability or the musicality of the voice pattern.

1. **Feminine intonation patterns and increased vocal variety** are important goals.

2. **Use of falsetto voice should be discouraged.** Many genetic women have low-pitched, although feminine-sounding voices. Morrison and Rammage (1994) note that the length and shape of the vocal tract influences formant frequencies. Therefore, some men, trying to sound like women, may consciously try to shorten vocal tract length by raising the larynx. They may also adopt a "fronted" or more precise articulatory pattern.

3. Older cross-dressers and transsexuals may be helped by the **trend toward F_0 increase in men and decrease in women during senescence.**

4. It is important for clinicians to point out to their clients that there is **considerable overlap in the pitch range of men and women.** Morrison and Rammage (1994) say, for example, that a mean F_0 around 160 Hz lies in the "gender ambiguous range." Oates and Dacakis (1983) also emphasize that the pitch ranges exhibited by males and females overlap. Their data on studies of fundamental frequency are summarized in Table 6–5.

5. **Goals for Maxine**

   a. **Increase pitch variability** (e.g., use more of the upper portion of the range during inflections).

Table 6–5. Frequency range overlap (Oates & Decakis, 1983) for males and females.

Gender	Age Range (in years)	Frequency Range (in Hz)	Mean (in Hz)
Male	20–29	60–260 Hz	130 Hz
Female	20–29	128–520 Hz	227 Hz
Gender amgibuous range		128–260 Hz	

b. **Incorporate stereotypical feminine intonation patterns** (e.g., tentative rising inflection at the end of some utterances).

c. **Increase musicality of voice** (e.g., practice singing sentences in "head voice" not "chest voice." Practice humming. Speak tunefully. Avoid falsetto).

d. **Avoid** coughing, laughing, throat clearing, and fillers in **masculine style**.

E. Loudness, Durational Characteristics, and Phrasing

1. Most men attempting to use feminine speech markers must learn to **speak more softly**, and this is frequently accomplished by using softer, breathier onsets; a less forceful style; and a linking of words in phrase units to suggest a legato rather than staccato pattern.

2. It is also helpful to suggest **increased duration of some vowels** (e.g., "s*o* g*o*rgeous").

3. **Phrases** that elaborate on the facts and are spoken at a different rate or loudness from the main part of the sentence, may also be practiced. For example, "Mary, my dearest friend, lives in Chicago."

4. **Goals for Maxine**

   a. Use an easy, breathy initiation of words.

   b. Link words together smoothly with light articulation.

   c. Linger on occasional vowel sounds for emphasis.

d. Reduce loudness level.

e. Practice loudness variation, especially getting softer when the meaning suggests it (e.g., "It was just a baby.").

f. Use increased resonance to project the voice (e.g., humming to improve resonance will demonstrate how the tone can swell. This is preferable to increasing laryngeal force.).

F. Language Structures and Vocabulary

1. **Tag questions** (e.g., "It's lovely isn't it?"), **qualifiers**, and **dis claimers** as well as increased use of adverbs and adjectives are used more frequently by women than by men in our culture.

2. It may also be necessary to practice **increased use of apologies and socially "polite"** phrases.

3. **Vocabulary differences** should also be addressed. There seem to be some terms (e.g., underwear, lingerie) that differ significantly, depending on whether men or women are speaking.

4. Use of many **linguistic structures** is related to differences in the way men and women use language to meet their needs and to interact socially with peers. For this reason, the underlying cognitive strategies should be addressed. For example, the indirect way some women use questions to signal their needs (i.e., "Are you thirsty?" rather than "I'd like a drink.").

5. Feminine communication often involves the use of **increased elaboration** and **indirect communicative strategies**.

6. Another area that may be addressed is the **underlying goals of communication**. Tannen (1992), says men try to establish a place in the hierarchy and get information whereas women try to build consensus and share thoughts and feelings.

7. **Goals for Maxine**

   a. Develop lists to compare masculine/feminine vocabulary use.

b. Practice alternative communicative strategies (e.g., direct versus indirect).

c. Role-play communicative exchanges aimed at dealing with relationships, sharing feelings, drawing out the other person. (Avoid literal, factual, direct patterns.)

d. Increase use of qualifiers, disclaimers, and tag questions.

e. Match nonverbal behaviors to person-centered oral communication style (e.g., eye contact, increased smiling and nodding, gestures and touching, inclining toward others).

G. Articulation

Women seem to open their mouths more than men and to articulate more clearly. However, they do not make hard articulatory contacts or punch out their words.

1. **Practice with a mirror and tape recorder** may be advantageous.

2. Also, **close observation and analysis** of speakers on television and in real-life situations may be recommended.

3. **Goals for Maxine**

   a. Practice soft, precise, articulatory contacts.

   b. Tape record practice sessions for evaluation.

H. Materials

Voice clinicians who are consulted by clients wishing to change their gender presentation need access to reading materials relevant to transgender issues.

1. One useful **guidebook with practice materials** that are especially helpful, is *Speaking As A Woman* by Alison Laing (1992). This book is distributed by Creative Design Services, Box 1263, King of Prussia, PA 19406.

2. The **Outreach Institute of Gender Studies** is a source for information and relevant literature for helping professionals. Write to: Outreach Book Service, Ltd., 126 Western Avenue, Suite 246, Augusta, Maine 04330 (see Figure 6–1).

3. The **American Educational Gender Information Service** (AEGIS) provides information and services for persons with transsexualism and interested care providers. Write to: AEGIS, PO Box 33724, Decatur, Georgia 30033-0724.

4. **Videotapes and class presentations** are useful ways to disseminate information. Figure 6–2 shows a picture of a leader in the national community of cross-dressers lecturing to speech and hearing majors at Indiana University.

Figure 6–1. Photograph of Ariadne Kane, Director of the Outreach Institute of Gender Studies.

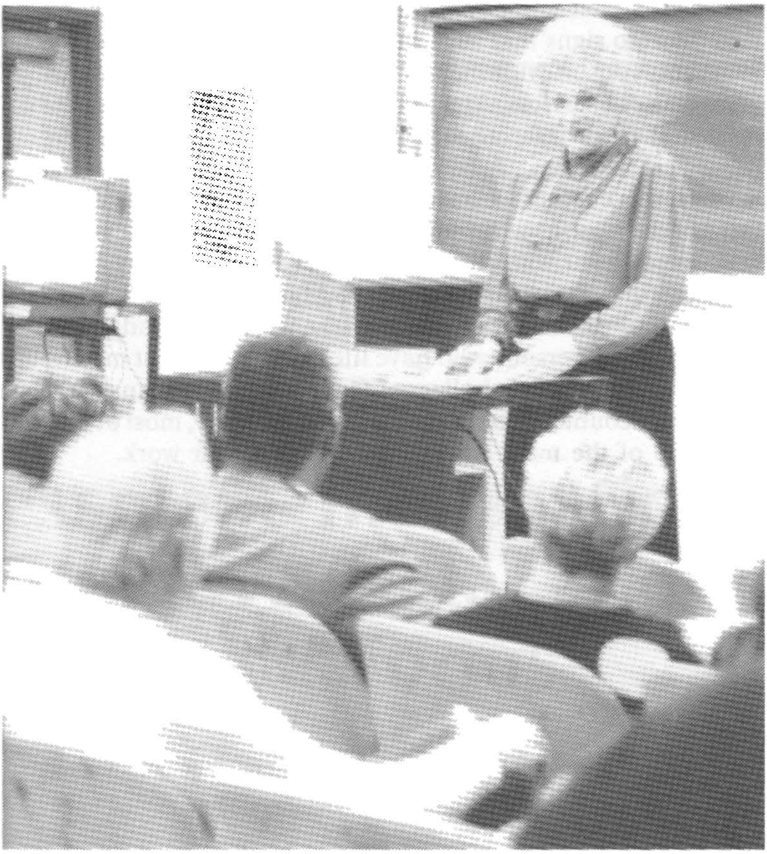

Figure 6-2. Speech and Hearing Science majors at Indiana University listen to a lecture on gender presentation.

IV. SUMMARY

In this chapter we have reviewed information relevant to the psychosocial dimensions of voice problems. We have focused on *the person with the voice problem*. We have discussed how a voice disorder affects roles, family interactions, life stage adjustments, and sense of self-worth. Because voice connects us with significant others and reflects our needs, joys, and pain, it must be understood and treated within a psychosocial context. Our ability to cope with different challenges at different stages of our life span is certainly affected by how well our voices serve us. Voice is often a barometer of stress and anxiety and can signal emotional disequilibrium. The voice clinician must be alert to signs that suggest the need for a team approach to treatment and consult with mental health professionals who can provide specialized services. Appendix F includes some summaries of behaviors that merit referrals of this kind.

In this chapter we have also discussed gender presentation and some of the reasons why individuals may seek our professional help as they experiment with different voice styles. As society becomes more accepting of diversity of all kinds, it is imperative that speech-language pathologists be well informed, as well as nonjudgmental, when consulted by persons who have life experiences that may not parallel our own. One of the challenges facing voice clinicians is the great variety we encounter in our case loads. This variety, most of us would agree, is one of the most rewarding aspects of our work.

APPENDIX

A

Assessment Information, Normative Data, and Sample Forms

CONTENTS

A-1. Clinician Information: Factors Affecting Vocal Fold Secretion Level

Dryness, or the presence of excessively thick secretions, can influence the way the membranous margins of the vocal folds are affected by use. For example, excessively dry folds are irritated by repeated impact more easily than folds with normal lubrication. Excessively thick and sticky secretions, resulting from allergic and infectious conditions of the respiratory tract, may impede smooth vibratory patterns. Stranding of thick mucus across the folds or blobs of thick mucus may increase the weight of a fold. Thick secretions also predispose a patient to habituate coughing and throat clearing which may exacerbate irritation. Adequate hydration is essential to maintain appropriately moist tissues and thin mucus that may occur. Appropriate fluid intake, which hydrates the entire system, as well as adequate humidification to promote local tracheal and laryngeal tissue lubrication, is necessary.

Minimize influence of drying agents:

smoke
cold/allergy medications/nasal sprays (e.g., antihistamines)
diuretics
alcohol
dry or dusty environments
psychotropic medications
chemical agents/pollutants

Recent newspaper articles have reported a rising incidence of the inhalation of mood-altering substances among teenagers. These include sniffing glue, propane gas, paint solvents, cleaning fluids, and other potentially lethal fumes. Such substances are frequently injurious to the laryngeal mucosa even with occasional use.

A-2. Clinician Information: Systemic Conditions Affecting Voice

Systemic conditions are those that affect the whole body rather than just an area of the body. Many diseases, for example, infectious diseases, fall into this category and may affect the voice in one way or another. Severe respiratory disorders have multiple effects on the body and may impact on voice production. Similarly, diseases that suppress the immune system may increase the likelihood of frequent upper respiratory tract problems that may become chronic. The diagnostician must be aware of the general health of the patient and knowledgeable about the ways coexisting conditions can impact on vocal behavior. Listed below are some systemic disorders that should be considered.

Disorder	Description
Arthritis	An inflammatory disease that may cause hoarseness and pain secondary to inflammation of the cricoarytenoid joint. The arytenoid joints may become fixed in severe cases of laryngeal involvement.
Asthma	Respiratory disease characterized by increased responsiveness and hyperactivity of the airway. The effects of coughing and wheezing and medication may affect voice quality.
COPD	Chronic Obstructive Pulmonary Disease refers to a category of disorders (e.g., emphysema) causing airflow obstruction.
Endocrine disorders	Dysphonia may result from hypothyroidism, hyperthyroidism, sexual hormone imbalance, and pituitary (growth) abnormalities.
Immunologic disorders	Dysphonia may be due to a depressed immune system (e.g., HIV).
Croup	Laryngotracheobronchitis occurs as a result of lower respiratory tract infection such as diphtheria. Inflammation and edema may lead to respiratory obstruction. Symptoms include stridor, hoarseness, and pain. This infectious disease is most commonly seen in children under 3 years.

Disorder	Description
Pertussis	Whooping cough is an infection caused by the bacterium *Hemophilus Pertussis*. A characteristic cough, hoarseness, excessive secretions, inspiratory stridor, and glottal spasms are symptomatic.
Pneumonia	Pneumonia is caused by a variety of infectious agents and results in inflammation of the lungs. Hoarseness, breathiness, cough, and secretions will be noted. Aspiration pneumonia is seen in patients, often pediatric or geriatric, with chronic swallowing or aerodigestive defects.
Tuberculosis	This infectious disease is caused by the bacillus mycobacterium. Laryngitis is secondary to active pulmonary infection. Laryngeal edema, pain, cough, and hoarseness will be seen.
Syphilis	Laryngitis occurs after the initial stage of this disease. A soft granuloma (gummata) may occur in advanced disease. Hoarseness and respiratory problems occur.
Sarcoidosis	This infectious condition may result from exposure. Supraglottal structures (e.g., epiglottis), and occasionally the larynx, are affected by edema and submucosal granuloma. Hoarseness and dyspnea may occur.
Scleroma	A condition characterized by indurated, circumscribed areas of granulation tissue in mucous membrane or skin. The larynx may be affected and hoarseness and dyspnea may be noted.
Laryngeal perichondritis	An inflammatory process caused by a number of different infectious agents. There is inflamed fibrous connective tissue of the laryngeal cartilages which results in hoarseness, cough, dyspnea, and dysphagia (in severe cases).
Leprosy	Leprosy is a rare, infectious disease caused by contagious airborne microbes. When the larynx is involved, peripheral nerve paralysis will result in hoarseness. The disease is due to mycobacterium leprae or Hansen's bacillus. Skin lesions and ulcers are seen.

(continued)

A-2. Systemic Conditions Affecting Voice *(continued)*

Disorder	Description
Glanders	This infectious disease is caused by infection due to *Pseudomonas Mallei* contracted by exposure to horses, donkeys, and mules. Inflammation of the skin and mucous membranes occurs. Small subcutaneous nodules develop into ulcers and spread. Hoarseness, cough, and throat pain may result.
Anorexia	This condition results in malnutrition. Malnutrition (which can occur in association with other conditions) affects health status drastically and often results in chronic respiratory tract problems because of reduced capacity to fight infection. Hoarseness may be a symptom of this systemic state.
Iatrogenic conditions	Treatments for specific health problems may result in damage or changes to other structures. Iatrogenic refers to the sequelae of previous treatments. For example, thickening of the folds as a result of taking male hormones for ovarian cancer, radiation therapy, and so on.

A-3. Clinician Information: Some Descriptive Voice Terms

Asthenic: This adjective is used to describe a weak or thin voice apparently demonstrating a lack of intensity and higher harmonics.

Breathy: Refers to the perception of excessive leakage of air during voicing. The first harmonic is relatively the strongest, and aspiration noise occurs around F_3 (Klatt & Klatt, 1990).

Diplophonia: This term is used to describe a "two-toned" voice when, for example, both the false and true folds are vibrating and two different frequencies occur. Acoustically, a bimodal distributions may be seen.

Jitter: Cycle-to-cycle frequency perturbation. Normal jitter can be as low as 0.10%.

Perturbation: Random deviations from complete regularity of the laryngeal waveform.

Phonetogram: This is a voice profile defining the vocal limits in terms of frequency and intensity. Frequency range is displayed on the horizontal axis and intensity on the vertical axis. A phonetogram may be generated with the help of a computer or using a pitchpipe and sound level meter. The instructions given to the patient affect the results. It is a useful way to measure changes in a voice pre- and post-training. It may be most useful when used with singers to indicate potential and document progress (see Shutte & Seidner, 1983).

Paroxysmal Laryngospasm: Episodic adduction of the membranous folds during inspiration with symptoms such as shortness of breath, anxiety and secondary gains, posterior chink, and mucus stranding. Frequently associated with gastroesophageal reflux. Panting is useful to interrupt the spasm.

Register: This term has never been defined to everyone's agreement. Singers refer to chest and head registers and speech scientists refer to modal and loft registers. Changes in the voice register (associated with specific pitch ranges) may be related both to mode of vocal fold vibration and supraglottal (resonatory) adjustments.

Shimmer: Cycle-to-cycle amplitude perturbation.

Singer's Formant: The "Singers Formant" or concentrations of energy involving the third, fourth, and fifth formants can be identified via spectrographic analysis. Supraglottal adjustments to enhance the "singer's formant" will improve vocal audibility in the presence of noise. Thus, singers can be heard over an orchestra, for example. "Singer's Formants" vary as a function of voice type. For example, Soprano: 3,200 Hz; Mezzo Soprano: 2,900 Hz; Tenor: 2,800 Hz; Baritone: 2,600 Hz; Bass: 2,300 Hz.

Tone Focus: A term used to describe the perception of the effect of suraglottal adjustments. For example, a good tone focus is characterized by the presence of the singers formant. Tone focus is affected by the adjustments of the size of the mouth cavity, by tongue mobility, and by the balance of oral and nasal resonance.

Vibrato: Small frequency and intensity variations occurring during singing that add color to the voice. Too much vibrato would be characterized as a "wobble."

Ventricular Phonation: Known as Plicae Ventricularis, or vibration of the false vocal folds. Reduced loudness, rough quality, diplophonia, and hyperfunctional tension occur.

Vocal Fold Paralysis: Vocal fold paralysis may be unilateral or bilateral and the folds may be fixed in various positions depending on the site of lesion. When both superior and recurrent laryngeal nerves are involved, a paralyzed fold assumes an abducted position. Recurrent nerve damage in the presence of an intact superior nerve results in a fold assuming a paramedian position closer to the midline. This is because of the action of the cricothyroid muscle, innervated by the external branch of the superior laryngeal nerve.

Vocal fry: Perceptually heard as a creaky sound. Acoustic analysis reveals extremely low fundamental frequency, in some cases a bimodal F_0 distribution is seen. True vocal fry is a nonmusical sound produced without excessive tension.

Voice breaks: Cessation of sound during voicing. Acoustically abrupt, stepwise changes in fundamental frequency may be seen.

A-4. Clinician Information: Rating Scales to Ascertain the Impact of a Voice Disorder

How well do people understand you? (Effect on intelligibility)

very well	not at all

How much is your voice affecting your work? (Occupational disruption)

not at all	impossible to work

How much does your voice affect your social interactions? (Social disruption)

not at all	completely

How much pain or physical discomfort do you have? (Physical discomfort level)

none	very severe

How upsetting is your voice problem to *you*? (Psychological discomfort level)

not at all	overwhelming distress

How do you think *significant others* react to your voice? (Effect on social relationships)

don't notice it	affects them severely

A-5. Clinician Information: The Use of High-Quiet Singing Tasks During Voice Evaluation

Bastian, Keidar, and Verdolini-Marston (1990) recommend the rating of a client's high-quiet singing during evaluation. This may be a task that professional singers, for example, may be asked to do so that their vocal function can be rated. Nonsingers may be intimidated by such a task, so the clinician must decide when the task is appropriate. A dB meter is used to monitor intensity. Most patients with significant changes in the mass of the vocal folds will have great difficulty singing or speaking *softly*. Their quality usually sounds best when they speak or sing loudly.

A demonstration of a high-quiet singing task will be needed and the client should be assured that the purpose of the task is to note changes associated with pitch and loudness levels. The client should not be concerned about producing a beautiful sound. The clinician models the first two phrases of a well-known tune, such as "Happy Birthday" (Bastian et al., 1990). The clinician rates the client's singing on a scale of 1 to 10.

1	10
Extremely delayed onset and discontinuous phonation	Immediate onset and continuous phonation

Bastian et al. (1990) suggest that ratings of 1–4 are consistent with lack of membranous fold closure. Ratings of 8–10 are within the normal range during quiet singing around 50–55 dB. High singing is usually demonstrated starting around 440 Hz (A_4) for women and at 329.6 Hz (E_4) for men (Verdolini, 1994).

Reference: Bastian, R. W., Keidar, A. K., and Verdolini-Marston, K. (1990). Simple vocal tasks for detecting vocal fold swelling. *Journal of Voice, 4,* 172–183.

A-6. Clinician Information: Reading Passages (Adult Level)

Reading Passage 1

Ethiopia, once known as Abyssinia, has a long history with extremely painful periods, including disastrous famines and civil war. For many people of African heritage, however, Ethiopia is the biblical Zion, the land where God dwells. It was a place of mythical status in the ancient world. Recently some Americans have had the privilege of viewing an art exhibition entitled "African Zion: The Sacred Art of Ethiopia." In February 1994, in honor of Black History Month, the Schomburg Center for Research in Black Culture, in New York, presented this exhibit. There were more than one hundred painted icons, illuminated manuscripts, coins, and liturgical gold and silver objects spanning the 4th to the 18th centuries. Many were borrowed from Ethiopian monasteries and churches, and some came from the Institute for Ethiopian Studies in Addis Ababa. Most of the art was seen on panel paintings and manuscripts, but there were also examples of work in less traditional media. All of the varied and beautiful images provided a glimpse of a rich culture barely known in the Western World.

Reading Passage 2

Dan Jansen finally won a gold medal by winning the ice skating 1,000 meters race at the Olympic Games in Lillehammer, Norway in 1994. His gold medal was hard-won. He had failed at the Calgary Olympics and in Albertville, France. He had failed in the 500 meter race a few days earlier in Lillehammer. He had only one remaining chance to make his dream a reality. All the experts agreed that he was clearly capable of winning and had demonstrated his skill over and over again in other competitions. However, he had to conquer the mental and emotional barriers that had denied him the Olympic Gold. He had consulted a sports psychologist to help him. His sister, Jane, had died the morning of the day he competed in the Calgary Olympics in Canada. The psychologist believed that Dan's fall, in his race in Calgary, had been symbolic. He, unconsciously, did not feel he should achieve great success and happiness on the same day his cherished sister had died. It took a lot of time to work through these feelings and move forward to a new level of awareness and strength of focus. When he finally won and the world cheered, he epitomized the true spirit of an Olympic athlete. He had persevered in the presence of tragedy and disappointment and in the end his dream came true. It was a moving moment when Dan skated his victory lap holding his new baby daughter, Jane, in his arms.

A-7. Clinician Information: How Rate Affects Voice

Rate can be measured either by counting words or syllables per minute. If bisyllabic or multisyllabic words are used in a passage, syllable counting will usually provide the most precise estimate of rate. Speaking and reading rates may vary. Rate may affect the way a client (with normal pulmonary function) uses breath during speaking and reading. Conversely, a client with pulmonary insufficiency may use very short phrases because of limited capacity. However, most clients do not have severe respiratory disorders but many have the habit of using a tidal volume that is too shallow or infrequently replenished. Thus, an evaluation of rate, phrasing patterns and the way a client *uses* breath is an important part of a voice evaluation. Note the following:

1. A speaker should have a quick, deep inhalation and speak during a long controlled exhalation. Some speakers may initiate phonation at an inappropriate phase of the respiratory cycle (e.g., after they have exhaled the tidal air). Others may inhale with inefficient patterns (e.g., raise shoulders) and thus have too little air available to talk on during exhalation.
2. Some speakers replenish too infrequently and use long phrasing patterns. Thus, their available air is depleted long before they replenish and their voice indicates they are speaking using their functional residual capacity (FRC).
3. A client's rapid reading or speaking rate may be a sign of using tidal breathing inefficiently, using poor coordination of air flow and voicing (e.g., hard attacks), or increasing laryngeal tension excessively in a vain attempt to conserve depleted air capacity. Slowing down the rate frequently decreases vocal hyperfunction.

A-8. Normative Data: Speaking and Reading Rates for Adults and Children

Normative Data for Adults

Speaking Range	Reading Range	Type of Measure
115 to 165[a]	150 to 190[b]	words per minute
162 to 230[a]	210 to 265[c]	syllables per minute

[a] Andrews and Ingham (1971).
[b] Darley and Spriesterbach (1978).
[c] Peters and Guitar (1991).

Normative Data for Children

Age	Speaking Range	Type of Measure
3[d]	116–163	syllables per minute
4[d]	117–183	syllables per minute
5[d]	109–183	syllables per minute
6[c]	140–175	syllables per minute
8[c]	150–180	syllables per minute
10[c]	165–215	syllables per minute
12[c]	165–220	syllables per minute

[c] Peters and Guitar (1991).
[d] Pindzola, Jenkens, and Lokken (1989).

A-9. Clinician Information: Some Clinical Applications of Instrumental Analyses

Pulmonary Function Tests

A respirometer yields measures of tidal volume, inspiratory capacity and expiratory reserve volume.

Whole body plethysmograph measures functional residual capacity (the volume of air remaining in the lungs at the end of quiet expiration).

Clinical Applications

If the functional residual capacity is high (e.g., emphysema), it may be possible to improve phonatory capacity with pulmonary exercises or medication.

Aerodynamic Measures

Smitheran and Hixon (1981) described a noninvasive clinical technique for measuring air pressure and air flow and estimated glottal resistance.

Clinical Applications

Hirano (1981) showed that when fold closure is compromised by mass lesion, poor muscular control or weakness, or neural problems, airflow rates will be greater than normal. The opposite (less than normal) airflow rates will occur with hyperadduction of the folds. (During normal speech, airflow rates range between 50–200 ml/s, with men producing higher rates than women). Shipp and McGlone (1971) showed normal subglottic air pressure for conversational speech to be between 3 and 7 cm of H_2O. Higher than normal pressure levels may indicate inefficient vocal fold closure or excessive lung pressures.

Visualization of the Larynx

Laryngostroboscopy allows a simulated slow motion view of vocal fold vibration showing:

degree of closure
vertical level of approximation
amplitude of vibration
status of mucosal wave
phase closure
phase symmetry
periodicity of vibration

Clinical Applications

Laryngeal stroboscopy shows mucosal alterations and pathological fold function. When video tapes are made, it can also document pre- and post-treatment changes.

Glottal Wave Forms

During *electroglottography*, surface electrodes are placed on the neck and graphs are made of vocal fold opening and closing. EGG provides information about the timing aspects of the closure and the duration of the closed and open phases. See Orlikoff (1991).

During *inverse filtering*, a mask is used to record oral flow. Thus, vocal fold movements are studied indirectly by deriving a volume velocity waveform at the glottis.

Clinical Applications

The electroglottogram (e.g., Kay Elemetrics CSL software option) can be used as a noninvasive measure to provide feedback to a client during treatment (e.g., client working on improved vocal fold closure). In a study by Hertegard et al. (1992), it was found that a small posterior chink (frequently found in women with normal voice) results in a minimum flow of <50–60 ml/s. If the chink extended into membranous folds, flow was higher — 60–100 ml/s.

Acoustic Measures

Perturbation measures (jitter and shimmer) and signal-to-noise ratios are frequently used analyses to confirm perceptual judgments of quality deviations. Perturbation analyses frequently also are used to document phonational instability such as tremors (Kay Elemetrics MDVP option for CSL). Since knowledge of results affects performance, acoustic documentation, including spectrographic analyses is beneficial in both evaluation and treatment.

Clinical Applications

Acoustic measures can be used as pre- and post-tests of treatment and to provide feedback during treatment.

A-10. Clinician Information: Assessing Vocal Fold Vibratory Patterns Using Videostroboscopy

Description of Parameters for Judgment/Measurement

I. GLOTTAL CONFIGURATION

A description of glottal configuration when the vocal folds are at their most closed point in the vibratory cycle. These descriptions are based on Bless, Hirano, and Feder (1987).

DESCRIPTIONS:

1. Complete 
2. Posterior 
3. Spindle 
4. Anterior 
5. Hourglass 
6. Incomplete 
7. Irregular 

II. GLOTTIC CLOSURE

Degree of glottic closure is rated on a 3-point scale. The rater should observe the entire length of the medial edge of the vocal folds and determine whether or not they completely approximate, and if not, to what degree they remain open.

SCALE:

1. Completely closed during all (or almost all) cycles along the entire vocal fold margins.
2. Some opening in at least half the cycles anywhere along the vocal fold margins.
3. Never completely closed.

III. EXTENT OF OPENING

Amount of opening when the vocal folds are in their most abducted position during phonation. If there are anteriorposterior differences in extent of opening, only opening at the widest point should be taken into account. The DIFFERENCE between vocal folds in their most closed position and most open position should not enter into this judgment. A 5-point scale is used.

SCALE: (0 used as a reference only — glottis is always completely closed.)

1. Very slight glottal opening in the majority of cycles
2. Slight opening
3. Moderate opening
4. Large opening
5. Extreme opening — glottis open to the width of breathing

IV. SYMMETRY OF AMPLITUDE

Whether or not the two vocal folds move outward to the same point of full excursion. A 5-point scale is used.

SCALE:

1. Exactly symmetrical — both vocal folds open to the same point of lateral excursion in all or almost all cycles.
2. Slight asymmetry — one vocal fold moves outward slightly less than the other.
3. Moderate asymmetry
4. Marked asymmetry
5. Extreme asymmetry — one vocal fold does not move at all.

V. SYMMETRY OF PHASE

Note if both vocal folds reach point of maximum closure at the same time, indicating that both vocal folds are vibrating at the same rate. A 3-point scale is used.

SCALE:

1. In phase for all or almost all cycles
2. Sometimes out of phase
3. Always out of phase — 180 degrees out of phase — vocal folds appear to be swaying.

VI. ANTERIOR-POSTERIOR SYMMETRY

Description of the vibratory pattern of the anterior portion of the vocal folds as compared to the posterior portion of the vocal folds. May include amplitude or phase.

SOME POSSIBLE DESCRIPTIONS:

1. Symmetrical anterior-posterior movements
2. Anterior portion of folds shows less movement than posterior portion
3. Posterior portion of vocal folds remains in a fixed position (such as open) while anterior portion of vocal folds vibrates

Or any description necessary to convey the observed behavior.

Rating Sheet

1. Glottal Configuration

complete   posterior   spindle   anterior

hourglass   incomplete   irregular

2. Completeness of Closure

1	2	3
completely closed, all cycles	some opening in at least half the cycles	never completely closed

3. Extent of Glottal Opening

0	1	2	3	4	5
no opening	very slight opening	slight opening	moderate opening	large opening	extreme opening

4. Symmetry of Amplitude

1	2	3	4	5
exactly symmetrical	slight asymmetry	moderate asymmetry	marked asymmetry	extreme asymmetry

5. Symmetry of Phase

1	2	3
in phase, all cycles	sometimes out of phase	always out of phase

6. Anterior-posterior symmetry: Description of the vibratory pattern of the anterior portion of the vocal folds as compared to the posterior portion of the vocal folds. May include amplitude or phase.

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Source: Bultemeyer, D. K. (1988, October). *Assessing vocal fold vibratory patterns in the normal population.* Unpublished master's thesis, Indiana University, Bloomington.

A-11. Normative Data: Prolongations of /s/ and /z/ by Young Children

Prolongation of /s/ and /z/ by normal children

		/s/		/z/		
Age (in years)	N[a]	Mean in Secs.	S.D.	Mean in Secs.	S.D.	Researchers
3.0–4.8	183	3.7	1.99	4.15	2.08	Frey
5.3–6.6	162	4.56	2.12	5.31	2.94	Frey
3.0–6.6	450	4.07	2.52	4.71	2.30	Frey
5	15	8.13	3.25	9.47	2.97	Michel & Tait
7	14	9.79	2.27	13.40	3.83	Michel & Tait
9	24	15.80	7.21	17.20	6.36	Michel & Tait
5–9	53	12.06	6.33	13.95	5.95	Michel & Tait

Sources: Marsha J. Frey, "The Prolongation of /s/ and /z/ by Preschool Children" (Master's thesis, Indiana University, 1978); and John F. Michel, University of Kansas, and Nancy A. Tait, University of Kansas Medical Center, Kansas City, "Maximum Duration of Sustained /s/ and /z/" (paper presented at ASHA, Chicago, November 3, 1977).

N[a] = sample size

Instructions to elicit sustained/prolonged voice samples from young children:

With young children, or children with developmental delays, it is important to be sure that they understand the instructions, "Keep going as long as you can." The concept of continuity is difficult for some young children. They need a model and visual cues. Visual cues that are useful include: a snake moving towards a cave /s/; a motorcycle moving towards a garage /z/. The clinician should manipulate the objects and provide the model and as many trials as are needed to ensure the best performance possible. Since the aim is to ascertain whether the child is able to prolong both /s/ and /z/ for the s/z ratio, just make sure the stimulation and number of trials are equivalent for each phoneme. Improvement with "coaching" tells us important information concerning a child's status and prognosis with treatment. Thus, prolongation tasks are often repeated as part of the voice stimulation activities during a voice assessment.

A-12. Normative Data: Prolongations of Vowels by 9-to 12-Year-Old Children

Average Duration of Sustained Vowels

		Average Phonation Time (in seconds)	
Age (in years)	Vocalization	Females	Males
9	/a/ /i/ /u/	8.8	11.4
10	/a/ /i/ /u/	9.4	10.4
11	/a/ /i/ /u/	11.5	12.8
12	/a/ /i/ /u/	12.2	12.8

Source: P. G. Launer, "Maximum Phonation Time in Children" (Master's thesis, State University of New York at Buffalo, 1971).

A-13. Normative Data: Maximum Phonation Time on /ɑ/ for Adults and children

Age (in years)	Sex	Norm. (in Secs.)	SD	Source
Adults				
18-38	F	20.90	5.70	Ptacek et al., 1966
18-39	M	24.60	6.70	Ptacek et al., 1966
66-93	F	14.20	5.60	Ptacek et al., 1966
68-89	M	18.10	6.60	Ptacek et al., 1966
Children				
3-4	M	8.95	2.16	Colton & Casper, 1990
3-4	F	7.50	1.80	Colton & Casper, 1990
5-12	M	17.74	4.14	Colton & Casper, 1990
5-12	F	14.97	3.87	Colton & Casper, 1990

Note: Also see Finnegan (1985). Maximum phonation time for children with normal voices. *Journal of Communication Disorders, 17,* 309-317.

References

Andrews, M. L. (1990). *Voice therapy for children.* San Diego: Singular Publishing Group.

Finnegan, D. E. (1984). Maximum phonation time for children with normal voices. *Folia Phoniatrica, 37,* 209-215.

Wilson, D. K. (1987). *Voice problems of children,* (3rd ed.). Baltimore, MD: Williams & Wilkins.

A-14. Normative Data: Acoustic Measures of Children's Voices

Glaze et al. (1988) studied prepubescent children (aged 5-11 years) with perceputally normal voices and samples were analyzed acoustically. Children were asked to sustain /ha/ at normal pitch and loudness.

Study	Age (in years)	All Children (N = 121)	Boys (N = 59)	Girls (N = 62)
Glaze (1988)	5-11			
Frequency (Hz)				
Mean		231.88	225.92	237.56
SD		23.12	20.32	24.32
Wilson (1987)	5-11			
Frequency (Hz)				
Mean			254.00	260.00
Range			210-297	221-294
Andrews (1988)	11			
Frequency (Hz)				
Mean			227.00	237.00
Lowest frequency produced (basal pitch)			186.00	196.00

A-15. Normative Data: Fundamental Frequency During Reading for Adults

Age (in years)	Sex	Average (Hz)	Range (Hz)	Source
20-29	M	120	—	Hollien & Shipp (1972)
20-29	F	224	192-275	Stoicheff (1981)
30-39	M	112	—	Hollien & Shipp (1972)
30-40	F	196	171-222	Saxman & Burk (1967)
40-49	M	107	—	Hollien & Shipp (1972)
40-50	F	189	168-208	Saxman & Burk (1967)
50-59	M	118	—	Hollien & Shipp (1972)
50-59	F	199	176-241	Stoicheff (1981)
60-69	M	112	—	Hollien & Shipp (1972)
60-69	F	200	143-235	Stoicheff (1981)
80-89	M	146	—	Hollien & Shipp (1972)
over 70	F	202	170-249	Stoicheff (1981)

Notes: Measures may be obtained using computer programs or a portable keyboard or pitch pipe. Sometimes the middle vowel in a multi-syllable word (e.g., Minn*i*haha) is used to avoid using a vowel at the end of a sentence where the pitch may spontaneously fall. Practice trials are given and the client may be asked to prolong the final vowels in the following sentences, as well as the middle vowel in the last sentence, for comparison purposes.

Sentences for prolonging vowel samples to match with pitch pipe or keyboard:

1. She lives in Alabam*a*.
2. He lives in Mississipp*i*.
3. The name, Minn*i*haha, is lovely.

A-16. Normative Data: Comparison of Acoustic Measures of Adults and Children's Voices

Glaze (1988) note that the upper limit for jitter in adults is 0.04 ms. Thus, her children's values fall within the normal adult range. The children exceeded the shimmer value for normal adults (4%). For signal-to-noise ratio, the value reported for noraml adults is 20 dB or higher. These children fell below this, averaging 15.39 dB with a SD of 3.55.

	All Children (N = 121)	**Boys (N = 59)**	**Girls (N = 62)**
Jitter (ms)			
Mean	0.0339	0.0320	0.0358
SD	0.022	0.020	0.024
Shimmer (%)			
Mean	6.28	5.51	7.01
SD	4.33	3.29	5.04
SNR (dB)			
Mean	15.39	15.74	15.06
SD	3.55	3.38	3.69

A-17. Normative Data: Aerodynamic Measures Showing Intrasubject Variability

		V_t (cc/s)	Q_a	F_0 (Hz)	P_s (cm H_2O)
Males (n = 11)					
1	*R*	144-193	.42-.53	101-114	6.0-8.7
	V	13	10	5	16
2	*R*	97-175	.40-.50	93-102	6.2-6.4
	V	25	10	8	2
3	*R*	138-183	.38-.45	102-108	6.0-8.6
	V	14	7	3	7
4	*R*	211-261	.49-.54	97-104	6.4-7.3
	V	11	4	3	5
5	*R*	95-134	.43-.48	167-194	7.7-8.6
	V	14	6	7	5
6	*R*	157-213	.36-.46	98-108	6.9-10.6
	V	15	11	4	17
7	*R*	191-288	.49-.53	129-139	5.9-7.3
	V	17	3	3	9
8	*R*	159-237	.42-.45	125-137	6.6-9.4
	V	22	3	4	15
9	*R*	133-157	.41-.47	139-160	7.3-8.2
	V	8	5	6	5
10	*R*	127-180	.47-.52	104-122	4.6-5.9
	V	18	4	7	11
11	*R*	151-188	.49-.51	108-112	6.4-7.5
	V	10	2	1	7
Females (n = 10)					
1	*R*	91-148	.41-.50	175-192	7.9-8.5
	V	21	7	4	3
2	*R*	123-129	.51-.64	151-161	5.9-6.5
	V	2	10	3	5
3	*R*	208-223	.48-.52	200-208	5.2-5.9
	V	3	3	2	6
4	*R*	106-153	.55-.66	207-221	6.4-7.5
	V	16	8	3	7

		V_l (cc/s)	Q_a	F_0 (Hz)	P_s (cm H_2O)
Females (n = 10)					
5	*R*	84-144	.47-.51	190-192	6.2-7.0
	V	23	3	1	7
6	*R*	146-175	.44-.50	206-216	6.1-7.7
	V	8	5	2	12
7	*R*	87-138	.47-.51	190-192	6.2-7.0
	V	20	3	10	10
8	*R*	122-153	.42-.49	184-217	9.4-11.1
	V	11	7	7	8
9	*R*	84-133	.51-.58	209-237	6.3-7.8
	V	18	7	5	9
10	*R*	98-126	.51-.60	166-195	5.9-6.6
	V	11	7	7	5

Source: Higgins et al. (1994). Aerodynamic and electroglottographic measures of normal voice production: Intrasubject variability within and across sessions. *Journal of Speech Hearing Research, 37,* 38-45.

Intrasubject ranges (*R*) and coefficients of variation (*V*) of mean phonatory air flow (V_l), abduction quotient (Q_a), fundamental frequency (F_0), and estimated subglottal air pressure (P_s) as 4 days for /pa/ syllable repetition.

A-18. Normative Data: Aerodynamic and Electroglottographic Measures Showing Intrasubject Variability

		Syllables		Sentences	
		[p]	[pi]	[pap]	[pip]
Males (n = 11)					
V_l	M	171	177	176	189
	V	21	18	18	23
	R	120–235	143–234	139–239	123–267
Q_a	M	.47	.48	.47	.49
	V	8	7	8	6
	R	.41–.52	.43–.53	.43–.53	.44–.54
F_0	M	120	125	121	126
	V	20	19	19	20
	R	100–177	101–181	95–181	97–192
P_s	M	7.1	7.2	6.8	7.0
	V	15	14	17	18
	R	5.3–8.8	5.5–8.8	4.1–8.2	4.4–8.7
Females (n = 10)					
V_l	M	135	132	124	126
	V	24	20	25	26
	R	110–216	101–183	96–200	91–195
Q_a	M	.51	.53	.51	.53
	V	10	9	9	8
	R	.46–.60	.45–.62	.44–.58	.47–.60
F_0	M	196	206	194	212
	V	10	10	11	11
	R	154–225	163–229	150–225	162–242
P_s	M	7.1	7.4	6.9	7.2
	V	18	20	20	19
	R	5.6–10.1	5.7–10.6	5.8–10.3	5.9–10.5

Source: Higgins et al. (1994). Aerodynamic and electroglottographic measures of normal voice production: Intrasubject variability within and across sessions. *Journal of Speech Hearing Research, 37,* 38–45.

Group means (M), coefficients of variation (V), and ranges (R) for mean phonatory air flow (V_l), abduction quotient (Q_a), fundamental frequency (F_0), and estimated subglottal air pressure (P_s).

Note: V_l is expressed in cc/s, F_0 in Hz, and P_s in cm H_2O.

A-19. Clinical Information: Semitone Scale

Notes	Hertz	Period	S.T. above O.F.L.
C_1	32.70	7.63	12
C#	34.65	7.20	13
D	36.71	6.80	14
D#	38.88	6.42	15
E	41.20	6.06	16
F	43.68	5.71	17
F#	46.25	5.40	18
G	49.02	5.09	19
G#	51.91	4.81	20
A	55.00	4.81	21
A#	58.26	4.28	22
B_1	61.75	4.04	23
C_2	65.40	3.82	24
C#	69.30	3.60	25
D	73.43	3.40	26
D#	77.76	3.21	27
E	82.40	3.03	28
F	87.35	2.86	29
F#	92.50	2.70	30
G	98.03	2.55	31
G#	103.8	2.40	32
A	110.0	2.27	33
A#	116.5	2.14	34
B_2	123.5	2.02	35
C_3	130.8	1.91	36
C#	138.6	1.80	37
D	146.8	1.70	38
D#	155.6	1.60	39
E	164.8	1.51	40
F	174.6	1.43	41
F#	185.0	1.35	42
G	196.0	1.27	43

(continued)

A-19. Semitone Scale *(continued)*

Notes	Hertz	Period	S.T. above O.F.L.
G#	207.7	1.20	44
A	220.0	1.13	45
A#	233.1	1.07	46
B_3	247.0	1.01	47
C_4	261.6	.954	48
C#	277.2	.900	49
D	293.7	.850	50
D#	311.1	.802	51
E	329.6	.757	52
F	349.2	.715	53
F#	370.0	.675	54
G	392.0	.637	55
G#	415.5	.601	56
A	440.0	.567	57
A#	466.2	.535	58
B_4	493.9	.505	59
C_6	1046.5	.239	72
C#	1108.7	.225	73
D	1174.7	.212	74
D#	1244.5	.201	75
E	1318.5	.189	76
F	1396.9	.179	77
F#	1480.0	.169	78
G	1568.0	.159	79
G#	1661.2	.150	80
A	1760.0	.142	81
A#	1864.7	.134	82
B_6	1975.5	.126	83
C_7	2093.0	.119	84

Source: Adapted from *American Standard Acoustical Terminology* (1960). New York: The Acoustical Society of America.

A-20. Sample Format: Consultation Report

Patient's name: ______________________ Age __________

Medical record number: ______________

Date seen: ____________ Reason for referral: ____________

Referred by: ___________ Attending physician: ___________

Description of Patient:

Test Results:

1. Behavioral

2. Acoustic

3. Aerodynamic

4. Laryngostroboscopic

Clinical Impressions:

Recommenations:

Signature of Consultant

____

Title: __________________________

Date: __________________________

A-21. Sample Form: Child's Assessment Summary

Child's name: ____________________ Birthdate: ____________________

Date(s) examined: ____

Time of day: ____________________ Examiner: ____________________

School: ____ Grade: ______

Room/teacher: ____

Siblings' names and ages: ____

Hearing testing results: ____

Cold or allergic reaction at time of testing? Yes ______ No ______

Physician's report received? Yes ______ No ______

History information on file? Yes ______ No ______

Check areas needing attention:

Respiration

Type and depth of inhalation: ____

Length of exhalation:: ____

Control of airflow: ____

Use of replenishing breaths: ____

Rate

Phrasing: ____

Length of Pauses: ____

Too rapid: ____

Too slow: ____

Phonation

Vocal-fold abduction-adduction: ____

Vocal-fold mass/tension adjustments: ____

pitch: ____ loudness: ____

Onset of phonation: ____

Evenness of vibratory pattern (quality): ____

High-risk Factors

Relevant: ____

Irrelevant: ____

Comments: ____________

____

Resonance

Oral resonance: ____

Nasal resonance: ____

Tone focus: ____

Mouth opening: ____

Tongue movement: ____

Lip movement: ____

Psycho-Dynamics

Self-esteem: ____

Motivation: ____

Family factors: ____

Social-emotional factors: ____

Referral needed: Medical: ____ Psychological: ____ Other: ________

Enroll in therapy? Yes _____ No _____

Comments:

____

____

____

____

____

Intervention Approach and Schedule:

____

____

____

Signature: ______________________________
Speech-Language Pathologist

Date:: ______________________________

A-22. Sample Format: Request for Physician's Report

This child has been evaluated by the speech pathologist. Because of voice symptoms that could be related to physiological or neurological conditions affecting communication, a physician's statement concerning pertinent medical information is requested. Please complete the following information and return to

Name: ____________________ Age: _____ Birthdate: ________

Date of Speech/Voice Evaluation: ______________________________

Presenting Problem: ______________________________________

____

____

SPEECH-LANGUAGE PATHOLOGIST'S FINDINGS: ____________

____

____

Signature of Speech Pathologist: _______ Evaluation Date: _______

I. Medical conditions that may be pertinent (circle all that apply):

allergies	deviated septum
hearing loss	craniofacial anomalies
excessive mucus	trauma
medications	mouth breathing
previous intubation	surgeries
thyroid condition	dryness of tract
frequent infections	reflux
psychological problems	enlarged tonsils and adenoids
bulimia	sleep apnea

Other: ____

II. Abusive practices (circle all that apply):

throat clearing	muscle tension
excessive talking	coughing
loud talking	loud singing
smoking	yodeling
sound imitations	impersonations
gargling	drug abuse

Other: ______________________________

III. Demands inherent in life-style environment (circle all that apply)

fatigue	noisy environment
cheerleading	choir
stress	solo singing
dramatics	sporting activities

Other: ______________________________

RESULTS OF PHYSICIAN'S EXAMINATION (e.g., condition of larynx, tonsils, adenoids): ______________________________

____

____

____

____

Is medical care related to the disorder recommended (e.g., surgery, prosthesis, medication)?

Yes _____ No _____ If yes, please explain:

____

____

____

Please describe any health or medical problems that would affect voice therapy: ____

____

____

____

____

Comments: ____

____

____

____

____

Date:: ______________ Signature of Physician: ________________

Stamped Name:

A-23. Sample Format: Voice History and Screening

SS #: ____________________

File #: ____________________

Part One (to be filled out by client)

Name: ______________________ Birthdate: __________

Address: ______________ Phone No.: ______________

Date: __________ Age: ________ Occupation: __________

Trained Singer Recreational Singer Non-singer (circle one)

Briefly describe the problems you are having with your voice.

How long have you had these problems?

Was the onset gradual or sudden? Describe.

Are there specific times when your voice is better or worse (e.g., first thing in the morning)?

If you have seen an ENT specialist, provide approximate date and findings:

Have you ever had treatment for your voice? If so, where and for how long?

What do you think caused this voice problem?

Describe any strategies you have used to try to improve your voice.

What helps or worsens the symptoms?

Part Two (to be filled out by the clinician)

Note: Instructions for the client are in quotes

Respiration:

Visible tension present: ____ neck, ____ chest, ____ none

____ clavicular breathing, ____ audible breathing,

____ appropriate patterns

Phonation

"Take a deep breath and exhale on /s/ as long as you can." (Repeat procedure for /z/ for a total of three trials each.)

/s/	____ seconds	/z/	____ seconds
	____		____
	____		____
average	____		____ s/z ratio

"Count aloud to 50."

# of replenishing breaths ______

Tape while the client reads a passage aloud (time for 60 seconds)

words in 60 seconds ______ WPM ______

Have client continue with the rest of the passage taking note of the following areas:

Type of onset: ____ hard ____ breathy ____ appropriate

Tone focus:	___ retracted tongue	___ closed mouth	___ appropriate
Quality:	___ aphonia	___ dysphonia	___ diplophonia
	___ appropriate		
Pitch level:	___ too high	___ too low	___ appropriate
Loudness level:	___ too loud	___ too soft	___ appropriate
Variability:	___ appropriate	___ inappropriate	
	___ fading at ends of sentences	___ monotone	
Vocal fry:	___ frequent	___ occasional	___ never
Visible tension:	___ present	___ absent	
Resonance:	___ hypernasal	___ hyponasal	___ appropriate balance

Fluency (circle all that apply):

Throat clearing   cluttering   word finding difficulties

repetitions   interjections   prolongations   poor rate

other: ______________________________

Hearing:

Screening completed: yes   no

passed   failed

A–24. Sample Format: Voice Examination

Name: ______________________ Age: _____ Sex: _____

Examiner: ______________________ Date: ______________________

1. Complaint:

2. Primary voice quality problem:

   ☐ breathiness ☐ harshness ☐ hoarseness

   ☐ resonance imbalance

3. Pertinent History

   a. History of the problem:

   Nature of onset:

   Duration of the problem:

   History of vocal abuse (e.g., talking in a noisy environment, excessive speaking, shouting, screaming): ☐ Yes ☐ No. If yes, describe:

   History of total loss of voice: ☐ Yes ☐ No. If yes, describe the circumstances:

   Description of how voice is used in daily routine:

Variations in the severity reported by the speaker and when variations occur:

Has speaker had voice therapy? ☐ Yes ☐ No. If yes, what was the nature of the therapy?

What were the results of therapy?

b. Family history of voice and speech problems.
Other members of the family with voice or speech problems:

☐ Yes ☐ No. If yes, describe the nature of the problem and relation of person to the speaker in each case:

c. General physical development and health. Is there history of:

	Yes	No		Yes	No
allergies	☐	☐	bulimia	☐	☐
P.M.S.	☐	☐	sleep apnea	☐	☐
hormone imbalance	☐	☐	neurologic disease	☐	☐
trauma	☐	☐	CVA	☐	☐
serious illness	☐	☐	arthritis	☐	☐
chronic sinusitis	☐	☐	alcoholism	☐	☐
dysphagia	☐	☐	dementia	☐	☐
tracheostomy	☐	☐	paralysis/paresis	☐	☐
ear disease	☐	☐	smoking	☐	☐
incoordination of face or tongue muscles	☐	☐	broken nose	☐	☐
gait peculiarities	☐	☐	mouth-bleeding	☐	☐
tremor	☐	☐	gastro-esophageal reflux	☐	☐
velopharyngeal problems	☐	☐	unusual sexual development	☐	☐
surgeries/intubation	☐	☐	heart/circulatory problems	☐	☐

other ______________________________

If the answer to any of the items above is Yes, give the relevant details:

Note medications taken currently:

4. Examination of Pertinent Physical Mechanisms

   a. Respiratory Mechanism:
   Breath supply and control appear to be adequate: ☐ Yes ☐ No.

   Any apparent muscular tension of the chest and neck which appear to be related to breath supply and control? ☐ Yes ☐ No.

   Describe and discuss any such deviations:

   b. Larynx:
   History of laryngeal conditions (growths, edema, erythema, sensations) ☐ Yes ☐ No

   Complaint of "tired throat" ☐ Yes ☐ No

   Evidence of "tight throat" during phonation? ☐ Yes ☐ No

   Muscular contractions exhibited during phonation which are similar to those exhibited during swallowing ☐ Yes ☐ No

   If the answer to any of the items above is Yes, give the relevant details:

   Does the speaker exhibit any of the following during speech?

   ☐ hard glottal attack ☐ two-toned voice ☐ tremulous voice

   ☐ infrequent pitch breaks ☐ frequent pitch breaks

   ☐ phonation interspersed with aphonia.

   Give the relevant details concerning any of the items that have been checked above:

Any voice training? ☐ Yes ☐ No.

If yes, note length and type of training: ____________________

Can the speaker sing up and down the musical scale?
☐ Yes ☐ No

Can speaker imitate inflectional patterns? ☐ Yes ☐ No

Number of tones in total pitch range including falsetto: ________

Number of tones habitual pitch level is above the lowest one produced: ________

Comment on speech variability: ____________________________

____

c. Articulatory Mechanism:
Activity of lips and jaws (extent of mouth opening while speaking): ☐ Immobile and clenched; ☐ slight movement; ☐ average movement; ☐ above average movement.

Tongue retraction: ☐ present; ☐ absent.

Diado rates within normal limits? ☐ Yes ☐ No

Discuss the significance of any deviations noted above:

d. Resonators:
Size of velopharyngeal space:
depth: ☐ shallow; ☐ normal; ☐ deep
width: ☐ narrow; ☐ normal; ☐ wide

Tonsils: ☐ none; ☐ small; ☐ moderately large; ☐ very large

Nasal obstruction:
right nostril: ☐ none; ☐ some; ☐ complete
left nostril: ☐ none; ☐ some; ☐ complete

Quality when nostrils occluded during sustained vowels:
☐ changed; ☐ unchanged

Discuss the significance of any deviations noted above:

e. Posture:
Overall posture of the body generally adequate: ☐ Yes ☐ No

Head held in upright position during speaking: ☐ Yes ☐ No

Is the position of the larynx in the neck normal? ☐ Yes ☐ No

Are the knees locked: ☐ Yes ☐ No

Does posture affect respiration? ☐ Yes ☐ No

Describe any deviation and discuss any possible relationship it may have to the voice problem:

5. Associated Variables

a. Pitch and Loudness:
Quality changes under any of the following conditions:
Sustained vowels:
lower than habitual pitch level: ☐ Yes ☐ No
higher than habitual pitch level: ☐ Yes ☐ No
softer than habitual pitch level: ☐ Yes ☐ No
louder than habitual pitch level: ☐ Yes ☐ No

Oral reading:
softer than habitual loudness level: ☐ Yes ☐ No
louder than habitual loudness level: ☐ Yes ☐ No

Tension changes:
increased effort: ☐ Yes ☐ No
decreased effort: ☐ Yes ☐ No

6. Personal and Social Adjustment

What is the degree of concern that the speaker has about the voice problem: ☐ None ☐ Some ☐ Marked

Comments: ____

____

Describe the speakers psychosocial behavior, compliance, and motivation:

How would you rate the speaker's overall adjustment:
☐ Above average ☐ Average ☐ Below average

7. Relationship of the voice quality problem to other variables, if any, not discussed above (e.g., rate, airflow, elicitation tasks, phonetic contexts):

8. Summary of clinical impressions.

9. Recommendations.

A-25. Sample Format: Adult's Short Intake Sheet

Patient's Name: ____________________ Date ____________________

Address ____

Date of Birth ____________________ Physician ____________________

Telephone (home) ____________________ (work) ____________________

Referred by: ____

Address: ____

Occupation: ____

The information provided below will help us to understand your voice problem.

Singing training ☐ Yes ☐ No. If yes, ________ years.

Briefly describe your voice problem: ____________________

____

How long has the problem bothered you? ____________________

What specific times is it better/worse? ____________________

____

If you have seen an otolaryngologist note findings: ____________________

____

Have you had previous voice treatment? If so, where and how long:

____

____

Medical Problems:

Allergies? ____________________ Ear problems? ____________________

Breathing problems? ____________________ Medications? ____________________

Surgeries? ____________________ Serious illness? ____________________

How does your voice problem affect your life. ____________________

____

How do significant others feel about your voice? ____________________

____

Person financially responsible (signature): ____________________

I authorize the release of information to my physician, counsellor and insurance company as needed (signature): ____________________

A-26. Sample Format: Child's Short Intake Sheet

Patient's Name: ____________________ Date ____________________

Address ____

Date of Birth ____________________ Physician ____________________

Parents: ____

Telephone (home) ____________________ (work) ____________________

Referred by: ____

Address: ____

The information provided below will help us to understand your child's voice problem.

Other children in family:

Name	Age	Sex

Ages for:

Sitting up: ____________________ Babbling ____________________

Walking: ____________________ First single words: ____________________

Putting words together into sentences: ____________________

Medical Problems:

Illness with high fevers? __________ Food allergies? __________

Physical injuries? __________ Ear problems? __________

Feeding problems? __________ Breathing tubes? __________

Describe your child's voice problem: ____

____

____

When was the voice problem first noticed? ____________________

How do family members feel about his or her voice? ____________________

____

Previous speech, voice, and language treatment? ____________________

Has he or she received a recent hearing evaluation? ____________________

Person financially responsible (signature): ____________________

I authorize the release of information to my physician/school and insurance company as needed (signature): ____________________

A-27. Clinician Information: Assembling and Organizing Information for the Report

Identifying Information

The patient's name, medical record number, address, birth date, gender, occupation or school grade level, reason and source of referral, and description of the problem. Sometimes the problem is reported in the exact words of the patient, person referring the patient, or family member. For example, Bill reported that his voice was "cutting out a lot during and after choir practice."

Background Information

Onset and progression of the problem; how the problem interferes with voice function in various ways (see Rating Scale in this appendix); the amount of effort needed to talk; symptoms and their fluctuation in relation to different demands, situations, or emotional states; medical conditions (developmental information in the case of young children); otolaryngological findings; previous surgeries or intubations; medications used; environmental and behavioral factors relevant to voice; typical patterns of voice use; family members with voice problems; patient's goals and level of motivation in seeking treatment; and previous treatment history.

Results of Voice Evaluation

Information obtained via visualization of the larynx. (This will appear here if it is part of this evaluation and in the section above if the findings are included in the otolaryngologist's report.) Information obtained through behavioral and instrumental analysis, including description of the measures and comparisons with normative data when available. Generally $\pm$ 1 standard deviation from the norm is reported and z-scores are used. Scores that fall within the normal range are within $\pm$ 1 standard deviation from the mean. If scores are not norm-referenced, they are summarized descriptively so that the reader of the report has a clear understanding of the meaning of the results of the procedure used. Statements concerning the results of the clinician's trained perceptions of the patient's behavior are also provided, including estimates of severity. The degree of functional impairment observed is noted in relation to the aspirations and context in which the patient operates. For example, a professional singer may have subtle symptoms (his report) and signs (noted by the clinician) and yet severe impairment because of his vocation.

Impressions

An overall description of the type of disorder, the severity and predisposing precipitating and maintaining factors that have been identified during the entire evaluation. Usually the physiologic reasons for the voice symptoms are summarized. This is the first time in the reporting process where the clinician may go beyond the reporting of factual information and describe clinical impressions. This is done in terms of the overall profile or pattern that has emerged. Impressions are based on knowledge of the literature and previous clinical experience. Prognostic statements are frequently included in this section, but may also be noted under recommendations (below).

Recommendations

Recommendations for treatment or referrals to other specialists (e.g., singing teacher) are made. If voice therapy is recommended, the length of sessions, an estimate of the duration, the treatment approach to be used and the patient's agreement to undertake treatment is recorded.

A-28. Sample Format: Report Outline for Use on Word Processor

Patient's Name: ____________________ Date: ____________________

Address ____

Date of Birth: ________________ Case Number: ________________

Telephone (home): __________________ (work): ________________

Soc. Sec. #: ____

__________________, age _____ years was seen for a voice evaluation on __________________. The reason for referral was "__________________ __________________." He/she was referred by __________________. __________________ described his/her voice problem in the following way: "____ ____."

Background Information

__________________ reported that he/she had been troubled by the voice problem for approximately __________________. The onset was (sudden/gradual) and marked by deterioration of __________________. __________________ judged the disruption in occupational and social performance to be (mild/moderate/severe). Times when the voice was (better/worse) included ____________________________________ ________________________. Significant others' reactions to the voice problem were described as ______________________________. __________________ reported that he/she has attempted to address the problem by ____ ____ and that (some/no) remission of symptoms had been noted.

__________________ reported he/she has engaged in the following activities requiring sustained voice use ______________________________ __________. A history of (voice training/treatment) for approximately __________________ was reported. Medically relevant information provided during the interview revealed a history of __________________ ____.

The (client/patient) is currently taking the following medications ________ ____.

Examination

A. Perceptual evaluation of the (patient's/client's) vocal behavior during the interview revealed that ______________________________ ____.

(Dysphonic/aphonic) episodes seemed related to _______________ ______________________________. Pitch level and variability was appropriate/inappropriate) with respect to age and gender. Respiration for speech was marked by (clavicular/lower chest) movement, (adequate/inadequate) use of replenishing breaths, and (appropriate/inappropriate) coordination of voice onset and initiation of the exhalation.

Continuity of voicing (was/was not) noted throughout the breath group and (voice breaks/tremor/fading at ends of utterances) were (present/absent). Quality characteristics included (hoarseness/harshness/diplophonia) and visible signs of musculo-skeletal tension (were/were not) seen. Facilitating techniques that were used included ___________ ____________ and (were/were not) noted to modify symptoms. The overall vocal pattern could be described as __________________. Symptoms were judged to be of __________________ severity and consistent/inconsistent) with respect to ______________________.

B. The following tests (MPT; s/z ratio; high-quiet singing; laryngeal diadochokineses; reading/speaking; rate analysis; hearing) were administered and results revealed ______________________________ ______________________________. (Acoustic/aerodynamic) findings were (consistent/inconsistent) with the perceptual assessment of ______ ______________________________.

C. Visualization of laryngeal structure and function using __________ ______________ revealed that the movement and closure patterns of the folds were ______________ and that (color/secretion level/evenness of margins/lesions) indicated ____________________.

D. Psychosocial factors noted during the examination included ______ ______________________________. The (patient/client) appeared to demonstrate (anxiety/depression/high level of stress) concerning his or her (situation/voice problem) and was (responsive/unresponsive) to the (stimulability activities/suggestions/questions/tasks).

E. An oral examination revealed normal structure and function for speech and a ________________ occlusion was noted. Tonsils and adenoids were ________________.

F. Resonance balance was (appropriate/inappropriate) during both nasal and oral test sentences, humming, and sustained vowels. (Presence/absence) of signs of (nasal obstruction/velopharyngeal closure problems) was observed.

Clinical Impressions may be summarized in the following way: ________
____
____

Recommendations (select appropriate numbers):

1. ________________ should be referred for (additional testing/consults) to ______________________________.

2. Voice therapy to address the areas of ____________________ should be implemented (immediately/following confirmation of clinical impressions by further testing). Therapy regimen should consist of ______________________________.

3. Voice therapy is not recommended at this time but __________ __________ should return if the condition (persists/deteriorates).

4. ________________ was counselled concerning ____________
____
____
____

Signature: ____________________ Title: ____________________

Date: ____________________

APPENDIX

B

Intervention Information and Materials

CONTENTS

B-1. Clinician Information: The Smith Accent Method of Voice Therapy

This approach to correcting faulty vocal behavior has been recommended by Kotby et al. (1991). They present data to support their suggestion that the method is useful in cases of functional dysphonia and selected cases of organic pathology (e.g., nodules, polyps, and Reinke's edema). **The Smith Accent Method** (Smith et al., 1976) involves correction of faulty vocal technique as well as counselling about vocal hygiene. Counselling focuses on two main categories and is prescriptive.

Counselling

1. *Do/do not do* includes avoidance of alcohol and spirits, smoking, and screaming.
2. *Try to* includes advice to increase fluid intake, avoid frequent throat clearing, and avoid dry, dusty places.

Vocal Procedures

1. Explanation concerning why voice training begins with breathing exercises. Relaxation is achieved through the regular, rhythmic diaphragmatic breathing. During the training, attention may be given to adjustment of patient's posture, activation of the articulators, and widening of the pharynx.
2. Using lower chest expansion during breathing, the patient "sings" the various vowels at a slow "3/4, largo" rhythm to produce an accentuated long relaxed phonation on the last vowel in a sequence. Faster rhythm "4/4, andante" and later double-speech, "4/4, allegro" rhythms are introduced. The aim is the production of repeated short phonations with increases in the length of the series (e.g., number of vowels sung). The different rhythmic types are randomized and then produced with interplay.
3. The patient is gradually led to (a) optimal pulmonary support; (b) optimal timing between pulmonary exhalation and onset of phonation; and (c) optimal phonatory effort. A breathy voice may be encouraged during the initial stages of the program. Modeling by the clinician and auditory monitoring by the patient are used until goals are achieved.
4. Simple articulated speech is then introduced and modeled by the clinician and imitated by the patient. The following steps lead the patient to spontaneous speech. (a) vocal play of nonsense syllables; (b) imitation of connected speech utterances; (c) reading aloud; and (d) self-generated monologue.

5 The therapy program usually requires twenty to twenty-five 20-minute sessions for completion.

References

Kotby, M. N., El-Sady, S. R., Basiouny, S. E., Abou-Rass, Y. A., & Hegazi, M. A. (1991). Efficacy of the accent method of voice therapy. *Journal of Voice, 5,* 316–320.

Smith, S., & Thyme, K. (1976). Statistical research on changes in speech due to pedagogic treatment (The Accent Method). *Folia Phoniatrica, 28,* 98–103.

B-2. Clinician Information: The Alexander Technique

Matthias Alexander was an Australian actor who experienced vocal problems. He solved his own problems by using an approach that has become known as **The Alexander Technique**. It is hard to describe and is best demonstrated by a qualified trainer. Essentially, the technique is about natural body alignment and optimal and free body movement. When Alexander spoke of the "self" he meant the entire mind/body entity.

The technique is probably best known as a way of achieving good posture without strain. Instead of contracting muscles to hold various parts of the anatomy in place, the Alexander student learns to release and relax the muscles that hold him or her in incorrect positions. Words used by students to describe improved movement patterns when walking include, "lighter, taller, more balanced, gliding, thinner, smoother, arms swinging, hip joints looser, less extraneous movement, shoulders released, straighter, less stiff, graceful, and energized." Musicians find they are more comfortable and performances improve, and actors learn to meet the physical demands of their roles and improve voice and stage presence. Changes in voice quality may occur as chronic tension is released. Alexander corrected his own voice problem in 1888 by observing himself in a set of mirrors as he spoke. He observed that he breathed in, tilting his head back and exerting downward pressure on the spine as he spoke. His tilt of the head was not an isolated movement, but connected to other patterns of misuse. He arched his back and tensed his legs and feet. This led him to hypothesize that there is, in all of us, an integrating mechanism that would guide us toward better coordination and function if allowed to operate without interference.

References

Alexander, F. M. (1942). *The universal constant in living.* London: Chaterson Ltd.

Rosenthal, E. (1981). Alexander technique: Notes on a teaching method. *Contact Quarterly,* 14–18.

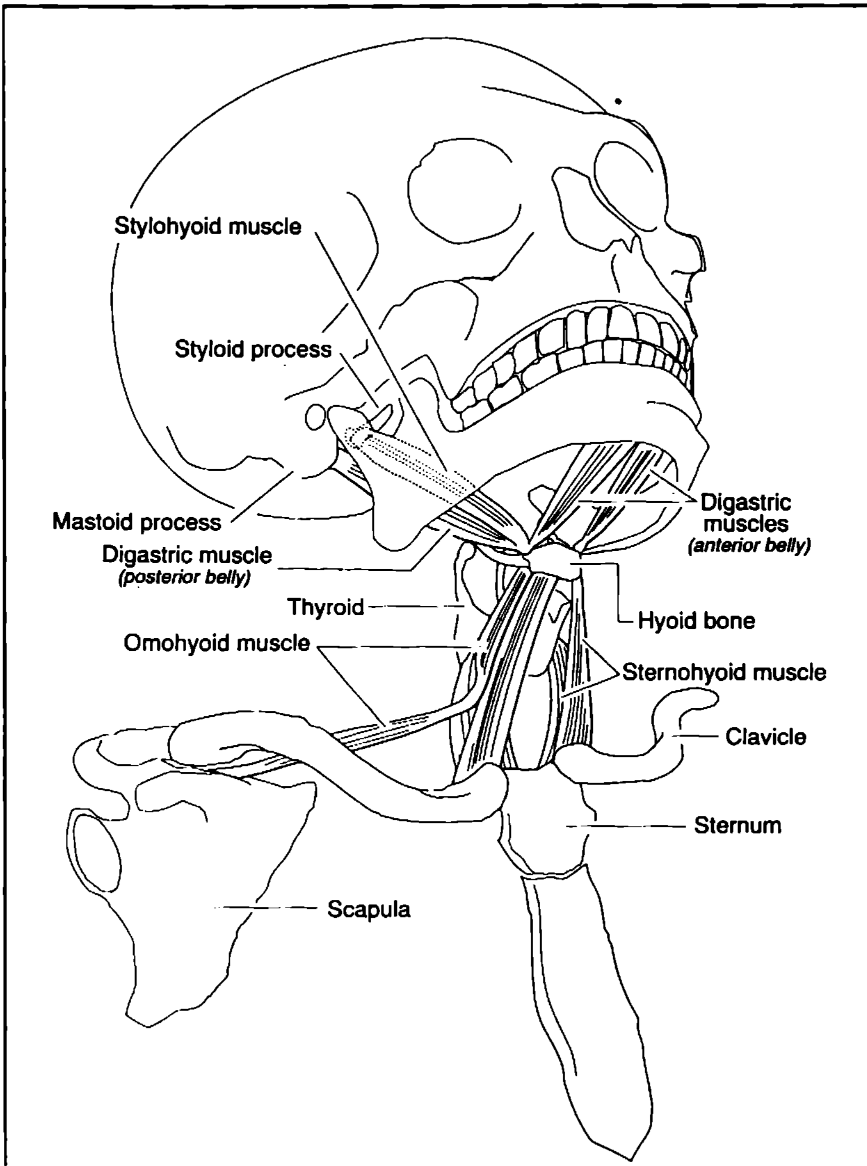


Figure B-1. Diagram illustrating the muscular connections between structures in the head and neck. This picture is useful to show clients the importance of correct postural alignment.

B-3. Clinician Information: Premenstrual Syndrome in Singers

Davis and Davis (1993) reported the results of a survey to evaluate the frequency and severity of 67 general physical and psychological symptoms and 20 vocal symptoms experienced by 104 female singers. The most frequently reported general symptom was abdominal bloating; the most frequently reported vocal symptom was difficulty singing high notes. They reported that, despite the many proposed treatments for PMS, none has been found to be universally or consistently effective. The following treatments are discussed in their article.

1. Lifestyle modifications including limiting caffeine, sodium, fats, refined sugar, and alcohol intake have been reported to be helpful by some women. Additionally, exercise and stress management programs have been recommended.
2. Vitamin and mineral supplements, medications including progesterone supplements, diuretics, vasoconstrictors, antihistamines, decongestants, beta-blockers, antidepressants, muscle relaxants, and analgesics have been noted as possible treatments but there are no efficacy studies to date.

Realistic compensations for PMS symptoms include rest, dietary changes, exercise, medications, and adjustments in singing routines. Being aware of the problem will help the singer avoid guilt and loss of confidence following disappointing performances.

3. Voice teachers should counsel students about the cyclical edema of laryngeal and nasal mucosa that some women experience. They can help singers to avoid overuse of the voice, general fatigue, and anxiety by adopting a practical approach to management. Some teachers may worry that discussion of PMS may encourage some students to use the condition as an excuse for not working hard. Rather, the reverse seems to be the case. When students are encouraged to problem-solve concerning ways to deal with minor vocal changes, their anxiety lessens and energy can be directed more effectively during practice.

Reference

Davis, C. B., & Davis, M. L. (1993). The effects of premenstrual syndrome (PMS) on the female singer. *Journal of Voice, 7,* 337–353.

B-4. Practice Materials: Worksheet of Voice Stimulability Materials

When we want to stimulate changes in vocal production we often use specific phonemes to enhance success. For example, if a client needs to strengthen vocal fold adduction, but avoid excessive compensatory tension, attention may be directed to the articulation of voiced sounds. This can distract from laryngeal effort and provide a way of demonstrating how voicing can be prolonged more easily. Conversely, if we have a client who overadducts the vocal folds and uses "pressed" phonation, the practice materials may be loaded with relaxed vowels and unvoiced consonants to stimulate higher airflow.

Activity I: Contrastive Pairs

lecher	leisure	grossing	groaning
insure	innure	writing	riding
bashes	badges	riches	ridges
eppy	eddy	scratchy	scrabby
etching	edging	lesser	leather
betting	bedding	conceit	concede
witchy	widgy	ouchy	Audi
flashing	flagging	flossing	flogging

Activity II

Take the following word pairs and lengthen the vowel *and* final consonant. Observe how it *feels* and *sounds*. Make the necessary adjustments in mouth, lip, and tongue movements in order to produce the best voice quality.

bustle	bundle	mash	Madge
batch	badge	leech	liege
ortchy	orgy	rusts	runs
ghost	goes	Jass	jazz
rope	Rome	light	line
weight	whale	gosh	Gods
ship	shill	smootch	smoodge

B-5. Practice Materials: Worksheet for Spontaneous Speech Practice

Read the sentences below then tell them to me in your own words. Feel free to change, elaborate, comment, or describe examples of your own experiences.

1. Winston Churchill said that success consists of going from failure to failure without loss of enthusiasm.
2. It has been said that the difference between a wise person and a smart person is that the smart person knows what to say and the wise person knows whether or not to say it.
3. Edmund Burke said that the way for evil to flourish is for good people to do nothing.
4. Shakespeare said they would smell as sweet by any other name; Robert Louis Stevenson said marriage was not a bed of them; Robert Herrick bid young girls to gather them while they may; Most Americans say they are their favorite flowers; and florists sell a lot on Valentine's Day.
5. Some people believe you can learn something from everything. Take tea for example. It appears stronger when it is in hot water.
6. It may sometimes be preferable not to see an insult than to have to avenge it.
7. A writer who obviously enjoys rhyme wrote that a pound of pluck is worth a ton of luck.
8. An old man once said that he had known many lovely women but no perfect ones. His companion remarked that she had never known a perfect man either.
9. Edward Gibbon said that the winds and waves are always on the side of the ablest navigators.
10. Abba Eban said that a lawmaker who keeps an ear permanently glued to the ground will have neither elegance of posture nor flexibility of movement.
11. Craig Claiborne remarked that cooking is both child's play and adult joy and also when it is done with care, it is an act of love.
12. Joe Paterno said that whether you're on a sports team, in an office, or in a family, if you can't trust one another, there's going to be trouble.
13. Benjamin Disraeli, who was Prime Minister of England under Queen Victoria, said that there is no index of character so sure as the human voice.
14. Joe Kogel remarked that the worst thing in your life may contain seeds of the best. When a person can see crisis as an opportunity, life becomes not easier, but more satisfying.

15. Laurence J. Peter suggests that you don't need to take people's advice to make them feel good. Instead, you merely have to ask for it.
16. Changing one's voice may be a little like losing a lot of weight. One has to revise one's inner image of oneself as well as practice new behaviors.
17. There are three stages in learning to eliminate throat clearing. The first stage is when you realize you've done it after you've done it. During the second stage, you catch yourself as you are doing it. Finally, you get to the point where you realize you are about to do it and stop before you do.
18. The eyes are called the windows of the soul and voices sometimes mirror feelings that we are not even sure we have.
19. Making conversation can be difficult if we are eager to make a good impression. Try to ask questions to draw out the other person's ideas and opinions. Remember too, that sincere compliments are usually well received.
20. In order to project confidence and authority, a speaker may need to limit the amount of talking and also the degree of elaboration used.

B-6. Practice Materials: Reading Passages on Humidifiers and Breath Support

Humidifiers

Humidifiers are sometimes recommended for problems such as respiratory tract conditions. However, great care must be taken to prevent contaminants such as bacteria, mold, mildew, and dust mites from invading these machines. Most manufacturers' instructions recommend daily cleaning and the use of distilled water. Even an ultrasonic humidifier that kills microbes can disperse fragments of them into the air. Mineral-laden tap water used in a humidifier also can cause irritating particles to be dispersed into the air along with the humidity. Some experts assert that modern steam humidifiers are less risky. Many believe that the humidity indoors should be between 30 and 50 percent. Others say it should be no more than 35 percent. Too much humidity leads to the growth of mold and mildew in the house itself, as well as causing deterioration of wood and paint.

Breath Support

When we talk about "breath support" for speaking, we are referring to the way a person *uses* his or her tidal volume of air for phonation. Most speakers do not have serious pulmonary difficulties (e.g., emphysema) that affect respiration. However, many do have problems making the best use of the air that is available. For example, for speech breathing we take a quick, deep inhalation and use the longer exhalation phrase during vocalization. We replenish before we are completely out of air in order to avoid talking on residual air. Air is free and so we should use it without trying to economize. If we do struggle to talk too long without replenishing, the voice sounds starved for air. During singing, the music dictates where we can breathe. This is not the case during speech so we can replenish whenever it makes sense to do so. Check the efficiency of your speech breathing patterns. Are you coordinating the onset of speech with the beginning of the exhalation phase and avoiding hard attacks? Are you replenishing frequently? Is your inhalation quiet and relaxed and deep enough?

B-7. Clinician Information: Addresses of Suppliers of Voice Amplifiers and Software

Voice Amplifiers

Communicative Medical, Inc.
P.O. Box 8241
Spokane, WA 99203-0241
(800)944-6801
FAX: (509) 838-0160

Head-neck equipment, including artificial larynges, voice amplifiers, batteries and stoma-care products.

Kelleher Medical, Inc./NAGASHIMA
9710 Farrar Court, Suite N
Richmond, VA 23236
(804) 323-4040
FAX: (804) 323-4073

NAGASHIMA manufactures a high-quality, compact, lightweight voice amplifier, which works via bone conduction.

Luminaud, Inc.
8688 Tyler Blvd.
Mentor, OH 44060
(216) 255-9082
FAX: (216) 255-2250

Personal and portable voice amplifiers for people with voice volume impairment or need of voice rest.

Stanton Magnetics, Inc.
101 Sunnyside Blvd.
Plainview, NY 11803
(516) 349-0235
FAX: (516) 349-0230

The Stanton ADDvox II amplifier/speaker system is a body-worn amplifier speaker intended for use with the Stanton M.I.T. (Miniature Inertial Transducer). The primary application is for speech enhancement of those who have difficulty projecting their voices, and where a microphone in front of the lips is impractical. System is available in headband or neckband versions.

Hocks Hearing Healthcare Products
P.O. Box 6616
3930 S.W. Kelly
Portland, OR 97208/97201
(800) 653-6257, (503) 274-9482
FAX: (503) 222-3539

Telephone accessories include ear pads, whistle stops, Tel-Ear, amplifiers-portable telephone and handsets, alerting devices, and a complete line of TDDs.

Voice Software

The Psychological Corporation
555 Academic Court
San Antonio, TX 78204-2498
(800) 228-0752
FAX: (800) 232-1223

A wide array of clinical software: THINKable™, SpeechViewer II™, Computerized Boston, CELF-R Clinical Assistant, Scoring Assistant, and Computerized Profiling.

Video Voice Speech Training System–Micro Video Corporation
210 Collingwood, Suite 100
P.O Box 7357
Ann Arbor, MI 48107-7357

(800) 537-2182
FAX: (313) 996-3838

Entertaining games and colorful graphic displays for training vowels, word articulation, pitch, intensity, duration, fluency, connected speech, and more; Apple II-, PC-, and Macintosh LC-compatible.

Laboratory Equipment

Glottal Enterprises
719 East Genesee Street
Syracuse, NY 13210
(315) 424-1780
FAX: (315) 478-6902

Instruments for noninvasive aerodynamic and electroglottographic measurement of vocal function for research lab or clinic, including Rothenberg masks for inverse filtering and patented dual-channel electroglottographs.

Kay Elemetrics Corporation
12 Maple Avenue
P.O. Box 2025
Pine Brook, NJ 07058-2025
(201) 227-2000, Ext. 111
FAX: (201) 227-7760

Hardware/software systems for assessment and treatment. Systems include the VisiPitch, Palatometer, Nasometer, and Computerized Speech Lab (CSL).

NeuroLogic, Inc.
1101 E. Southdowns Drive
Bloomington, IN 47401
(812) 339-3289

AEROSPEECH: A noninvasive system for assessment and feedback of aerodynamic function.

APPENDIX

C

Clinician Information and Materials for Pediatric Phonatory Disorders

CONTENTS

C-1. Clinician Information: When to Refer Children to a Mental Health Professional

A. Therapeutic Approaches Used in Psychotherapy with Children

1. **Behavioral therapy** grew out of experimental psychology and uses principles of conditioning. A child is given incentives or rewards for modification of specific behaviors. Parents are helped to change the ways they respond to their child as a means of extinguishing or shaping behaviors that are targeted. Hierarchies are established, and behavioral patterns are addressed through a sequence of steps.

2. **Psychodynamic therapy** grew out of Freudian psychoanalytic therapy. It focuses on the origins or underlying issues of a child's problem. Young children are encouraged to engage in activities that elicit symbolic representations of family interactions (e.g., mother, father, and child dolls). Drawing or interpretation of drawings is also used. Therapists usually work privately with each child and establish relationships that help them share and understand their feelings.

3. **Family systems therapy** examines patterns of interaction among family members. Typically this approach may include some behavioral as well as psychodynamic techniques. Usually an entire family meets with the therapist and is also given specific homework assignments (e.g., listening for a set period of time without interrupting or commenting while others speak).

B. Behaviors That Warrant Referral

Most mental health professionals believe that a healthy family is one where parents and children learn to handle most crises and problems but know when they need to seek outside help. All children face emotional difficulties of one kind or another and certain stressful events are common precipitating factors (e.g., births, deaths, divorce, and moving to a new location). Descriptions of problems that most commonly cause children to be referred to a mental health professional follow.

1. **Parent-child conflicts that are constant or worsen across time**

   a. Stormy or silent power struggles

   b. Step-parent conflicts

      (1) Child blames adult for parents' divorce

      (2) Child feels disloyal if close to step-parent

   c. **Child is violent and harms self or others**

2. **School problems** may reflect problems at home or be related to learning disabilities that are undiagnosed

   a. Sudden poor grades

   b. Withdrawal

   c. Acting out

   d. Extreme procrastination in older children

   e. Becoming increasingly anxious over tests

3. **Misconduct** that is chronic, rather than occasional, and takes on new forms across time. These children are difficult to handle both at home and at school.

   a. Do not get on with other children

   b. Develop a reputation for being difficult or dangerous

   c. Ignore or flaunt rules consistently

4. Prolonged or excessive **anxiety**

   a. Anxious about life in general

   b. Phobias concerning objects or situations

   c. Excessive separation anxiety (serious if child is over 4 years old, persists for weeks, or child refuses to go to school)

   d. Extreme reticence (long-term and inhibits function)

5. **Attention-Deficit Hyperactivity Disorder**

   a. Inability to finish tasks, follow instructions or take turns

   b. Difficulty mastering basic skills

   c. Unfocused and often in trouble

6. **Depression** has been identified in children as young as 2 years of age. Sadness is frequently *not* the most obvious sign in children under 8 years. Depression requires a referral only if it is long-lasting and cannot be explained by grieving over a specific stress or trauma.

   a. Anger, belligerence, irritability

   b. Trouble concentrating

   c. Vague physical complaints

   d. Marked change in personality

   e. Lack of participation in daily life activities

7. **Bed-wetting** (enuresis) that occurs at least twice a month in a 6-year-old or once a month in an older child is a cause for referral. It is believed that about 7% of boys and 3% of girls have this problem at 5 years and that it persists in about 3% of 10-year-olds. Possible physical causes include diabetes or obstruction of the urinary tract. Some behavioral modification therapies are used (such as "bed alarms") to treat this problem.

8. **Obsessive-compulsive disorder** is characterized by obligatory rituals and such behavior is worthy of referral if it is repeated more than occasionally. Children with this problem may not realize their obsessive beliefs are irrational (e.g., continuous hand washing because of fear of germs).

   a. Unbearable tension builds if ritual not repeated

   b. Rituals take up excessive amounts of time

   c. Belief that a dreaded event can be prevented by ritual

9. **Eating disorders** have been reported in girls as young as 7 years of age but occur more frequently in teenagers. These are serious and dangerous emotional problems and referral should be made if bulimia or anorexia nervosa is suspected.

   a. Distorted body perceptions

   b. Weight loss (anorexics)

   c. Weight fluctuations (bulimics)

C-2. Clinician Information: Mental Health Referrals for Adolescents

It is important to recognize signs of emotional disequilibrium in teenagers and to make appropriate referrals promptly. Suicide is the third leading cause of death for teens and one American teenager attempts suicide every 60 seconds. Every 90 minutes one succeeds. Such shocking statistics underscore the importance of recognizing the signals patients send through noticeable changes in their behavior.

Suicide Signs to Watch For (refer if you note more than two)

Changes in eating/sleeping habits

Avoidance of normal activities

Angry outbursts/irritability

Tearfulness

Personality changes/moodiness

Self-abusive behavior (i.e., reckless driving)

Use of alcohol and drugs

Irrational or bizarre behavior

Giving away prized possessions

Talking about death

Suicide threats or attempts (take these seriously)

Drug Use Signs to Watch For

Wild mood swings (dramatic changes in behavior)

Poor concentration (may be signs of marijuana, cocaine, or crack use)

Bloodshot eyes (may be caused by marijuana)

Serious lack of sleep or unusual pattern (may result from cocaine or crack)

Changes in appetite (dramatic increase may signal marijuana use and dramatic decrease may signal use of cocaine or crack)

Enlarged pupils (may be due to cocaine or crack)

A frequently runny or stuffy nose or regular nose bleeds (may indicate use of cocaine)

C-3. Clinician Information: Bibliography of Readings Concerning Cheerleaders

Aaron, V. L., & Madison, C. L. (1991). A vocal hygiene program for high-school cheerleaders. *Language, Speech and Hearing Services in Schools, 22,* 287–290.

Andrews, M., & Shank, K. H. (1983). Some observations concerning the cheering behavior of school-girl cheerleaders. *Language, Speech and Hearing Services in Schools, 14,* 150–156.

Blager, F. B. (1991, December). Follow-up study of high-risk voice users. Paper presented at the American Speech-Language-Hearing Association, National Convention, Seattle, WA.

Blager, F. B., Scherer, R. C., Brown, L. R., & Lemke, J. N. (1993, June). Measuring the impact of prevention on vocal abuse: University cheerleaders. *NCVS Status Report, 4,* 113–119.

Campbell, S., Reich, A., Klockars, A., et al. (1988). Factors associated with dysphonia in high school cheerleaders. *Journal of Speech and Hearing Disorders, 53,* 175–185.

Gillespie, S., & Cooper, B. (1973). Prevalence of speech problems in junior and senior high schools. *Journal of Speech and Hearing Research, 16,* 739–743.

McHenry, M. A. (1983). *Vocal SPL control in cheerleaders with a history of frequent, acute, cheering-related, dysphonic episodes.* Unpublished doctoral dissertation, University of Washington, Seattle.

McHenry, M. A., & Reich, A. R. (1985). Effective airway resistance and vocal sound pressure level in cheerleaders with a history of dysphonic episodes. *Folia Phoniatrica, 37,* 223–231.

Reich, A. R., & McHenry, M. A. (1987). Respiratory volumes in cheerleaders with a history of dysphonic episodes. *Folia Phoniatrica, 39,* 71–77.

Sander, E., & Ripich, D. (1983). Vocal fatigue. *Annals of Otology, Rhinology and Laryngology, 92,* 141–145.

Scherer, R., Gould, W. J., Titze, I., Meyers, A., & Sataloff, R. (1988). Preliminary evaluation of selected acoustic and glottographic measures for clinical phonatory function analysis. *Journal of Voice, 2,* 230–244.

Yumoto, E., Gould, W. J., & Baer, T. (1982). Harmonics-to-noise ratio as an index of the degree of hoarseness. *Journal of the Acoustical Society of America, 71,* 1544–1550.

C-4. Handout: Information for Parents of a Child with Tracheostomy

A tracheostomy is the formation of an opening in the trachea (windpipe) and the insertion of a rigid or flexible tube to establish and maintain an open airway to the lungs. The incision is made below the larynx (voice box) near the base of the neck. The length of time a child requires a trach varies. It may be days or years depending on the medical condition. Your physician will explain the reasons for the trach, in detail, if you ask. It is important that you fully understand your child's condition as every situation is different.

Small trach tubes, such as those used for children, are usually either a one-piece or two-piece construction (e.g., trach tube alone or with an obturator. The obturator serves as a guide during insertion.). In larger tubes, such as those used with adults, an inner cannula or sleeve may also be used. This may be removed for cleaning. Trach tubes may be fastened around the neck with cotton tapes.

You will be trained in the care of the trach before your child leaves the hospital. If, after your child is home, you decide to train other care providers in trach care, supervise their practice carefully and ask them to explain the procedures in their own words to be sure they understand. Make sure they can perform all of the procedures appropriately under your supervision.

Routine suctioning of mucus may be upsetting to a child at first. Sometimes a doll is used to teach children about trach tubes. Children must be taught not to pull on the tube or insert anything into the tube. Other family members should also be taught about the importance of keeping the airway unobstructed. For example, sand and water games should be avoided. Your child will need reassurance and support, but should be treated as normally as possible.

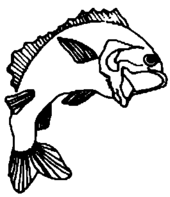
Some Important Points

1. The looser your child's secretions, the easier the breathing and coughing of mucus will be. Maintain fluid intake, use humidifiers or nebulizer-type mist as directed by your physician. This helps to avoid blockage of the tube with mucus plugs.

2. Clothing should be open at the neck. Clothing that sheds or has lint deposits should be avoided. Beware of pets that shed hair or fur. Use a

There once was a rat
Who got very fat
And scratched noisily. (scratch on table)
He didn't like light, (when Jay switched it on)
So he ran out of sight,
And just said "tee tee tee."

Then lip movements were emphasized and /b/ was paired with the vowel /i/. The tempo for this rhyme was slow and the lip movements were exaggerated and involved some fish-like lip smacking much to Jay's delight.



There once was a fish, (hand movement)
Who lived in a dish (arms in circle)
And swam about lazily. (hand motion)
He moved his lips, (lip rounding)
And wiggled his hips, (hip movement)
And just said "bee bee bee."

Jay blew bubbles in a glass of water (to sustain airflow), made "fish" noises with his lips, made fish mouth shapes, kissed like a fish, and made rapid repetitions and also long "bee" sounds.

The continuity of theme and rhythmic patterning provided the enjoyment implicit in recognition and anticipation of enjoyable refrains. Exposure to, and play involving vocal patterns, is a critical part of voice therapy with preschool children.

C-6. Practice Materials: Vocal Variation for School-Age Children

Instructions: Make sure your voice shows a pitch difference for each speaker as you read these jokes. You may also try other ways to vary your voice as you practice these jokes.

1. Question: "What did the hat say to the scarf?"
   Answer: "You hang around while I go on ahead."

2. Piano Tuner: "I've come to tune your piano."
   Man: "But we didn't send for you."
   Piano Tuner: "No, but your neighbors did."

3. Question: "What were the Chicago gangster's last words?"
   Answer: "Who put that violin in my violin case?"

4. Question: "What is a certain way to get a wild duck?"
   Answer: "Buy a tame one and annoy it."

5. Question: "What did one ear say to the other ear?"
   Answer: "Between us we need a haircut."

6. Question: "Sir, would you like to buy a pocket calculator?"
   Answer: "No thanks. I know how many pockets I've got."

7. Question: "What did the river say to the elephant who sat on it?"
   Answer: "Well, I'll be dammed."

8. Question: "What do you give an elephant with big feet?"
   Answer: "Plenty of room."

9. Question: "When is it bad luck to have a black cat follow you?
   Answer: "When you are a mouse."

10. Question: "When do you get that run-down feeling?"
    Answer: "When a car hits you."

    Question: "What is a synonym?"
    Answer: "A word you write when you can't spell the other one."

12. Question: "What did the hotel manager say to the elephant who couldn't pay his bill?
    Answer: "Pack your trunk and clear out."

13. Question: "What do you give to an elephant who is agitated?"
    Answer: "Trunkquillizers."

14. Question: "How can you avoid falling hair?"
    Answer: "Get out of the way."

15. Drugstore Owner: "You owe me for this tube of lip balm."
    Duck: "Just put it on my bill."

16. Question: "What's purple and has sixty legs and big teeth?"
    Answer: "I don't know, but if you see one, run for your life."

17. Question: "What do you get when you cross a crocodile with a rose?"
    Answer: "I don't know, but I wouldn't try smelling it."

18. Question: "What's the best way to communicate with a fish?"
    Answer: "Drop it a line."

19. Question: "What is the best way to make fire from two sticks?"
    Answer: "Make sure one of the sticks is a match."

20. Question: "Where does an 800-pound gorilla sleep?"
    Answer: "Anywhere he wants."

C-7. Practice Materials: Worksheet for School-Age Children to Match Voice with Meaning/Feeling in Sentences

1. Say these words in a loud voice and then in a soft voice and decide which is best and why. Your teacher will help you.

   a. The baby is asleep. Don't wake her.
   b. Fire! Fire! Call the Fire Department!
   c. I'm sorry. I won't do it again.
   d. Surprise! Surprise! Happy Birthday!
   e. Halt! Who goes there?
   f. This kitten is very timid and shy.
   g. Do you have a headache, Mom?
   h. Billy is busy doing his homework.
   i. The patient is ill and cannot be disturbed.
   j. Hooray! We won! Wow!

2. Say the following sentences using the pitch of your voice to show what is happening.

   a. I zipped my jacket up and down.
   b. The boat sank lower in the water.
   c. The rocket shot up and then dropped to earth.
   d. See the cat, right up on that high branch?
   e. The flute played a high, happy tune.
   f. The drum went "Boom, Boom, Boom."
   g. Hang on, the roller coaster goes up and down.
   h. See the stars twinkling up there in the sky?
   i. I'll climb up and then throw the ball down to you.
   j. The diver went down into the murky depths.

3. Say the following sentences using a different pitch for the direct (what the person actually says) and indirect speech.

   a. My friend Mary said, "I don't want any cookies, thanks."
   b. "Make sure you wash your hands well," Dad said.
   c. Mike was excited and yelled, "The ball is out!"
   d. The bus driver said, "Next stop is tenth street."
   e. The sales clerk said, "That will be ninety-nine cents."
   f. The dog looked friendly and so I called, "Come."
   g. "Please sit down," said the school bus driver.
   h. "Green beans or corn?" said the cafeteria worker.
   i. "Now, remember," said the teacher, "Read the questions over carefully."
   "Hi," said Rodney, "I just moved in next door."

C-8. Practice Materials: Worksheet for Rate Variation

Goal: To practice "reading" nonverbal messages.

Rationale: Some children cannot accurately decode face and body language and voice cues.

Activity: Timing Cues

The teacher shows the child two pictures. One is of a child in a hurry and the other one is of a child moving slowly. The child and teacher together match the words (fast/slow) to the appropriate pictures. Then the child practices rate variation.

Sample sentences: I can't stop now.
My legs are so tired.
I wish someone would give me a ride.
I'm in a hurry to get home.

References:

Andrews, M. L. (1993). *Using your best voice.* Tucson, AZ: Communication Skills Builders.

Flynn, P. T., Andrews, M. L., & Cabot, B. (1990). *Using your voice wisely and well.* Tucson, AZ: Communication Skills Builders.

Nowicki, S., & Duke, M. P. (1992). *Helping the child who doesn't fit in.* Atlanta: Peachtree Publishers.

C-9. Practice Materials: Worksheet for Prosodic Change Using Imagery

A. Pictures in our head help us to make voice changes. When we think about slow moving things, for example, our sentences are slow.

1. The crocodile slid quietly into the water.
2. The turtle inched its way along the path.
3. The long worm slowly moved through the mud.

Think about these sentences.

1. The horse galloped as fast as the wind.
2. The motor boat raced across the lake.
3. The train went one hundred miles an hour.

B. See if you can let your voice show us the pictures of these scenes.

1. The waves rippled gently on the sand.
2. The boy jumped high and then fell as he landed.
3. The tires squealed as the car sped around the corner.
4. There was a thud as the mail bags hit the sidewalk.
5. The drum boomed and the cymbals crashed.

C. Listen to the beat[1] and see if you can match your words to it.

1. The music played and the children marched (or ran or walked).
2. The children sang a happy song (or sad or skippy).
3. The band went on and on and on and on . . .

D. Think of some different things and try to make your voice sound like them. Think of how they feel and look.

1. My voice is like a bunny's velvet ears.
2. My voice is rich like dark chocolate.
3. My voice is like tinkling wind chimes.
4. My voice is smooth like the sand in the desert.
5. My voice is like a submarine gliding through the depths of the ocean.

---

[1] The tempo may be clapped or a digital metronome may be used. Digital metronomes, such as the pocket-sized Seiko DM-40, are useful also for providing stimulus tones with frequency display in Hz.

C-10. Practice Materials: Worksheet to Learn Descriptors of Voice

Animal Voices

1. Which has a loud voice, a bird or a lion?
2. Which has a squeaky voice, a cow or a mouse?
3. Which has a rough voice, a cat or a gorilla?
4. Which has a high voice, a chicken or a big, black bear?
5. Which has a soft voice, a kitten or a big dog?
6. Which has a hissing voice, an elephant or a snake?

People's Voices

1. Who has a high voice, a man or a baby?
2. Who has a whispery voice, a girl talking in class or a T.V. newsperson?
3. Who has a jerky voice, someone humming or someone talking while out of breath?
4. Who has a low voice, the father or his first grader?
5. Who has a hoarse voice, someone with a sore throat or someone with a broken leg?

Feelings (Draw lines between the ones that match.)

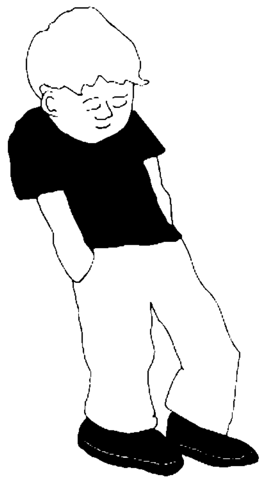
1. Opening presents	polite voice
2. Answering the telephone	quiet voice
3. The baby is asleep	happy voice
4. Umpiring a game	whining voice
5. Annoying your Mom	a loud voice

Talk about when you use these voices

1. a friendly voice
2. a defiant voice
3. a tired voice
4. a soothing voice
5. a scared voice

Match your voice to the way this boy feels as you say these sentences

1. I don't know the answer.
2. I'm embarassed.
3. I can't do it.
4. I failed the test.
5. My Mom said I can't play.



C-11. Practice Materials: Poems to Evoke Prosodic Variation

1. I'm a lean dog, a keen dog, a wild dog and lone.
   I'm a rough dog, a tough dog, hunting on my own.
   I'm a bad dog, a mad dog, teasing silly sheep.
   I love to sit and bay at the moon, to keep you all from sleep.

   Irene R. McLeod

2. We climb out of bed with a frouzly head,
   and a snarly-yarly voice;
   We shiver and scowl, and we grunt and we growl
   At our bath and our boots and our toys.

   Rudyard Kipling

3. *Coyote*

   Blown out of the prairie in twilight and dew,
   Half bold and half timid, yet lazy all through;
   Loath ever to leave, and yet fearful to stay,
   He limps in the clearing, an outcast in gray.

   A shade on the stubble, a ghost by the wall,
   Now leaping, now limping, now risking a fall,
   Lop-eared and large-jointed, but ever alway
   A thoroughly vagabond outcast in gray.

   Bret Harte

4. *The World*

   Great, wide, beautiful, wonderful world,
   With the wonderful water round you curled,
   And the wonderful grass upon your breast
   World, you are beautifully dressed.

   You friendly Earth! How far do you go,
   With the wheat fields that nod and the rivers that flow
   With cities and gardens, and cliffs and isles,
   And people upon you for millions of miles?

   W. B. Rands

5. *Rilloby-Rill*

Grasshoppers four a-fiddling went,
Heigh-ho! Never be still!
They earned but little towards their rent,
But all day long with their elbows bent
They fiddled a tune called Rilloby-rilloby,
Fiddled a tune called Rilloby-rill.

"Madam, you see before you stand,
Heigh-ho! Never be still!
The old Original Favorite Grand
Grasshoppers' Green Herbarian Band,
And the tune we play is Rilloby-rilloby,
Madam, the tune is Rilloby-rill."

Sir Henry Newbolt

6. *Mr. Nobody*

I know a funny little man,
As quiet as a mouse,
Who does the mischief that is done,
In everybody's house!
There's no one ever sees his face,
And yet we all agree,
That every plate we break was cracked
By Mr. Nobody.
He puts damp wood upon the fire,
So water cannot boil;
His are the feet that bring in mud,
And all the carpets soil.
The papers always are mislaid,
Who had them last but he?
There's no one tosses them about,
But Mr. Nobody.

Anonymous

7. *Sleep*

In the dark and lonely night,
When the stars are all alight,
Sleep comes creeping up the street,

With her naked, silent feet;
Carrying upon her back,
Dreams of all kinds in a sack;
Though the doors are bolted, still
She can enter where she will;
And she lingers, it is said,
Longest by the children's bed;
Smooths their pillows, strokes their curls;
Happy little boys and girls!

Charlotte Druitt Cole

8. He was a rat, and she was a rat,
And down in one hole they did dwell,
And both were as black as a witch's cat,
And they loved one another well.

He had a tail, and she had a tail,
Both long and curling and fine;
And each said "Yours is the finest tail
In the world, excepting mine."

Anonymous

9. I had a little dog, and my dog was very small;
He licked me in the face, and he answered to my call.
Of all the treasures that were mine, I loved him most of all.

His body covered thick with hair, was very good to smell.
His little stomach underneath was pink as any shell;
And I loved him and honored him, more than words can tell.

Frances Cornford

10. *If I Knew*

If I knew the box where the smiles were kept,
No matter how large the key,
Or strong the bolt, I would try so hard,
'Twould open, I know, for me;
Then over the land and sea broadcast
I'd scatter the smiles to play,
That the children's faces might hold them fast
For many and many a day.

If I knew a box that was large enough
To hold all the frowns I meet,
I would gather them, every one,
From nursery, school and street.
Then folding and holding, I'd pack them in
And turn the monster key,
And hire a giant to drop the box
To the depths of the deep, deep sea.

Anonymous

11. *Who has seen the wind?*

Who has seen the wind?
Neither I nor you:
But when the leaves hang trembling,
The wind is passing through.

Who has seen the wind?
Neither you nor I:
But when the trees bow down their heads
The wind is passing by.

Christina Rossetti

12. *The Wind in a Frolic*

The wind one morning sprang up from sleep,
Saying, "Now for a frolic! Now for a leap!
Now for a madcap galloping chase!
I'll make a commotion in every place!"

William Howitt

13. *Autumn*

Whirling leaves, golden and brown,
Twisting and turning,
Hurrying down.

Driving wind, gusty and strong,
Whistling and sighing,
Rushing along.

Scudding clouds, grey-leaden sky
Laughing and playing,
Galloping by.

Roaming birds, gathered for flight
Chirping and preening,
Seeking sunlight.

F. Politzer

C-12. Clinician Information: Equipment Suppliers and Addresses

Tracheostomy, and Ventilator Speaking Valves

Boston Medical Products, Inc.
87 Rumford Avenue
Waltham, Massachusetts 02154
(617) 894-8844
FAX: (617) 894-5466

Boston Medical Products, Inc. is a full service ENT product manufacturer, featuring the Montgomery® Speaking Valve, a new low-resistance tracheotomy valve.

Passy-Muir, Inc.
4521 Campus Drive, Suite 273
Irvine, California 92715
(714) 833-8255
FAX: (714) 833-8299

The Passy-Muir tracheostomy and ventilator speaking valves provide uninterrupted speech without finger occlusion with many secondary benefits including: reduced secretions, improved swallowing, and more.

COMMUNItrach
Talking Tracheostomy Tube
Spectrum Medical of California
P.O. Box 16215
Irvine, California 92713
(714) 551-6610
FAX: (714) 551-2204

Spectrum Medical of California is the exclusive supplier internationally, of talking trach tubes.

Therapy Aids

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3857 Birch, Suite 194
Newport Beach, California 92660
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FAX: (714) 833-1005

Specializes in therapeutic materials designed for use with tracheostomized and/or ventilator dependent adults and children. Ask about Toby Tracheasaurus™ the newest line of pediatric therapy toys and materials.

Video Voice Speech Training
System Micro Video Corporation
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P.O. Box 7357
Ann Arbor, Michigan 48107-7357
(800) 537-2182
FAX: (313) 996-3838

Supplies entertaining games and colorful graphic displays for training vowels, word articulation, pitch, intensity, duration, fluency, connected speech, and more; Apple II-, PC-, and Macintosh LC-compatible.

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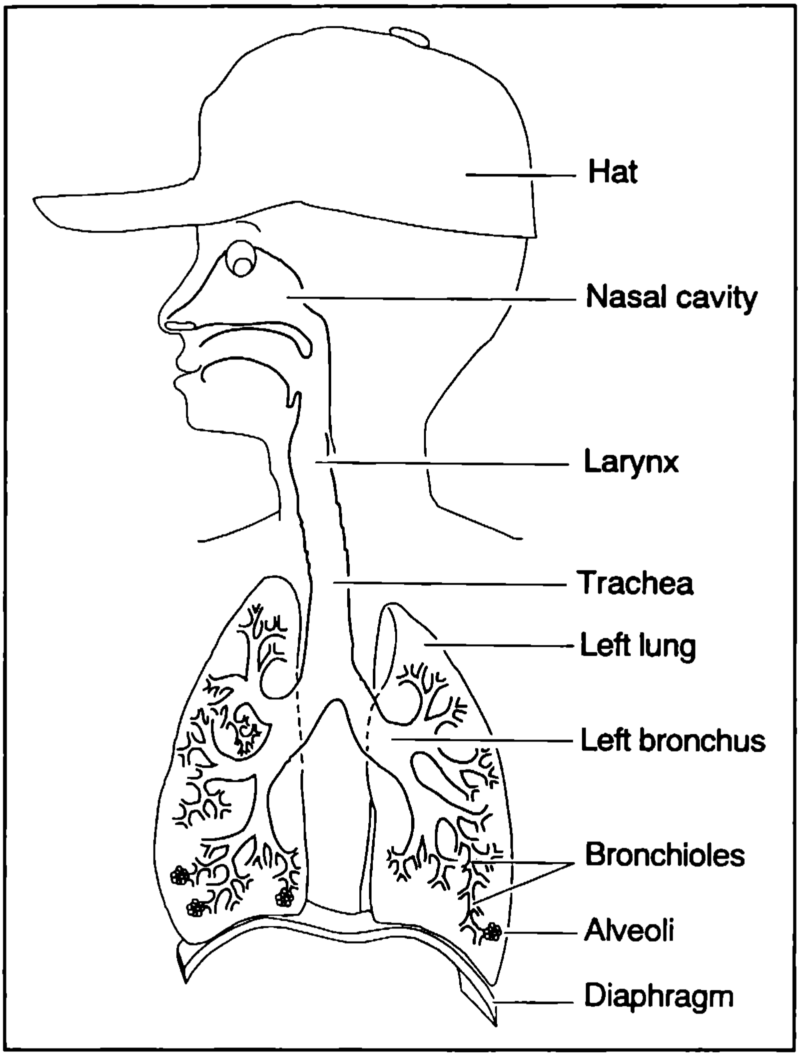
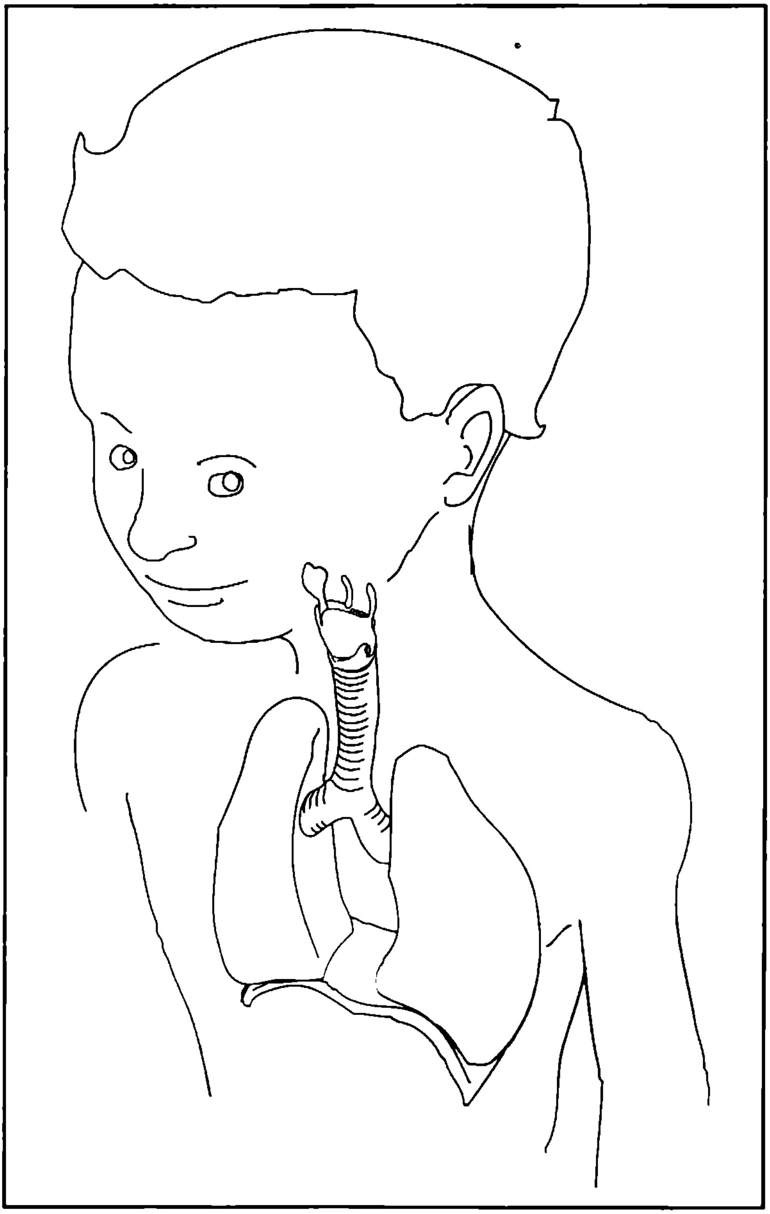
Tucson, Arizona 85716
(602) 323-7500, (602) 325-0306

Provides hands-on voice therapy materials. Our resources are packed with photos and reproducible activities and recordkeeping forms. Call for a free catalog.

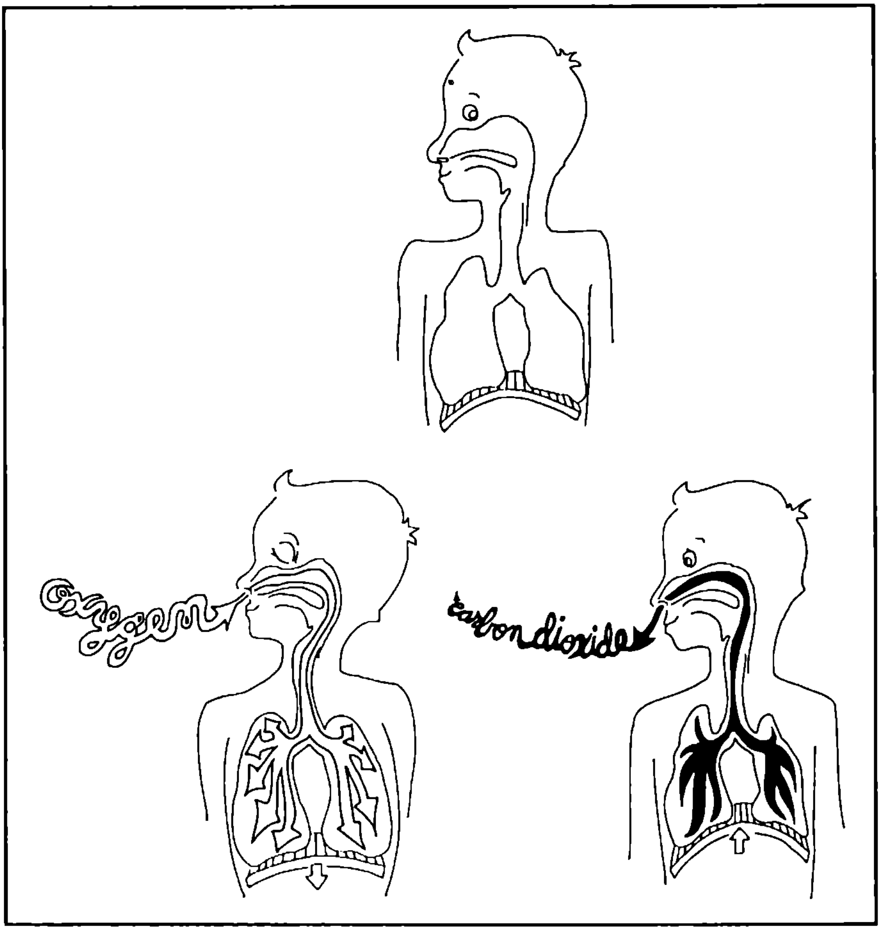
C-13. Handout: Diagrams for Children Learning About the Respiratory System



Lungs



Voice/Lungs



Breathing

APPENDIX

D

Clinician Information and Materials for Adult and Geriatric Disorders

CONTENTS

D-1. Clinician Information: Summary of Neurologic Disorders Affecting the Larynx

I. Lower Motor Neuron Paralysis (flaccid type)

Disorders may affect sensory as well as motor function, but motor dysfunction is usually more obvious. Incongruous or diminished laryngeal sensation may also be seen in association with infectious disease (e.g., tuberculosis) and psychogenic disorders (e.g., globus hystericus).

A. Loss of muscle tone (hyponia)

B. Loss of muscle bulk (atrophy)

1. Fibrillations (detected by EMG)

2. Fasiculations (muscle twitching)

C. Absent or reduced reflex response (if peripheral nerve affected by LMN lesion)

1. Areflexia

2. Hyporeflexia

D. No clonus

E. No Babinski sign (reflex toe sign)

F. Normal abdominal reflex (twitching of navel)

II. Lesions of the Lower Motor Neuron

A. Flaccid (bulbar) Dysarthric Dysphonia

1. Breakdown may occur at various levels (Kotby, 1992)

a. The muscles (e.g., muscular dystrophies [myopathy])

b. The neuromuscular junction (e.g., myasthenia gravis [a myoneural disorder])

c. The peripheral nerve system (e.g., main trunk vagus, inferior laryngeal nerve, or superior laryngeal nerve)

(1) Lesions of the PNS (neuropathy) may occur at the posterior fossa, intracranially, or at the jugular foramen, neck, mediastinum, and pulmonary apex.

(2) Syndromes resulting from combinations of cranial nerve lesions in the posterior fossa and jugular foramen include Vernet syndrome (IX, X, XI), Schmidt syndrome (X, XI), Hughling Jackson syndrome (X, XI, XII), Collet Sicard syndrome (IX, X, XI), and Horner syndrome (IX, X, XII).

2. Airflow rates in the presence of paralysis

Type	*Mean Flow*	*Source*
Unilateral paralysis	442.2 ml/sec	Yanagihara & Von Leden (1967)
Bilateral paralysis	312.8 ml/sec	Hirano et al. (1968)

III. Lesions of the Upper Motor Neuron (Spastic Dysarthric Dysphonia)

A. Symptoms

1. Increased muscle tone (hypertonia)
2. Hyperreflexia (exaggerated tendon reflexes)
3. Spastic paralysis
4. Clonus
5. Babinski sign
6. No fascilulations
7. Little or no atrophy (but muscle weakness)
8. Diminished abdominal reflex
9. Limited range of movement
10. Slow rate of movement

B. Breakdown may occur **as a result** of CVA, head trauma, tumor or infection causing damage to the corticobulbar or corticospinal tract. Unilateral tract damage does not usually affect communication significantly. Bilateral corticobulbar tract damage (pseudobulbar palsy) involves swallowing, chewing, and speaking.

C. There is a pattern of spastic dysarthria with the following **voice characteristics:**

1. Harsh quality
2. Strained/strangled
3. Excessively low pitch/breaks
4. Monoloudness
5. Reduced stress/inappropriate stress
6. Hypernasality

D. **Pyramidal bilateral lesions** cause spastic, hypertonic patterns.

E. **Amyotrophic lateral sclerosis** (ALS) has involvement of both lower and upper motor neurons and thus a mixed flaccid and spastic pattern is seen.

F. **Other conditions** in which the UMN has been implicated are multiple systems atrophy and paradoxical vocal fold motion.

IV. Extrapyramidal Lesions: Dyskinesias

Lesions in the basal ganglia and extrapyramidal pathways may result in either hypokinetic or hyperkinetic dysarthric dysphonia.

A. **Parkinsonism** is characterized by hypokinetic patterns. with a perception of harshness. hoarseness. breathiness. tremor, and rapid rate.

B. **Chorea** is characterized by hyperkinetic patterns with a perception of harshness and strain, lower than average pitch level, voice and pitch breaks, and hypernasality.

C. **Dystonia and athetosis** are movement disorders characterized by slow hyperkinesia. Dystonia is characterized by harsh or strain-strangled phonation, phonation breaks due to involuntary movements, and tremor. Athetosis (seen in cerebral palsy) may severely affect the coordination of respiratory, phonatory, and articulatory patterns.

V. Cerebellum and Pathway Lesions: Ataxic Dysarthric Dysphonia

Lesions may be specific to the cerebellum or there may be more global damage affecting multiple sites. There is disruption of smooth movement, intention tremor, irregularity of repetitive movements and hypotonia. The voicing patterns are characterized by prosodic irregularities and excessive loudness variations may also be seen.

A. **Multiple sclerosis** is characterized by a mixed pattern of spastic and ataxic dysarthria. Loss of control of loudness and pitch is seen in some patients and quality is usually harsh or less frequently, breathy.

B. **Shy-Drager syndrome** may include symptoms of cerebellar damage as well as pyramidal or extra-pyramidal damage. Voice disruptions include paresis and paralysis of the folds and variable ataxic and hypokinetic dysarthric patterns.

VI. Disorders with Unknown Etiology

The following disorders are believed to be neurologic in origin although site of lesion is not documented.

A. Respiratory dyskinesia

B. Spasmodic dysphonia

1. Abductor type

2. Adductor type

C. Essential voice tremor

D. Palatopharyngeal myoclonus

E. Gilles de la Tourette syndrome

D-2. Clinician Information: Neuroanatomical Areas Important in Speech and Song

Cerebrum

During speaking and singing, most motor control of the voice begins at the cortical level. It is the *primary* site even though some volitional movements do seem to be initiated at other locations. Inputs are both internal and external (e.g., an externally heard sound). Although the comprehension and production is generally mediated by the left cerebral hemisphere, neural control of the larynx and vocal tract involve both sides of the mechanism (e.g., paired nerves). Therefore, phonatory gestures probably rely on activity in both hemispheres. Fine control of the necessary muscle movements is dependent on events occurring in subcortical areas as well. The control of fine laryngeal movements depends on contributions from areas of the precentral gyrus, the corpus callosum and associated contralateral systems linking the two hemispheres, and the collateral pathways at lower levels. The diencephalon (mainly made up of the basal ganglia) relays and coordinates messages from the cerebrum to the midbrain. Additionally, some of the extrapyramidal tracts arise in the diencephalon.

Lower Level Brain Contributions

The basal ganglia are a group of subcortical extrapyramidal nuclei. Fibers connect specific nuclei with prefrontal areas of the cerebrum as well as the primary motor and sensory cortex. Efferent fibers from the basal ganglia act on the premotor and motor cortex through the thalamus. The ventrolateral nucleus of the thalamus is also the mechanism through which the cerebellum is linked back to the primary motor and sensory cortex.

The Hindbrain

The hindbrain, or rhombencephalon, is made up primarily by the pons, the medulla, and the cerebellum. The pons contains a number of cranial nerve nuclei including V and VII. The medulla contains the nuclei of the XIIth cranial nerve and the Xth and XIth (both important to phonation) and the IXth which is of secondary importance to phonation.

Cranial Nerves

Of the 12 pairs of cranial nerves, two (the Xth and XIth) are important to laryngeal control. Some spinal nerves also play a role, especially since respiration is controlled by the spinal system. The IXth cranial nerve also has some relevance to voice since it is involved in the movements of the lower pharynx (e.g., swallowing). There is a special relationship between the vagus (X) and the accessory (XI) nerve. The accessory originates in both the medulla and the spinal cord and is a motor nerve. The cranial portion of the pathway supplies some of the velar muscles (e.g., the levator) as well as some of the pharyngeal and laryngeal regions also innervated by the vagus. Also, the motor neurons originating in the spinal cord terminate in the sternocleidomastoid and trapezius muscles. The accessory nerve thus influences constriction of the laryngeal walls and movement of the larynx.

Spinal Nerves

These nerves are important in speech and song because they innervate the respiratory muscles (thoracic and abdominal) and muscles that control posture. This may be especially important in singing when higher than usual lung volumes or pressures are needed. Although the mechanical breathing process is partly controlled by the respiratory centers in the medulla, it may be modified by sensory input from the nerves and proprioceptive input from the muscles. There are also receptor systems in the laryngeal mucosa that may contribute to opening and closing reflexes in the glottis, but there seems to be a preset of the abdominal musculature that precedes this mucosal stimulation during expiration.

Reference:

Hollien, H., & Gould, W. J. (1990). Neuroanatomical model for laryngeal operation. *Journal of Voice, 4,* 290–299.

D-3. Clinician Information: Addresses for Information and Voice Aids

Spasmodic Dysphonia

National Spasmodic Dysphonia Association, Inc.
P.O. Box 203
Atwood, California 92601-0203

Gender Issues
(e.g., Information on sexual reassignment and cross dressing)

The Outreach Book Service Ltd.
126 Western Avenue, Suite 246
Augusta, Maine 04330

Prostheses for Head-Neck-Chest Surgery
(e.g., Panje Voice Prosthesis)

Hood Laboratories
575 Washington Street
Pembroke, Massachusetts 02359
(800) 942-5227

Electronic Speech Assistance Devices
(e.g., Voice Amplifiers and Cooper-Rand Speech Aid)

Luminaud, Inc.
8688 Tyler Boulevard
Mentor, Ohio 44060
(216) 255-9082

Speech Aids
(e.g., voice loudness indicator; Pausaid for regulating rhythm and rate; speech amplifier)

Park Surgical Co., Inc.
5001 New Utrecht Avenue
Brooklyn, New York 11219
(800) 633-7878

Artificial Larynges

Siemens Corporation
(e.g., Servox Speech Device)

16 East Piper Lane, Suite 128
Prospect Heights, Illinois 60070
(800) 333-9083

Aurex
(e.g., Intraoral adapter kit)

315 South Peoria
Chicago, Illinois 60607
(312) 733-0480

AT&T National Special Needs Center
(e.g., Western Electric artificial larynx)

2001 Route 46, Suite 310
Parsippany, New Jersey 07054
(800) 233-1222

D-4. Clinician Information: Effect of Age on the Voice

Shipp et al. (1992) studied three discrete (no overlap with respect to chronological or perceived age) groups of male speakers categorized as young (27–35), middle-aged (53–57), and old (75–85).

	Frequency in Hz		
	Young (*N* = 10)	**Middle (*N* = 10)**	**Old (*N* = 10)**
Mean F_0	121	106	149
SD	10.87	2.27	19.97
Min.	104	91	116
Max.	139	131	188

Number of intrasentence breaths required to complete the third sentence of the Rainbow Passage were calculated.

	Number of Intrasentence Breaths		
	Young	**Middle**	**Old**
Mean	1.4	1.5	3.2
SD	0.9	0.8	1.5
Min.	0	0	1
Max.	3	3	6

The total duration of the utterance (measured in milliseconds) and the number of syllables per second were also calculated.

	Temporal Measures		
	Young	Middle	Old
Total Duration (in msecs)	6.67	7.99	10.80
SD	0.51	0.85	2.35
Min.	6.01	6.63	8.20
Max.	7.64	9.52	16.51
Rate (syll/sec)	5.29	4.09	3.96
SD	0.44	0.44	0.41
Min.	4.67	3.43	3.01
Max.	6.23	4.74	4.26

No differences among groups were found in the proportion of speech time spent in phonation, aspiration, and silent pauses. In terms of breath management, older subjects required more intrasentence breaths. This may be because of decreased vital capacity and the expending of larger lung volumes per syllable. Other studies have shown more frequent recharging to be related to inefficient laryngeal valving (Ryan & Burk, 1974). Older speakers also seem to need longer pause time to recharge. Speech rate slows with age (Ryan & Burk, 1974).

References:

Bless, D., Glaze, L. E., Lowery, D. B., Campos, G., & Peppard, R. C. (1993, June). Stroboscopic, acoustic, aerodynamic, and perceptual analysis of voice production in normal speaking adults. *NCVS Status and Progress Report No. 4*, 121-134.

Shipp, T., Qi, Y., Huntley, R., & Hollien, H. (1992). Acoustic and temporal correlates of perceived age. *Journal of Voice, 6*, 211-216.

D-5. Clinician Information: Depression in the Elderly

It is estimated that 15–25% of the elderly in America suffer from some form of significant emotional or psychological problem. The most common problem is depression. This contributes to the fact that seniors have the highest suicide rate of all age groups. Although depression can be treated, seniors are the least likely group to seek professional assistance. Therefore, it is especially important for speech pathologists and other professionals to notice symptoms of depression in older adults and assist them in getting professional care. Listed below are the symptoms to note. If two or more symptoms are noted in a patient (in the absence of significant other problems, e.g., dementia), consult with a mental health professional.

Check items noted:

- ☐ Loss of interest in normal activities.
- ☐ Prolonged feelings of sadness.
- ☐ Inability to concentrate.
- ☐ Changes in eating/sleeping habits.
- ☐ Fatigue/loss of energy.
- ☐ Difficulty making decisions.
- ☐ Withdrawal from social contact.
- ☐ Irritability.
- ☐ Talk about death.
- ☐ Suicide threats/attempts.
- ☐ Reduced initiation of talking.
- ☐ Reduced vocal expressiveness during talking.
- ☐ Excessive crying.
- ☐ Recurring nontreatable pains and aches.

The National Institute of Mental Health, through its Depression Awareness, Recognition and Treatment Program, provides information on depression and its diagnosis and treatment. The institute's booklet, "If you're over 65 and feeling depressed . . ." can be obtained from

D/ART Public Enquiries
National Institute of Mental Health
5600 Fisher's Lane, Room 15C05
Rockville, Maryland 20857

Treatment should first include a thorough medical evaluation to rule out an undiagnosed, underlying physical disorder. Medications taken should be evaluated carefully. Involvement in meaningful activities, counselling and antidepressants (e.g., Prozac and Paxil) may be helpful.

D-6. Reading Passage: Conditions Affecting the Respiratory System

Scientists have known for many years that allergy may cause asthma. The most common allergies are pollens, molds, house dust, animal danders, insecticides, feathers and Kapok in pillows, cosmetics and sprays, insect particles, dyes, perfumes, cottonseed, and chemicals. Foods may also cause allergies and asthma attacks, and drugs may cause severe reactions. Nonallergenic mechanical or chemical substances may also irritate the bronchial tubes of asthmatic patients. Coal and chalk dust may trigger attacks. Fumes from cleaners, paints, and varnishes can also cause problems. Some asthmatic individuals also react to temperature changes, barometric pressure, wind, and humidity.

Sinus problems occur when the sinus cavities are obstructed because of an allergy or an infection. Nearly 70% of chronic sinusitis is caused by an allergy and aggravated by an infection. During the night, nasal fluids accumulate and swollen tissues prevent drainage so pressure builds up. This is why many sinus headaches occur in the mornings. Side effects of inflammation of sinus membranes can be fever, muscular aches, and swelling and discomfort.

According to the U.S. Public Health Service, there is strong evidence that air pollution is associated with chronic bronchitis. It has been clearly documented that more people with bronchitis die when air pollution levels are high. Pollutants constrict the air passages and aggravate allergic asthma. It is wise for asthmatics to stay indoors on days when air pollution levels are high. Modern history is full of examples of prolonged high levels of air pollution causing problems, and even death, for individuals with respiratory ailments and heart disorders. A dense, wet smog in Donora, Pennsylvania in 1948 caused 17 persons to die in just 4 days. All of the victims had histories of heart and respiratory problems. In Holland, in 1930, a similar stagnation of industrial gases resulted in the death of 60 persons. Most of them were elderly with pre-existing conditions. Stringent enforcement of antipollution laws is needed. Although the first smoke-abatement laws were proposed in the 13th century, much still remains to be done. Industry and transportation advances in modern eras have been responsible for the interaction of smoke and fog to produce dense layers of smog over most of our larger cities.

The upper part of the breathing system, the nose, mouth, and throat, warms, filters, and moistens the air. The air is then moved to the trachea or windpipe and through bronchial tubes of smaller and smaller size. These tubes are lined with cells, some of which secrete mucus. Mucus lubricates the surface and also assists in removing irritating particles that may be inhaled. Usually, this mucus is not extensive enough to have to be ejected through coughing. However, there are nerve endings in the larynx (voice box), windpipe, and larger bronchi that are stimulated by the presence of irritating substances and initiate the coughing reflex to clear the airway. During a cough, the bronchial tubes narrow and expel the air. This moves the mucus up into the windpipe. Additional coughs expel it through the mouth. When a cough expels mucus it is described as a productive cough. A dry, repetitive cough is described as nonproductive. It is always helpful to drink fluids to hydrate the body and thin mucus secretions.

Tim Brookes, an asthmatic, has written an interesting book entitled "Catching My Breath: An Asthmatic Explores His Illness." The book is published by New York Times Books/Random House 1994. Mr. Brookes is a commentator for National Public Radio and he writes eloquently about his relationship with his illness and describes an array of medical theories and treatments of asthma.

D-7. Reading Passage: Sibling Relationships

As we grow older, we often seem to value special relationships even more than we did when we were young. Leo Tolstoy, the novelist, said that the simplest relationships are those between brother and sister. Eighty percent of Americans have at least one sibling. Researchers tell us that sibling relationships affect how people feel about themselves and others, and may even shape our personal interactions throughout our entire lives. Rivalry among siblings may teach a lot about how to resolve conflict, how to make jokes, and how to understand the actions and emotions of others. In troubled homes, siblings sometimes grow closer and provide support for each other. There may be gender differences in reactions, however. Sometimes sisters grow closer during troubled times, while some brothers may seem wary of tight, emotional bonds. The teasing, wrestling, competing for attention, and make-believe play of childhood prepares us for real life. But, personality differences play a part also. Children who grow up with similar experiences and opportunities turn out differently and interpret what happened in astonishingly different ways. Perceptions are certainly colored by our individual temperaments.

The same childhood events may be later interpreted quite differently by the child who came out feeling the winner in a series of squabbles and the one who felt vanquished. Brothers and sisters don't really share the same emotional reality in a family. They share economic and social class, parents, living quarters, and so on, but each has a unique emotional world. Each child perceives the reactions of significant others differently, and perceives inequalities in parental behavior to themselves and others. Children are very concerned with what they believe to be fair. "It's not fair," is a common cry in childhood. Even the parents who try most carefully to be fair are not always perceived that way by their children. From the perspective of an older child, a younger sibling might always appear to be favored, for example.

Rivalry between siblings wanes after adolescence and later geography, marriage, and careers may detach siblings even more. For some, this is a relief. In middle and later life, more sisters than brothers will maintain close ties. Sisters, too, are the ones who keep in touch with other family members most, after parents die. Some arguments among family members in later life reflect the same themes as earlier squabbles. Who is doing the most for an ailing parent; how inheritances are shared, and so on. For most people, however, there comes a time when it seems sensible to let go of old hurts and renegotiate sibling connections. The personal history shared with siblings is shared with no others. There is no one else with whom we share precious memories of our early years. We value this and see our siblings, or our memories of them, differently, as age makes us wiser.

D-8. Reading Passage: The Loss of Parents

The loss of our parents reminds us that we too, will inevitably grow old and die. When our parents die, we move into the position of being the oldest living generation of their family. This realization causes an array of feelings to be experienced and is, of course, a perfectly normal reaction. The intensity of the feelings, however, surprises us, especially if our parents had a long illness or if we hadn't felt close for many years. Regardless of our relationship with our parents, they represented a connection to our very personal and unique past.

A common reaction to a second parent's death is a renewed mourning for the first parent who died, even if it occurred a long time before. Another realization is that for the first time in a lifetime, one does not have a parent's emotional support. This forces one to confront the fantasy that one will always be taken care of. It also reminds us that we do not have unlimited time to achieve our life's goals. There's also guilt over not having been the ideal son or daughter. Dr. Robert Veniga interviewed 115 people who had experienced a recent loss and found that most who had lost a parent felt remorse over not having done enough for that parent. There may also be a stock-taking of the condition of other personal relationships. In fact, this reappraisal may even result in improved relationships with children and grandchildren. The more support we have in dealing with our losses, the easier it will be for us to deal with our feelings, understand them, and move on.

Reference:

Veninga, R. (1986). *A gift of hope: How we survive our tragedies.* New York: Ballantine Books.

D-9. Handout: Information for Patients Concerning Stress Management

Goal: To reduce stress by learning how to induce relaxation.

Rationale: Dr. Herbert Benson of Harvard University has written a book entitled *The Relaxation Response.* Meditation may reduce the effects of cortisol, a hormone released by the body in response to stress. Both physiologic and psychologic benefits result from relaxation techniques. Meditation is one way of calming the mind.

Suggested Activities: Sit in a quiet spot where you won't be disturbed. Sit comfortably in an upright position and close your eyes.

1. Concentrate on the sensation of your quiet breathing. Don't try to control your breathing, just be aware of the breath coming in and going out. Do not allow any other thoughts distract you from your concentration on the inhalation and exhalation of your breath. Dwell on the sensations associated with even rhythmic breathing. If your mind wanders, draw it back into yourself with the breath.

2. Anchor your mind by saying silently to yourself "in" as you breathe in and "out" as you breathe out. You may also count "one" on the inhalation and "two" on the exhalation until you reach ten and then begin counting again at one. Some people move the fingers of each hand to keep track. Keep focused on the breath and let the silent counting be only a quiet whisper in your mind.

3. Choose a word that is meaningful to you such as "peace" or "love" or "calm" or "listen" and hold that word in your mind as you breathe.

4. Switch to a different rhythm of breathing. Lengthen the exhalation by counting "one" during the inhalation and "two, three, four" as you breathe out. Gradually lengthen the exhalation phase as it feels comfortable.

5. Let thoughts that are distracting go by or consciously exhale them with the breath. Feel that you are immune to their power to grip you. Enjoy the sensations of lightness and relaxed alertness.

6. Breathe out the words "cease and desist" on each exhalation ten times.

D-10. Handout: Information for Patients Concerning Tremors

The most prevalent movement disorder in the United States is essential tremor (ET) which affects an estimated 4 million people. Although there is no cure, it isn't life-threatening and it is not believed to lead to Parkinson's Disease.

ET strikes the hands, the head, or the voice, and it worsens gradually. Fatigue and heightened emotions aggravate symptoms. Tremors occur during actions such as writing, eating, holding something, or extending an arm.

Treatment involves the use of two drugs: propranolol (Inderal) and/or primidone (Mysoline) which improve tremors in 60–70% of patients. Some patients also benefit from surgery although the results are somewhat unpredictable. Some people fail to seek treatment because they believe they have "the shakes" because of old age or stress.

Even with medication, many patients with ET need help with everyday tasks and also with dealing with the embarrassment they feel about their tremor. It is always important to tell family, friends, and employers about the problem. Otherwise, others may assume the tremor results from drugs, alcohol, or Parkinsonism. Other adaptations to the condition include the following:

- Drink using straws
- Fill cups half full
- Use thick pens and pencils with rubber holders
- Wear heavy bracelets
- Don't withdraw from social contact
- See a speech pathologist if voice is affected
- Consult a neuropsychologist for adjustment difficulties
- Find out about the International Tremor Foundation, 360 W. Superior Street, Box MM, Chicago, Illinois 60610
- Remember, alcohol may reduce tremors, but too much will intensify tremors the following day
- [illegible] the differences between Essential Tremor and Parkinsonism.

Essential Tremor

Hands do not shake at rest
No muscle stiffness
No slow movement
No benefit from drug levodopa
Drugs Mysoline and Inderal help
Alcohol helps
Head and voice tremors
Usually a family history

Parkinsonism

Hands usually shake while resting in lap
Muscle stiffness
Slow movement
The drug levodopa helps
Mysoline and Inderal not helpful
Alcohol does not help
Head and voice tremors are rare
Possible family history

D-11. Handout: Information for Patients Concerning Depression in Women

One in four American women will suffer from depression at some time in their lives. Depression may be triggered by such things as hormonal changes, life-style changes, biochemical processes, and stress. Women are often the primary caretakers for family members both young and old. They also often feel overly responsible for relationships and family tasks. When women trying to juggle home and work responsibilities become fatigued and overwhelmed by stress, they are at risk for clinical depression. Depression is a real illness and may be diagnosed if five or more of the following symptoms occur:

Poor concentration/irritability

Feelings of worthlessness

Fatigue/loss of energy

Restlessness

Sleep disturbances

Weight change

Lack of pleasure in life

Feelings of sadness

Thoughts of death or suicide

Difficulty making decisions

Prompt, appropriate diagnosis and treatment help to minimize the disruption of depression on ourselves and our families. A combination of medication and psychotherapy seems to help 80-90% of people.

Although everyone suffers from the blues from time to time or when losses occur, depression that lasts for a long time may or may not be related to specific events in one's life. Depression may last for long periods of time (e.g., months, years) and immobilize a person. Yet, clinical depression can be treated effectively if professional help is obtained.

D-12. Handout: Information for Caregivers of Alzheimer's Patients

Determining self-defense is the best way caregivers can avoid becoming the "second victims" of Alzheimer's, experts say. Here are some pointers:

- Learn as much as you can about the disease so you'll know what's ahead.
- Get advice early on from a lawyer familiar with elder law. For example, you may want to learn about guardianship.
- Take care of your health. Studies suggest that strong support, a regular respite from caregiving duties, and good medical care can keep you going.

It is not hard to find support services. (A directory of the Family Survival Project in San Francisco, for instance, lists 900 resources in California alone.)

The Alzheimer's Association at (800) 272-3900 can help you locate a local support group (or tell you how to start one). With 35,000 volunteers in 220 chapters nationwide, the association offers a myriad of services, from providing information on home care to awarding grants to eligible caregivers for respite care. Some chapters even function as ombudsmen for families that get ensnared in red tape while seeking help from public services.

The association has also launched "Safe Return," a federally funded computerized "lost and found" to locate patients who have wandered away from home. "Safe Return" plugs families into a registration and identification system, linking them to a computer data base via a toll-free telephone number.

Other helpful groups to call include:

The Alzheimer's Disease Education and Referral Center (ADEAR), for printed materials and lists of helpful groups and government agencies. The number is (800) 438-4380.

Eldercare Locator, for referral to local agencies that can provide information on adult day care, legal assistance, home-health or transportation services. Call (800) 677-1116.

The American Health Assistance Foundation, for a list of state and county agencies that can help. Call (800) 437-2423.

Try your local Area Agency on Aging, Department of Health or Mental Health, area hospitals, health clinics, churches, and civic groups, too.

Publications:

Some useful books and brochures on Alzheimer's disease:

"The 36-Hour Day," by Nancy L. Mace and Peter Rabins, M.D. Send check or money order for $8.45 to the Alzheimer's Association, 919 North Michigan Avenue, Suite 1000, Chicago, IL 60611.

"Coping and Caring: Living with Alzheimer's Disease." No charge. Send a postcard requesting stock no. D12441 to: AARP Fulfillment (EE0611), P.O. Box 22796, Long Beach, CA 90801-5796.

"The Caregivers Guide and Source Book." No charge. Call the American Health Assistance Foundation at (800) 437-2423.

"Taking Care of Caregivers," by Jeanne Roberts, M.D., Bull Publishing Co., Palo Alto, CA. The cost is $14.95.

D-13. Handout: Information for Patients Concerning Gastroesophageal Reflux

Sometimes hoarseness may be associated with gastroesophageal reflux. Leakage of acidic secretions from the esophagus (food pipe) causes redness and swelling of the laryngeal mucosa. Seepage of secretions from the esophagus occurs at night, especially if a person goes to bed quite soon after eating. Some foods and beverages (e.g., spicy foods and milk products) are thought, by some people, to be particularly likely to cause reflux. Performers who eat after a show may be at risk for reflux and may need to take precautions to protect the voice mechanisms from this type of irritation. An acid, or bitter, taste in the mouth upon awakening may be a sign. The following suggestions may help minor problems. If problems persist it is important to consult a physician.

1. Do not eat within 3 hours of retiring.

2. Raise the head of the bed 6 to 12 inches so that gravity assists in reducing reflux.

3. Use liquid, nonprescription antacid medications as needed.

4. Observe reactions to specific foods and beverages and avoid those that seem associated with discomfort.

5. Avoid nicotine, caffeine, and alcohol, and any foods that cause discomfort such as heartburn or a burning sensation in the chest.

D-14. Handout: Performance Anxiety Behavior Questionnaire

Answer the following questions.

1. I experience stage fright when I perform (circle one)

   always sometimes never

2. I'd judge the severity to be (circle one)

   severe moderate mild

3. My most troublesome symptoms of performance anxiety are (check any you experience)

   ☐ heart palpitations

   ☐ dry mouth

   ☐ muscle tremor

   ☐ breathing disturbances

   ☐ other: ______________________________

4. I've used the following strategies to try to relieve it (check any that have been used)

   ☐ artificial saliva to help dry mouth (e.g., Salivart)

   ☐ deep breathing to relax

   ☐ medications such as ______________________

   ☐ biting down on my tongue to increase saliva flow

   ☐ overpreparation/longer warm up

   ☐ rituals or objects to "bring me luck"

   ☐ cognitive restructuring (i.e., organizing my thinking)

   ☐ chewing gum in a relaxed manner before I go on stage (to relax mechanism and increase saliva flow)

   ☐ meditation techniques

   ☐ specify others: ______________________________

   ____

Suggested Reading:

Gates, G. A., & Montalbo, P. J. (1987). The effects of low-dose β-blockade on performance anxiety in singers. *Journal of Voice, 1,* 105–108.

Summary: Thirteen singing students received placebo or 20 mg of Nadolol prior to performing. The performance was repeated 48 hours later with cross-over drug regimen. Performances were judged by experts. No statistically significant difference could be identified as a function of whether the singers took the drug or the placebo. The authors note the small sample size, but suggest that these data, viewed together with previous information, suggest that β-blockers are not helpful in coping with performance anxiety.

Additional References:

Brantigan, C. O., Brantigan, T. A., & Joseph, N. (1982). Effect of beta-blockade and beta-stimulation on stage fright. *American Journal of Medicine, 72,* 88–94.

Gates, G. A., Saegirt, J., Wilson, N., et al. (1985). The effect of beta-blockade on singing performance. *Annals of Otolaryngology, Rhinology and Laryngology, 94,* 570–574.

D-15. Practice Materials: Word List to Practice Easy, Breathy Phonation

Goal: To elicit easy, breathy phonation.

Rationale: For patients who need practice in reducing vocal fold tension, easy breathy phonation may create an awareness of relaxed vocal fold approximation. (Breath may be felt on the hand.)

Instructions: Breathe out the whole word as you say it.

anthology	sweetheart	militia	Catholic
myths	plastic	machete	official
synopsis	plaster	coup d'etat	feature
Abyssinia	zephyr	lasso	Scottish
Ethiopian	bluster	tradition	lattice
penthouse	hyacinth	section	buckshot
attrition	chlorophyll	resuscitation	Africa
hosta	affair	Hiroshima	perception
pension	bashed	torrential	cuckoo
weight	hashed	inhabitant	ashes
ephemeral	facial hair	generation	hotel
poppy	ancients	inherit	sunshade
cappuccino	motif	picture	church
captain	myth	chocolate chips	Dinah
chief	youth	earthy	shipping
mischief	lusty	exhume	cashmere
handkerchief	deity	orthodontia	Ruth
nasturtium	delighted	witch	Arthur
tortuous	gracious	affectionate	shrubbery
torso	offspring	expression	options
dissolve	precious	intact	bachelor
beauty	vegetation	sapphire	potion
ambition	crashing	Harlequin	riches
iridescent	fashion	Spanish	squishing
miniature	sparta	eventual	wits
Haiti	affections	initial	corporation
[illegible]ssian	hippopotamus	Lithuania	Hamish
[illegible]skey	Aristophanes	Hawaii	renaissance
[illegible]phobia	Russian	puce	bleached
[illegible]plasty	fenestration	taupe	Cynthia
[illegible]	surpassed	white	Mississippi
[illegible]	formation	station	hundred
[illegible]	retribution	smashing	fortieth
[illegible]	astute	cashier	Oprah

D-16. Practice Materials: Sentences to Practice Easy, Breathy Phonation

Goal: To maintain easy, breathy phonation throughout the sentence.

Instructions: Replenish breath whenever the meaning allows. Use the technique of breathing out the words. Don't try to conserve air.

1. A xiphias in English is a swordfish.
2. Ethereal stars shine brightly in constellations.
3. Wishy-washy politicians manipulate situations shamelessly.
4. Intoxicated people are said to be blitzed or smashed.
5. Ishtar is cited in the scripture story of the Jewish queen Esther.
6. Ancient Persians hoped for heavenly intervention.
7. Astronauts are star-sailors in space ships.
8. Socrates was an ancient Greek philosopher.
9. Euripides wrote that a human being is but a breath and a shadow.
10. The word "silhouette" was once used as a synonym for "x-ray photograph."
11. Nicholaus T. Host was a nineteenth-century botanist.
12. The traditions of searching for rabbits and eggs in springtime were popular pagan fertility rites.
13. It is poor etiquette to push when purchasing tickets.
14. Express polite sentiments and extend a peace offering.
15. Persistent whispering is especially irritating at theaters.
16. Soothing properties are attributed to physicians' healing herbs.
17. In 1666, heretics were harassed by church officials.
18. Harry found it hard to hold onto his hat.
19. Hundreds of expressions of heartfelt sympathy were heard.
20. Hector's qualifications won't assure him a scholarship in literature at this institution.

D-17. Practice Materials: Word List to Practice Continuity of Voicing

Goal: To maintain voicing evenly throughout the entire word.

Rationale: Patients who have difficulty sustaining an easy continuous vibration benefit from practicing continuity of sound. Focus on prolonging the vowels and voiced continuants without tension. There are no unvoiced sounds to interrupt the voicing.

Instructions: Keep the voicing going throughout the entire word.

Louvre	everyone	moslem	Armenian
viola	resembling	rearranging	remember
nozzle	leverage	marine	angiology
nuzzle	villagers	aurelia	Virginia
nose	ordering	legionnaire	narrower
rave	unnerving	union	Louisiana
Lillian	rhyming	version	Malvolio
Virgin Mary	organs	removing	annual
lemon jam	manilla	rainbow	visionary
minimum	vanilla	reasoning	animal
oiling	revision	maligning	Zuni
revenge	visionary	Loralei	languages
Jamie	raisins	manure	Angela
women	imagery	leonine	oozing
yearly	lawyers	engraving	money
yearling	overalls	many	azure
wailing	Iowa	Nirvana	loanword
wine	lover	involving	region
villain	young	revolving	edging
orange	rivals	another	riding
oriole	enamoring	mirroring	ridges
royal	musing	Malaysia	leisure
yellow	muses	Malayan	leather
miles	relaying	whaling	beige
Asia Minor	meanwhile	worrying	badge
easel	Germany	mules	Madge
mellowing	Romans	origins	bundle
[illegible]	vagina	allusion	muddle
membrane	maneuver	laying	venial
[illegible]	manubrium	remains	Leona
[illegible]	rains	mural	rivers
[illegible]	although	Czar	Joanne
[illegible]	millennia	larval	grave
[illegible]	geranium	normally	mirage

D-18. Practice Materials: Vocal Warm-ups and Exercises

Goal: To strengthen the voice through systematic exercises.

Rationale: Voice function may be improved through supervised careful exercise of the voice musculature.

Instructions: Choose some times during the day when you can easily incorporate these exercises into your daily schedule. For example, warm ups could be done in the shower or in the car while you are driving to work. Like all muscles, the voice muscles should be treated gently and gradually built up. Also make sure you keep well hydrated to maximize improvement (e.g., drink 8 glasses of water a day).

1. *Warm ups: Tone focus and range*
   a. Hum gently, gradually letting the sound swell. Begin with an /h/ to get the breath going first (e.g., h__________mmmm).
   b. Hum gently on two comfortable pitches.
      - Start on a middle note and then slide to one higher.
      - Start on a middle note and slide to one lower.
   c. Hum gently on three and then four different pitches. For example, think of a simple tune and hum a phrase. Then hum a series of chimes.
   d. Hum a simple melody maintaining a smooth, even humming sound. Breathe frequently. Keep the humming focused on the front of your face so your lips tickle.
   e. Slide from your middle note down as far as you can in your range. Smooth out the sound. Now slide from your middle note up as high as you can. Try to increase the number of smooth easy notes you can hum.

2. *Warm ups: Jaw, lips, and tongue*
   a. Blow out all of your air as you say the word "whoo" prolonging it as long as you can.
   b. Prolong, "prrr" (the word "purr" without the vowel) and "trrr" and "hrrr" with mainly breath and just a little sound. Roll the "r" if you can. Make sure it is relaxed and the tongue is not tense. Think of it as a light, easy motion, as if you are blowing air into a hot cup of coffee.

c. Drop mouth open downwards as far as you can. Say "ta ta ta ta" while gently feeling jaw motion with hand. Breathe out as you say the syllables. Say as many as you can in one breath. Prolong one "ta" for as long as you can without your voice wavering or breaking. Jaw and tongue should be loose. Work on this until you can prolong "ta" for ________ secs.

d. Produce the vowels "oo — ee" with strong lip movement, prolonging each vowel sound. Make sure you drop your jaw down on the "ee" vowel. Do not make a spread, tense mouth posture. Now gradually increase the loudness of the vowel sounds while maintaining easy voicing.

e. Practice prolonging or chanting the word "oboe" bouncing your lips well on the "b" sound and lengthening the vowels. Repeat the word gradually increasing and decreasing the loudness. Use an easy onset and easy voicing.

f. Practice relaxed chewing motions. Open mouth well like a cow chewing its cud. Say the word "was" repeatedly as you chew, feeling the final sound vibrate your teeth. Use exaggerated lip movement.

g. Practice the following words using strong lip movement, frontal tone focus and resonance, practically on the final sounds as you prolong them . . .

warming, warming, warming	wheezing, wheezing, wheezing
warning, warning, warning	wheeling, wheeling, wheeling
warming, warming, warming	wheezing, wheezing, wheezing

h. Maintain the even vibratory pattern while chanting the words above as *softly* as you can without devoicing. Now alternate soft and loud productions. Now change pitch on each word as you chant.

i. Hum down a scale five distinct notes. Now sing down five notes on "yum yum yum yum yum." Now sing up the scale. Gradually increase the number of notes you sing up and down the scale to increase your range. Practice increasing the power or loudness once you feel comfortable and secure with the pitches.

j. Practice forward tone focus and pitch and loudness changes as you repeat the following:

Many young men.	My own money.

D-19. Practice Materials: Hidden Messages in Vocal Expression

Goal: To analyze the hidden messages in vocal patterns.

Rationale: Listeners may react negatively to the actual words that are said and also to the paralinguistic aspects of the communication (e.g., voice patterns, nonverbal behaviors, etc.). Developing an awareness of all the aspects of the message helps a speaker to improve communication skills. What a listener hears may be different from what a speaker really means to communicate.

Instructions: Consider the following list of strategies that may be used by a speaker and communicated through the vocal tone and pattern.

ordering
commanding
moralizing
preaching
non-committal acknowledgment
arguing
persuading
paraphrasing
reflecting meanings/feelings
judging
blaming
generalizing
placating
genuine praise
inappropriate praise
analyzing
diagnosing
patronizing
summarizing
questioning
expanding/elaborating
suggesting
prompting
tentative agreement

In the list of utterances below, find some examples to illustrate various vocal strategies. Use the same utterances to produce different messages. Record, play back, and evaluate the potential impact on a listener.

1. Would you like to talk about it?
2. But I showed you that last week...
3. If you had done it carefully the first time...
4. I don't care how busy you are — just get this done.
5. When I was a junior executive we worked long hours.
6. I'd like to hear more.
7. What I hear you saying is that this isn't the case.

8. How can you get around this road block?
9. Now make sure to be nice to this client.
10. Oh . . . I see . . . uh huh . . .
11. I understand how you could see it that way.
12. If I were in your position . . .
13. You always do such a good job.
14. In spite of your problems, I know you'll do a good job.
15. You always come in late.
16. You men are all alike.
17. I'm a little confused about how this happened.
18. This really is my fault, but it won't happen again.
19. I was the one who made the mistake on that account.
20. You surely can't be serious about these figures.
21. The balance sheet is not accurate, is it?
22. You'll be sure to tell her. You won't forget?
23. But I told you that yesterday.
24. You missed the deadline on that project.
25. Could it have been rectified?
26. Oh, I did that wrong. I must have given you the wrong figures.
27. My boss found that the research took longer than he expected.
28. Clue me in about what happened.
29. It's never wrong to make the boss look good.
30. If you don't do it, no one else will.

D-20. Practice Materials: Vocal Variation During Projected Speech

Goal: To use vocal variation during projected speech.

Rationale: Projected speaking allows the speaker to use greater variability.

Instructions: Read the following as if you were on a stage.

Many words in English are derived from the Indo-European "ped." These include "pedestrian," "pedal," and "podiatrist" as well as "piedmont" which means "foothill country." The word "podium" means "small foot" and actually refers to the platform or dais on which a speaker stands. This is surprising because most people believe that podium refers to the lectern behind which the speaker stands.

"Half the world is composed of people who have something to say and can't, and the other half consists of people who have nothing to say and keep on saying it."

Robert Frost

"The only guide to a man is his conscience; the only shield to his memory is the rectitude and sincerity of his actions. It is very imprudent to walk through life without this shield, because we are so often mocked by the failure of our hopes and the upsetting of our calculations; but with this shield, however the fates may play, we march always in the ranks of honor."

Winston Churchill

"A keen sense of humor helps us to overlook the unbecoming, understand the unconventional, tolerate the unpleasant, overcome the unexpected, and outlast the unbearable."

Billy Graham

"We tend not to choose the unknown, which might be a shock or a disappointment or simply a little difficult to cope with. And yet it is the unknown with all its disappointments and surprises that is the most enriching."

Anne Morrow Lindbergh

"We grow neither better nor worse as we grow old, but more like ourselves."

May Lamberton Becker

"All through the long winter I dream of my garden. On the first warm day of Spring I dig my fingers deep into the soft earth. I can feel its energy, and my spirits soar."

Helen Hayes

"In recognizing the humanity of our fellow beings, we pay ourselves the highest tribute."

Thurgood Marshall

"No one on his deathbed ever said, "I wish I had spent more time on my business."

Arnold Zack

"The winter wind is like a cold surf beating through the bare treetops and sweeping through the valleys. It roars in the night, an elemental voice; it whistles at the house corner and rattles the shutter and the pane. We sit before our fires and cherish our warmth, our snug security. And we know that the rush of wind just beyond our stout walls is the rush of winter passing. It is the fierce breath of change itself. The earth turns and the winds eddy and swirl. And one fine night there will be a whisper of spring in the wind, and another winter will have blown itself away."

Hal Borland

"Courage is not limited to the battlefield or the Indianapolis 500 or bravely catching a thief in your house. The real tests of courage are much deeper and much quieter. They are the inner tests, like remaining faithful when nobody's looking, like enduring pain when the room is empty, like standing alone when you're misunderstood."

Chris R. Swindoll

"Humor is a spontaneous, wonderful bit of an outburst that just comes. It's unbridled, it's unplanned, it's full of surprises."

Erma Bombeck

D-21. Practice Materials: Easy Onsets

Goal: To practice a variety of strategies to avoid use of hard onsets in phrases, sentences, and paragraphs.

Rationale: Linking words together minimizes opportunities for hard onset on vowel-initial words.

Instructions: When a consonant does not precede a vowel, insert a linking sound such as a /w/ or a /y/. Breathe out on and increase duration of vowels that begin an utterance.

Phrases:

Cry out.
easy over
Eva Anderson
Ellie Austin
I am eager.
I aimed it.
She's energetic.
sea urchin
blue angels

Amanda Osborne
I ate oranges.
Eric asked Amy.
I understand Andy.
He eavesdropped.
She ate oysters.
Try all options.
two olives
fine education

Sentences:

1. Fuel oil is efficient and easily obtained.
2. She understands algebra equations.
3. Ava irons undershirts exquisitely.
4. I eyed Alan's earring enviously.
5. Ease up on your eating, Arthur.
6. Eli abhorred opportunists.
7. Ego inflation is everywhere.
8. Otto is an excellent observer.
9. All of us are opera addicts.
10. Two infants are underfoot.
11. Joy always orders everyone around.

12. Two extra exits are an advantage.
13. Does Esther express any interest in it?
14. Ray asks everyone's advice always.
15. A koala is an Australian animal.
16. Kay is also an expert on ostrich eggs.
17. She also instructs others on oboes.
18. Is anyone actually in authority?
19. Audrey asks, "Are any instruments exact?"
20. Abdominal aches are awful.
21. Always allow others to answer initially.
22. Sea Island is in the ocean.
23. Three educators exchanged ideas on education.
24. The opposite of enter is exit.
25. Try it on after Anna alters it.
26. Individuals in our area are energetic.
27. Excel in all our assignments.
28. Illinois is often arid in August.
29. Advertising is often irresponsible.
30. Ask about the areas under attack.

Paragraphs:

Modern osteopaths and orthopedic experts admit that advances in arthritis treatment have actually occurred. Some authorities ask if aspirin does indeed inhibit pain. Different antidotes are often advocated initially and exercise is advisable also. Hopefully, additional advances are expected to eventually eradicate all errors in our treatment approaches.

In Asia and in Africa many interesting animals existed in early times and I understand, many still exist in our era. Some elephants are extinct in populated areas of course. Easy identification of animals is often impossible even for avid animal observers.

Projected speech:

Repeat the Pledge of Allegiance, linking words to ensure continuity. Pretend you are addressing a large group and stand to deliver it and slow your rate.

> "I pledge allegiance to the flag of the United States of America, and to the Republic for which it stands, one nation, under God, indivisible, with liberty and justice for all."

Introduce a performer in a concert. Provide the name, some biographical information, and the title of the piece to be performed.

D-22. Practice Materials: Replenishing Breaths

Goal: To practice appropriate use of replenishing breaths during connected speech.

Rationale: Replenishing the breath supply appropriately helps the speaker avoid running out of air at an inappropriate place. Phrasing and meaning, punctuation, and planning ahead are all aspects that relate to the development of skill in replenishing appropriately without interrupting or distracting from, the flow of ideas.

Instructions:

1. Count to 50, replenishing the breath with small "catch" breaths after each 4 numbers. This will help create an awareness of how easy it is to keep replenishing smoothly in a series of words. Do the same with the alphabet, days of the week, and so on.
2. Read the paragraphs below and mark places where it makes sense to pause. Remember that listeners need pauses in the flow of words in order to process the preceding ideas.

"The whole course of human history may depend on a change of heart in one solitary and even humble individual — for it is in the solitary mind and soul of the individual that the battle between good and evil is waged and ultimately won or lost."

M. Scott Peck

"The natural effort of every individual to better his own condition is so powerful that it is alone, and without any assistance, capable not only of carrying on the society to wealth and prosperity but of surmounting 100 impertinent obstructions with which the folly of human laws too often encumbers its operations."

Adam Smith

As we grow older we hopefully become wiser although that is not necessarily the case as we all well know if we stop to consider. Many people believe that it is out of our pain and problems, rather than through comfort and prosperity, that our richest emotional development occurs. It is [illegible]ing to think about why it is that burdens such as adversity, loss and [illegible] [illegible]sh some individuals yet cause others to grow stronger and not only [illegible] [illegible] also enjoy the benefits of their persistence and hope.

We are often told that if we have a handicap we should mention it openly to strangers so that they are not constantly distracted by wondering what it is. This is probably good advice and I have certainly tried to do this at the onset of every speech I give so that the audience can give full attention to what I am saying instead of wondering about my voice. I usually start by saying that I hope those at the back can hear me even though I have a damaged vocal cord as a result of a car accident some years ago. Then I get on with my talk and the audience can concentrate on the topic rather than continuing to try to guess why my voice sounds the way it does.

Sir Edmund Hillary was the first person to climb Mt. Everest in the Himalayan mountains which are so very remote, treacherous and challenging. It is significant that after his triumph in those forbidding mountains when he endured so much to achieve his dream, he said "It is not the mountain we conquer but ourselves."

Although women make up at least half of our population no woman had ever served on the highest court in the land until Sandra Day O'Connor was appointed to the Supreme Court. She had a stiff climb through the ranks to achieve this exalted position as a supreme court justice and she once said that no one learns more about a problem than the person at the bottom. Her advice to everyone is to do the best you can in every single task you do, no matter how unimportant it seems at the time, and her advice is probably worth listening to as she has practiced what she preaches and achieved success.

D-23. Practice Materials: Paragraph with All Voiced Sounds

Goal: To practice easy voicing during a reading sample with all voiced sounds.

Rationale: This passage is loaded with voiced phonemes to encourage smooth continuity of voicing throughout the entire words, phrases, and sentences. Once smooth, easy vocalization is achieved, additional demands (see instructions 3 and 4) are made to encourage variability while still maintaining the continuity.

Instructions:

1. Read this passage making sure that your voice continues throughout each entire word.
2. Blend the words to avoid hard onsets and smooth out the phrases.
3. Try to use different voices for the brothers during the direct speech, and contrast it with the indirect speech.
4. Read the passage with different feelings evident in the voice of the narrator. For example, read it with an amused tolerance of these eccentric brothers; read it as if you are a neighbor who has lost patience with them; read it in a confidential tone as if apologizing for gossiping; read it as if you are in an oratory contest and speaking from a stage.

Do you know the Arnolds? They are brothers, Leonard and Wendell, and they are always arguing. I believe that no one in the wide world argues all the time as they do. All of their neighbors know the arguing Arnolds by now, and leave them alone. Wendell is older than Leonard. No one really knows their real ages though. Nine years ago they lived in New Zealand and then moved all their goods in one of Air New Zealand's airplanes. Now they live in Northern Ireland and annoy their neighbors there. Why do they argue I wonder? They ride and drive along the old roads near where they live arguing loudly all day long, every day, all year. In the evening, the arguing goes on in their livingroom and library mainly. "No, no, no," Wendell yells every now and then. "By George, your angle is wrong as usual," bellows Leonard. "No one would ever believe you," yells Leonard. "I read all the news," replies Wendell, waving his arms madly. "No news is good news anyway!" yells his brother. Neither Wendell or Leonard ever wins. No one will ever win the verbal games organized by these wild brothers. Leonard will enjoy verbally abusing his brother as long as they live. Wendell loves the games even more then Leonard does. No neighbors are more miserable than those living near those noisy brothers, in Northern Ireland. They never even realize their verbal manners are abnormal. Those Arnold brothers, Wendell and Leonard, are busily unaware, yelling and arguing their lives away. They are engaged in an endless drama in their own narrow world of words.

D-24. Practice Materials: Paragraph with Predominantly Voiceless Consonants

Goal: To practice reading a paragraph using easy, breathy phonation.

Rationale: This paragraph is designed to increase airflow and decrease tension in the laryngeal musculature.

Instructions:

1. You are trying to relieve the tightness in your throat. Try to use more breath to increase airflow as you read.
2. Use easy onsets and blend words together.
3. Use relaxed, smooth phrasing.
4. Pause frequently to replenish your breath.
5. Remember that air is free so you don't need to struggle to conserve it. You can take in more, not only at the ends of sentences, but whenever the meaning allows.

Historically, Haiti has had an interesting but impoverished population. Residents are blessed with lush vegetation, fresh air, and ocean winds. However, there is widespread poverty and residents have poor living conditions to contend with and little industry anywhere. Fishing is naturally something that both satisfies hunger and generates some cash, so most people have some connection with fishing. Some are full-time fishing industry workers in some capacity or another. Others just fish occasionally to supplement their dependent's diets. Lots of different types of fish are found in the ocean. Deep sea fish are somewhat expensive in restaurants and hotels but inexpensive for those residents who have boats and can catch the fish. The tourist industry in Haiti has been taking a beating in recent times because of the political unrest. What a pity for the people there who have lost their source of support. Political upheaval is hard on the poor folk who just want peace and quiet, shelter and a paycheck so they can eat. Conditions in Haiti have pushed some people to try to flee to the United States. Some flee because of serious political persecution and others say they just want a better life. Hundreds have perished, as boats that were too crowded, have sunk in the ocean with desperate Haitian people on board. It was the pursuit of better conditions, happiness, or whatever, that ended in the disastrous deaths of those unfortunate escapees. Who can help that nation? There does not seem to be an obvious solution to the complexity of that situation.

D-25. Practice Materials: Worksheet Used to Explore Prosodic Patterns

Activity I:

Consider all of the different ways you could say the following sentences. For example, reflecting various moods or intents. You could be fatigued, bemused, puzzled, annoyed, teasing... You could be trying to evoke a certain response...

1. You went everywhere, all over the city, without even thinking about the fact that it was your fortieth birthday.
2. It was a new book, one I'd wanted to read and never had the opportunity to get.
3. Sometimes that music really affects me and I can hardly imagine that everyone else doesn't necessarily react the same way.

Activity II:

Some people find it useful to explore different voice patterns by using specific images. For example, they think of an animal, object, or landscape and reflect the characteristics in their voice.

1. My voice is like a panther, dark and sinuous. It moves smoothly, muscles rippling underneath smooth, shining fur, noiselessly gliding and leaping on silent padded feet.
2. My voice is like the coastline of Oregon, grand and majestic...
3. My voice is like a mighty redwood, standing rooted for a hundred years...
4. My voice is like a dolphin playing in the Pacific Ocean...
5. My voice is like diamonds, brilliantly faceted...
6. My voice is like the wind...
7. My voice is like the ski slopes...
8. My voice is like fresh bread baking...
9. My voice is like a fire...
10. My voice is like vats of dark, red wine...

Activity III:

Sometimes we use our voices to match the feelings in another's voice. Other times we try to shape the speaker's feelings by the way we use our voices to respond. Try the following examples.

1. Stimulus sentence

   I hate it when you do that.

   a. Response: I know you do (mirroring the anger).

   b. Response: I know you do (soothingly, to diffuse the anger).

2. Stimulus sentence

   I was about to explain.

   a. Response: Well, explain then (mirroring the anger).

   b. Response: Well, explain then (accepting, or teasing).

3. Stimulus sentence

   You didn't mention you'd be late tonight.

   a. Complainingly

   b. Tentatively

   c. Teasingly

   d. Worriedly

D-26. Practice Materials: Speech Worksheet for Singers

Many singers who monitor their singing very carefully are much less aware of their speaking habits. Frequently, they may inadvertently use speech practices that are injurious to the larynx. It is wise for singers to be aware of how they speak since so much of each day is spent speaking. Study the checklist below and note some common problems.

Hard glottal attacks

Tight/extended jaw

Infrequent replenishing breaths

Staccato speech pattern

Rapid rate

Tension in neck

Postural misalignment

Tension in laryngeal musculature

Retracted tongue

During speech we can replenish the breath whenever it makes sense to pause. This is different from singing where the music dictates the phrasing. Develop the habit of replenishing frequently and avoid overlong sentences. Think of breathing as a tidal process, not as something where the air must be stored for long periods of time. Think of the exhalation flowing out as you speak and this image may help to avoid a voice that sounds "starved for air." Some speakers use the image of "a cushion of air" between the folds as a method of avoiding laryngeal tension.

Activities:

1. Count to 15, replenishing the air after every three numbers.
2. Blend phrases and sentences together in a smooth (legato) fashion.
3. Drop jaw straight down as you repeat "land, lend, lind." Use tongue tip.

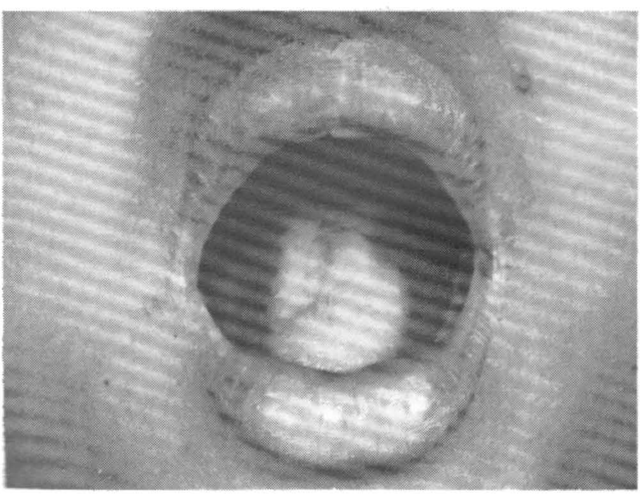
Readings:

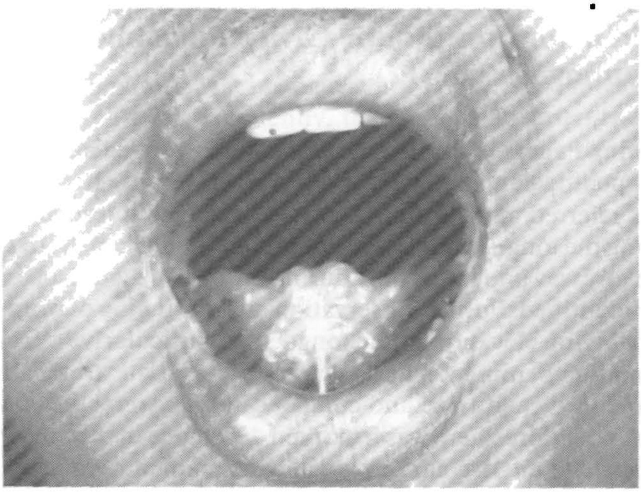
Sataloff, R. T. (1991). *Professional voice: The science and art of clinical care.* New York: Raven Press.

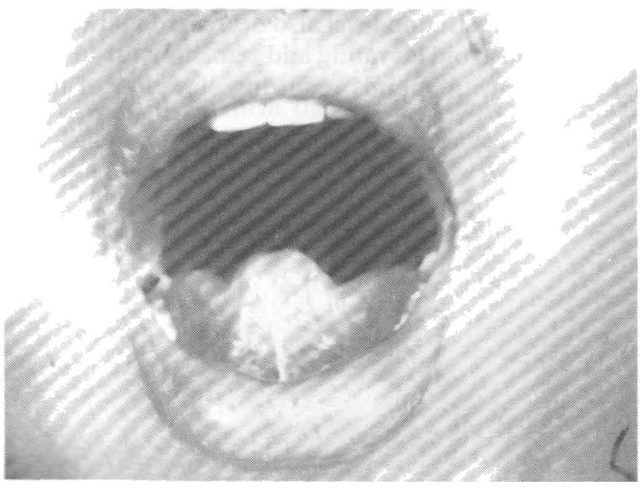
Koufman, J. A., & Isaacson, G. (Eds.) (1991). *The Otolaryngologic Clinics of North America: Voice Disorders, 24*(5).

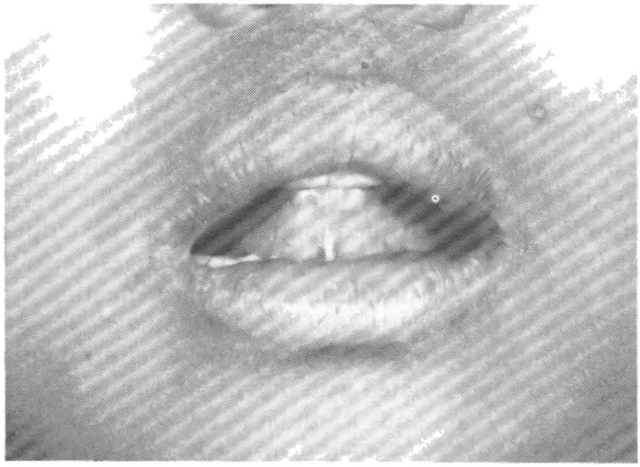
D-27. Clinical Information: The Influence of a Short Frenulum on Mouth Cavity Adjustments During Singing

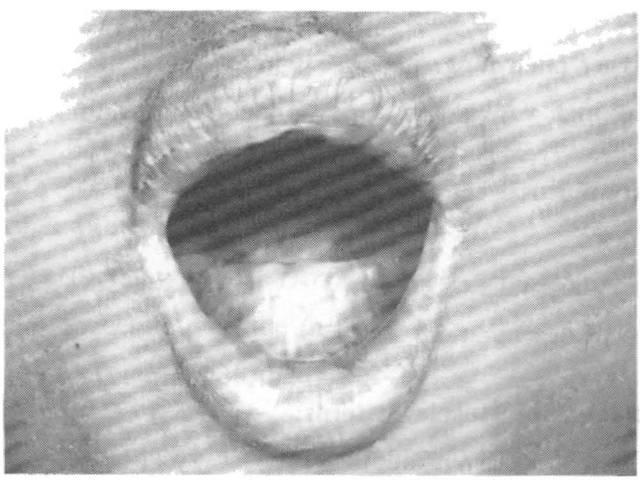
The following figures (1 through 6) illustrate the tongue activity in relation to mouth opening demonstrated by a young, classically-trained singer. The singer was referred to the Voice Clinic by her singing teacher because she was "tensing the tongue." The short frenulum did not constrain speech production in any way and it was only during the oral mechanism examination that it was identified. Further observation during singing of words with consonants involving elevation of the tongue tip, particularly /r/, revealed that reduced mouth opening was necessary for appropriate articulation and resulted in reduced cavity size and compensatory movements of the body of the tongue. Therefore, there was a marked difference in the quality of a sung vowel adjacent to an alveolar or palatal consonant and one that was not. It seemed that the singer was compensating for restricted tongue tip mobility in a manner that negatively affected oral resonance and created a perception of excessive tension. When the problem was identified, it seemed easier for both the singer and her teacher to discuss more appropriate compensations. The singer's frustration level also decreased markedly and this also seemed to help her to avoid elevating and retracting the body of the tongue when singing words with sounds requiring elevation of the tip.











D-28. Clinical Information: Laryngeal Isometric Disorder

Morrison and Rammage (1994) define this disorder as a "generalized increase in muscular tension throughout the larynx and paralaryngeal areas. The etiology usually includes a combination of poor vocal technique, extensive and extraordinary voice use demands, and interacting or secondary psychological factors" (p. 55). They believe that "when the larynx is in a general hypertonic state, the sustained contraction of the posterior cricoarytenoid muscle (PCA) may deflect the arytenoid cartilages down the cricoarytenoid joint and open the posterior commissure, creating a posterior glottal chink (PGC)." The magnitude of the chink may also be associated with hypertonicity in the suprahyoid musculature. In clinical populations, this pattern may also be associated with other muscle misuse particularly lateral contraction. Morrison and Rammage (1994) also note the following characteristics:

- elevation of the larynx as the client sings up the scale
- extension of the mandible as the client sings up the scale
- increased suprahyoid tension
    - in higher pitch range during singing
    - during high vowels and during phoneme transitions in connected speech
- secondary mucosal changes may occur
    - nodules
    - chronic laryngitis
    - polypoid degeneration

Activities to Improve Muscle Patterns:

- general and specific relaxation
- postural realignment
- improved air flow patterns
- easy voice onset
- lip and tongue trills
- relaxed jaw and tongue movements

Specific Practice Activities:

1. It is useful to practice in the mid part of the range at first and gradually descend (and later ascend) at a comfortable loudness level. High-flow consonants and low-vowels can be used. As the relaxed muscle patterns are identified, the singer should use the "facial" and "nasal" buzz as sensory cues to increase loudness. Transitions from unvoiced continuants to vowels facilitate coordinated onset of voicing. For example,

   shah_shah_shah

   persian_shah   persian_shah

   show_shah   show_shah

2. In the next set of exercises, the singer concentrates on tongue or lip movement to initiate voicing while maintaining a relaxed laryngeal posture. Two pitches can be used on these two-syllable words that contain a medial high-flow phoneme.

   marshy marshy, mushy mushy

   marshmallow marshmallow

   Lillehammer Lillehammer

3. Three pitches can be used to descend on these words.

   Minnehaha (breathy and easy)

   brouhaha (breathy and easy)

   Cynthia (concentrate on the /n/)

   wizardry (concentrate on the /z/)

4. Try to avoid tension during anticipation of the /dʒ/ sounds.

   wages wages wages wages

   wedges wedges wedges wedges

   ravioli (trill the /r/; buzz the /v/)

   George_Isuzu, George_Isuzu

   organize. organize (watch the transition between /r/ and /g/)

5. Chant down the scale on the following.

   Herman loves the zoo.

   Lionel ran away.

   No my name is Jim.

6. Chant up the scale on the following.

   Who/w/are you?

   Romanov my love?

   Why are you alone?

7. Go up in pitch as you repeat the following.

   revise revise revise again?

   millions millions millions more?

   No one is rolling on the lawn?

   I'll wage you are my age.

   Ron wears your robe of beige.

D–29. Practice Materials: Worksheet to Aid Oral Resonance

Activity I:

A. Practice opening up the oral cavity with these warm ups. Drop the jaw loosely.

yippy, yappy, yippy, yappy
whizz whazz, whizz whazz
whoa there, whoa there
yellow jello, yellow jello
bow wow, bow wow

B. Jiggle your jaw with your hand — up and down, side to side, forward and backward. Make sure the movements are relaxed.

Activity II:

A. Chant-talk the following list of words. Linger on all the consonants and extend the vowels also.

Louise	leave	liver	lies
Lynn	low	lazy	leaves
love	lay	lily	lose
Lowry	loon	Lizzie	Lulu

B. Reverberate the /v/ on your lips.

veal	visa	viola	vowel	vile	vision
viva	Vi	vase	view	vizor	violin

C. Buzz the /z/ on your teeth.

zulu	zeal	izuzoo	ooze	Israel
Zaire	zoo	Zoe	easy	Zara
raze	easel	zebra	zippy	weezie

D. Link these words with the /z/.

his__ale	was__able	Liz's__eel
he's__Al	Weezie's__alley	Kings__Island

Activity III:

Practice the following sentences. Chant them first and then speak them with lots of mouth opening and "facial buzz." Remember to linger on the vowels. Don't "scrunch" them.

1. Louie was a very lazy lizard.
2. Therese, always raise your eyes.
3. Years ago Gabriel was early.
4. July is Jules' brother's birthday.
5. Wally won by one.
6. Old olive oil is awful.
7. Ozzie's owl always argues.
8. Eli's jewels are real rubies.
9. Joel's and Ollie's eyes were dazed.
10. Joe's paisley robes are really lovely.

Activity IV:

A. Think of a sentence using the word "wow."

B. End a sentence with the word "really."

C. Start a sentence with the word "asian."

D. How many words can you think of that rhyme with "other?" (buzz the "th")

E. Here are some more words to use in sentences:

Azure, veil, loathes, roses, glows, lather

D-30. Practice Materials: Worksheet for Easy Onset Drill

With /h/	Without /h/	1	2	3	4	Total Correct
WHOSE	OOZE					
HALL	ALL					
HATE	ATE					
HALE	ALE					
HE'S	EASE					
HERB (the name)	HERB (plant)					
HEDGE	EDGE					
HELEN	ELLEN					
HIKE	IKE					
HIVE	I'VE					
HOE	OH					
HILL	ILL					
HIS	IS					
HAS	AS					
HABIT	ABBOT					
HOW	OW					
HIGH	EYE					
HOWL	OWL					
HERE	EAR					
HER	ER (as in father)					

D-31. Practice Materials: Worksheet for Easy Onset Data Collection

	Trial 1	Trial 2	Trial 3	Phrase	Sentence
exit					
equity					
exodus					
equitable					
equal					
expectation					
oxen					
oxygen					
exclude					
execute					
expedite					
excel					
exactly					
exile					
exhale					
exchange					
exception					
exonerate					
exhaust					
exchequer					

D-32. Practice Materials: Worksheet for Blending Words

Activity I:

A. Blend these words together. Try each pair 3 times. Blend a lot on the first trial and slur less on the next two trials. Maintain an "easy connection" between the words.

was_open	he's_acting	I'm_angry
am_honest	it's_easy	I'm_anxious
choose_any	all_eager	loathes_olives
knows_all	warm_ocean	eats_ice
in_Iceland	Mom's_apple	she's_under
please_ask	has_eaten	voice_over
her_aunt	ear_ache	cheer_up

B. Practice these pairs. Insert a /j/ or a /w/ between the vowels.

I oppose	I understand	you alternate
two others	tee off	she argues
he eats	the others	the animal
three inches	the egg	he asks
you order	you owe	I am
two eyes	I ache	two ears
silly actors	easy exercise	Ellie Edwards
Amy Isaac	I apologize	you answer

Activity II:

A. Some words, especially those with "ex" prefixes are difficult to say with an easy onset. Make up sentences using the following words.

exercise	expectation	excellent	exit

B. Now try using some words with /k/ and /g/ sounds following the initial vowel.

eggs	ego	Eggleston	egomaniac
egotist	eggshell	egocentric	egress

eke	Eckart	eclectic	actor
Eccles	axe	action	extra
equus	echo	ecology	economic
ecru	ecstasy	ecstatic	Ecuador
eczema	equal	equestrian	icky

C. Now try blending the words in these longer sentences.

1. Edward Eggleston was an American novelist.
2. Sweetbriar is another name for eglantine.
3. Equal amounts of iron ore are expected.
4. The equator is an imaginary circle around the earth.
5. An equation is an expression in which symbols are used.
6. An equerry is a personal attendant to the English Royal Family.
7. Equilibrium is a state of balanced adjustment.
8. During an equinox, day and night are equally long in all parts of the earth.
9. To equip means to arrange or make ready.
10. If you are purposely ambiguous you are equivocating.
11. If you are an actor, you are almost always anxious.
12. Use another exit if you are expecting excess traffic.

D-33. Practice Materials: Worksheet for Vocal Variability

Instructions: Vary the rate, pitch, and loudness of your voice while reading these sentences smoothly. Don't punch out each word. Use a legato style and highlight words with voice changes.

1. Music may soothe or excite the mind and heart or even lull one to sleep.
2. Leave work, pick up the cleaning, buy a few groceries, fight the traffic, make dinner, watch T.V., fall into bed.
3. I ran as fast as I could, breathing in gasps, feeling as if I'd never make it on time. Luckily for me, the bus was late.
4. The voice droned on and on as time passed interminably until the lecture was finally over and I was out of there like a shot.
5. I was dreaming I was lying on a beach somewhere sunny, peaceful, and warm; and then the alarm went off and I woke with a start.
6. Life is so hectic and busy and I never have time to just sit and rock and remember those wonderful, lazy, summer days in the country.
7. Will you call me if you hear anymore news as I am terribly concerned about how she recovers from the surgery.
8. I just don't have time to stay now, but I suppose I could give you 1 minute, but that's all.
9. Someone tried to explain it to me, I was very confused, it seemed so very complicated, but then I suddenly got it.
10. After I moved from Seattle to the East coast it was very hard, and I was lonely for the longest time as I didn't know a soul and money was really tight. Then after about a year I began to feel really at home here and life became really exciting and interesting.
11. Don't make a sound, tiptoe quietly, and maybe we won't wake anyone.
12. I am trying not to cry, I swallow hard, take deep breaths, think about something else, and sometimes, it works.
13. She was so very excited, she could hardly tell us the good news, she was so overcome by the surprise.
14. He is an old, old man, nearly 98 and frail, with snow white hair, but he has this magnetic personality that warms the room.
15. You don't mean to tell me, that after all this time, you still haven't finished the first page of that report?

D-34. Practice Materials: Vowel Duration in Varied Phonetic Contexts

Goal: To focus attention on the duration of vowels in varying contexts.

Rationale: Failure to produce the vowels with appropriate voicing and duration increases the perception of poor vocal quality. Speakers should capitalize on the musicality of the vowels and increase oral resonance through mouth opening.

Instructions: Note the effect of the voiced and voiceless consonants on the vowels. Be careful to make all the vowels voiced. Open the mouth well.

A. **Contrastive Pairs**

stitch	Lyn	face	male
heat	lean	coit	boil
pet	Nell	shout	brown
hook	would	fight	mine
pootch	booze	soak	zone
perch	burn	cute	view
hutch	mum	fiat	Rhyadd
hatch	lambs	pus	gun
chop	non	fate	rage
taught	maul	teeth	deal

B. **Sentences**

1. Sasha, shut up that piteous pet puppy.
2. Lloyd and Velma won Vernon's violins.
3. Shut off Chip's auto fast, Chuck.
4. Dylan drove by the garbage bins.
5. Pick cooped-up chicks to chirp-cheep.
6. Remain always in view of a few yews.
7. Shout out at Pete's hot house.
8. Royal voyagers roam around England.
9. Fierce cats eat at Coyote camps.
10. Ring the bells every morning and evening.

11. Cough up cash quick at stick-ups.
12. Juniors earn millions yearly in Israel.

C. **Contrast the italicized words in the following sentences, but lengthen both vowels.**

1. Only a *few* noticed the *view.*
2. The fruit is *fine* there on the *vine.*
3. The poor little *waif* gave a pitiful *wave.*
4. He was safe and *sound* though nearly *drowned.*
5. Inside the *hive,* the bees were *alive.*
6. Use these *cloths* to wipe the *clothes.*
7. That lowly *serf* will always *serve.*
8. If you miss the *bus,* give me a *buzz.*
9. The small *safe* was easy to *save.*
10. Not one *leaf* did the wind *leave.*
11. His name was *Ross,* her name was *Roz.*
12. She says *vase,* but I say *vase.*
13. His name is *Jas,* and he loves *jazz.*
14. She is *ditsy* and also *dizzy.*
15. The very *rich* build up on that *ridge.*

D-35. Practice Materials: Worksheet for Reduction of Intrinsic Muscle Tension on Vowels

Here are some examples of activities to help you "feel" a more relaxed production of voiced sounds. We'll use high air flow consonants surrounding the vowels to help "imagine" the vowel "floating" with the help of glottal opening on adjacent sounds. Have some water to swallow from time to time between trials. Use a medium to low pitch and soft to medium-soft loudness level. A keyboard or pitch pipe may be used as a stimulus as needed. If necessary, a v.u. meter can be used also. Later, pitch and loudness levels can be varied.

Activity I:

Warm ups

Yawn/sigh

Gentle repetitions of prolonged syllables (e.g., ha, hoe, who; pay paw pee; she, shy, shay, sow; sigh, so, say, sue, see)

Activity II:

Vary the context of each prolonged vowel

Read down the following columns.

toast	Seuss	sash	pep	pate	feet
toes	suze	sad	ped	page	feel
doze	zoos	jazz	bed	beige	fees

Activity III:

Alternate repetitions of the same vowels in high flow versus low flow phonetic contexts. Read across each line.

shosh	shop	shone	shod	cod	god	mod
shosh	shone	shop	shod	strong	scrod	bod
shush	hut	shut	up	bum	dumb	mum
shut	up	hut	shush	gun	lunge	nudge

Activity IV:

Try the **close tense vowels.** Remember to relax the jaw. Read down.

heat	pete	sheet	hit	tish
heed	peed	she'll	hid	dish
deed	lead	deal	did	bib

Activity V:

Remember to produce the vowel with a feeling of ease, and linger on the vowels and voiced continuant consonants. Don't tense the vowel as you change from continuant consonants to stops. Sometimes the stop consonants tend to make the vowel too short and tight. Try the following pairs. Read across.

She's chic; peas peak; bees beak

sis sick; sill lick; Liz Dick

Activity VI:

Try some consonant clusters. Don't let your larnyx tighten up as a result of explosive consonants affecting the vowels. Linger on all the voiced sounds. Read across each line.

thrill	shrill	trill	drill
theme	team	dream	scream
cheese	cheek	shriek	creek
stream	truck	struck	streak

Activity VII:

Try some harder words. Read across each line.

exiting	exit	editing	editor	edit
exciting	excite	acting	actor	act
factual	fact	facsimile	faxing	fax
squeezing	squeeze	aging	agent	age
squander	scram	scrunching	scrunch	scrunge

Activity VIII:

Remember that what happens *above* the larynx affects the quality of the sound. Relaxing the tongue, the back of the throat, and the jaw always helps. Practice the words above, varying supraglottal behaviors and observing differences you hear, feel, and see in the mirror.

Activity IX:

These sentences are tricky. You'll have to maintain your relaxed laryngeal posture by remembering what you've learned.

Close kid, but no cigar.

Truck drivers exited in Albany.

Can you ever ignore Edgar's ego?

[illegible] and it's all over in a second.

[illegible] agitate everyone.

D-36. Practice Materials: Worksheet for Geriatric Speakers with Reduced Vocal Power

A. Chunking

Practice small chunks of words and pause between them to breathe.

1. I'd like	some milk	before bed.
2. I'll have	a cheeseburger	and fries.
3. I need	to call	my son.
4. Thank you	for being	so nice.
5. Please	hand me	my sweater.
6. I need	to use	the bathroom.
7. I have	a pain	in my leg.
8. Please	turn off	my light
9. Please	comb	my hair.
10. There's	lotion	in the drawer.
11. My grandson	is a senior	in college.
12. Mary's	granddaughter	called.

B. Emphasis

Emphasize each word in the sentence in turn.

1. *Please* go on.
   Please *go* on.
   Please go *on.*
2. *What* do you want?
   What *do* you want?
   What do *you* want?
   What do you *want?*
3. She was busy.
4. It was great.
5. Fish tastes awful.
6. Please give my some.
7. I hate big pills.

8. Call my doctor please.
9. Is she a nurse?
10. I don't feel sick.

C. Voice Energy

Try to sound as upbeat as you can on these phrases.

1. Let me sit near you.
2. Thank you for coming.
3. What a good idea.
4. That's a nice outfit.
5. I enjoyed it very much.
6. What a lovely day.
7. The sun feels good.
8. Thank you for asking.
9. I feel much better.
10. Happy Birthday George.

D. Voice Patterns

Curve your voice as much as possible on the following phrases.

1. My favorite meal.
2. What's new with you?
3. Nice to see you.
4. Are you okay?
5. No, no more for me!
6. I feel pretty good.
7. You must be kidding.
8. I enjoy this music.
9. I like your perfume.
10. Give me a break.

D-37. Case History: Globus Hystericus

Melissa G., an 18-year-old female freshman voice major, was referred to a university voice clinic because of a feeling of "a lump in her throat." She had been evaluated in her hometown over the summer, and that clinic forwarded the following report.

"Discussion with the patient revealed no history or evidence of vocal abuse in her conversational speech. She began singing about 3½ years ago and plans to make it her career. Her current range is that of a high soprano, but she indicated that at the present time it is difficult for her to reach higher notes and her singing voice has become "breathier." Trained perceptual analysis of the patient's speaking voice revealed soft intensity and slightly breathy quality. Instrumental analysis revealed that both acoustic and aerodynamic measures were within normal limits for age and gender. It should be noted, however, that her air flow rates, although falling within normal range, might be considered slightly high for a singer. This would correspond with her perception of increased breathiness in her voice.

Videostroboscopy-endoscopy revealed normal appearing vocal folds with adequate adduction and abduction. No masses or lesions were seen (thus there was no physiological evidence of Melissa's reported lump in the throat). Glottal closure was characterized by a small posterior glottal chink present during all phonatory attempts. During glissando tasks, the larynx remained relatively stable until she reached higher notes and then a laryngeal ascent was noted. She appeared to struggle more with higher notes and was perceived as more breathy and strained at the higher frequencies. Some minimal thickening of secretions was present. Laryngeal vibratory patterns were symmetrical with normal amplitude of excursion. Tension in supra glottic structures was noted. There was a clinical impression of vocal hyperfunction. The initial cause of this is unknown. Patient was counseled to increase hydration and to discuss appropriate techniques to avoid hyperfunctional behaviors, with her new singing teacher and speech pathologist."

Intake

The clinical supervisor in the Department of Speech and Hearing Sciences met with Melissa for the first time on August 30, 1992, which was the first day of classes in the Fall semester. In a brief clinical assessment session, Melissa indicated that "the sensation of the lump in her throat was worse during periods of stress but also sometimes occurred when she was not stressed." She also said that she frequently got sore throats and upper respiratory tract infections. She had been counselled in Pennsylvania to inrease her intake of water. Following the history taking, the supervising clinician noted that Melissa's conversational speech was characterized by "rapid rate, hard onsets, breathy quality, observable tension in the neck and pharyngeal (i.e., back of the mouth) tone focus." To reduce hyperfunctional behaviors (e.g., excessive muscle tension in face, neck, and torso), facilitating techniques (yawn-sigh, relaxed jaw and neck, humming, shoulder shrugs, neck rolls, and deep breathing) were introduced.

Following the discussion of the need to modify the overt hyperfunctional behaviors, the supervisor led Melissa into a discussion of the relationship between tension and vocal problems. She asked Melissa to tell her the circumstances surrounding the onset of her problem with her throat. Melissa could not identify any significant events or stressors that could be related to her perceived physical problem. It was clear to the supervisor that the client was not yet ready to deal directly with the possible existence of psychosocial factors (e.g., the conversion of anxiety into behavioral manifestations). As a result, the supervisor concluded that the approach to therapy should include both counselling and symptom modification. However, initially, emphasis should be devoted only to symptom modification in order for Melissa to become more at ease before addressing the psychosocial aspects directly. At this first meeting, Melissa agreed to attend therapy for one hour per week.

Goals of Therapy

The therapy approach was two-pronged in that both behavior modification and insight development were employed. Her overall speaking pattern was judged to be tense so the behavior symptoms that were addressed in therapy had to do with tension during speaking. However, the singing teacher also worked on reduction of tension during singing and the development of appropriate technique.

The general goals of voice therapy were stated as follows. Melissa will:

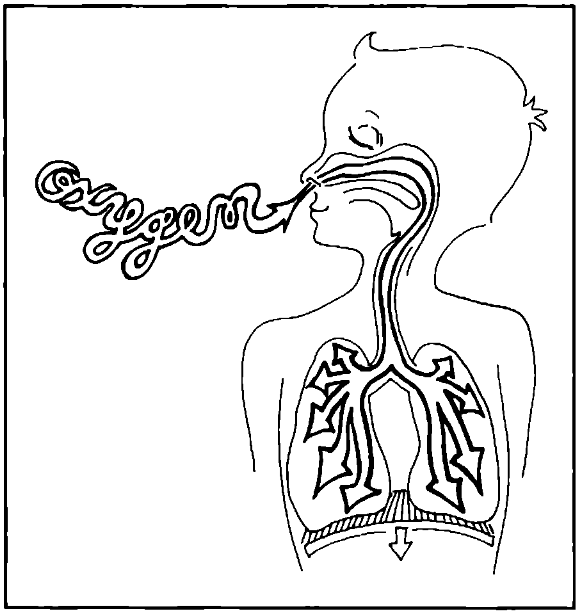
1. Increase the length and control of the exhalation phase of speech breathing.
2. Increase the number of replenishing breaths used during reading and speaking.
3. Monitor her voice production during reading and identify inappropriate behaviors (voice onset, breath support, tone focus, mouth opening, postural alignment, and muscular tension).
4. [illegible] a relaxed vocal quality at the sentence level with 90% accuracy.

5. Reduce the rate of words per minute, by approximately 50, during reading and spontaneous speech.
6. Discuss information concerning relaxed voice production techniques.
7. Discuss the relationship between physical sensations, musculo-skeletal tension, and life stresses.
8. Describe her ongoing activities, adjustments, and adaptations to campus life.

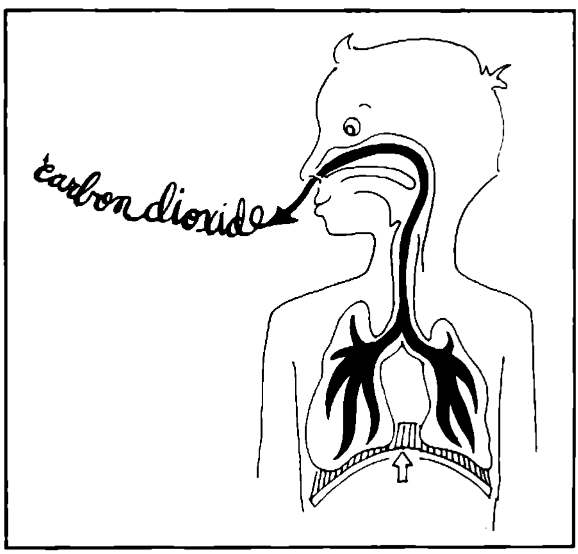
Results

Melissa attended 10 of a possible 12 weekly sessions. By the third session, she had begun to talk freely about her ambivalence about attending a university so far away from her home and her anxiety about whether she was "good enough" to make singing her career. Although she spent a large portion of subsequent sessions discussing her feelings and fears about adapting to college life, she was able to adjust her vocal behaviors and meet her targeted behavioral objectives. Undoubtedly, the ventilation of her feelings and gradual adaptation to her new life style helped reduce her laryngeal tension and hyperfunctional behavioral. She reported that she no longer felt the lump in her throat and that her singing teacher, whom she really liked, felt she was doing well. At the final meeting it was agreed that Melissa would return for monthly check-ups during the following semester to ensure that the gains were maintained.

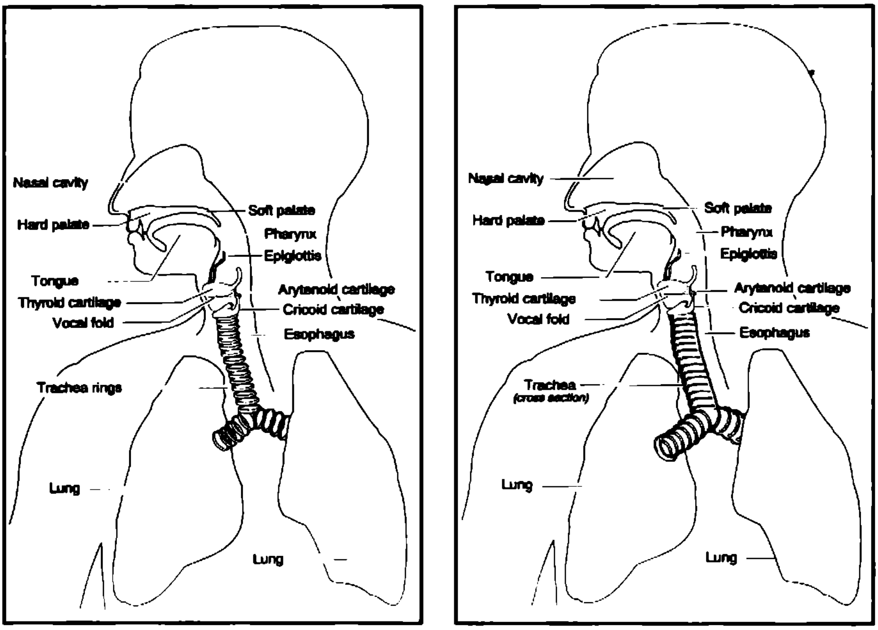
D-38. Practice Material: Worksheet for Adults Showing Structures Relevant to Voice Production



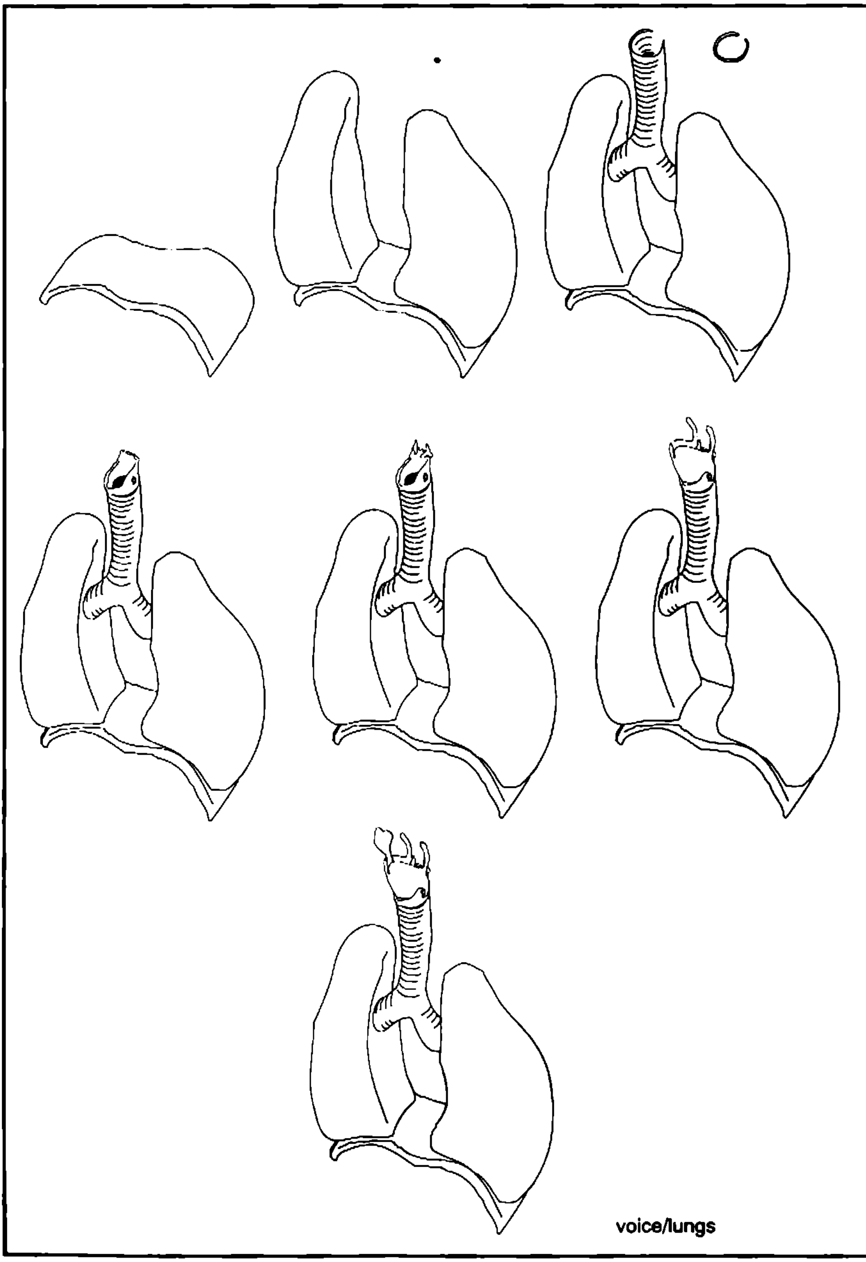
Inhalation



Exhalation



Upper Respiratory System



This series of drawings illustrates the relationships between the diaphragm, lungs, trachea, and larynx. The lungs are protected from the entrance of foreign bodies by the epiglottis, and false and true folds.

APPENDIX

E

Clinician Information and Materials for Laryngectomy and Tracheotomy

CONTENTS

E-1. Clinician Information: Universal Precautions

The Center for Disease Control, U.S. Department of Health and Human Services, has developed guidelines for health-care workers. These are known as *Universal Blood and Body Fluid Precautions to Prevent Occupational Human Immunodeficiency Virus and Hepatitis B Virus Transmission.* The modes of transmission of the two viruses are similar, and the guidelines address work practices, use of personal protective equipment, and other protective measures that are intended to supplement routine infection control with *all* patients. High-level disinfection (e.g., the use of an EPA-registered "sterilant" chemical) is recommended for all reusable instruments and devices (e.g., laryngoscopes, endotracheal tubes, etc.) that come in contact with mucous membranes. The type of gloves to be used is also discussed. All voice clinicians should be conversant with these guidelines. Clinicians are also advised to protect themselves by having a series of injections to prevent Hepatitis B. Information concerning the Universal Precautions is also available from the ASHA office. Ask for ASHA's "AIDS/HIV Update" (1990). Information about specific products used to disinfect equipment can be obtained from Disease Control Centers and local medical centers.

E-2. Clinician Information: Management of Acute Airway Obstruction

Voice clinicians work with patients who are at risk for airway obstruction. When the upper airway is blocked, the lower airway and respiratory system is unable to meet the body's oxygen requirements and immediate action must be taken.

Causes of obstruction include:

a. neurological conditions causing the tongue to block the pharyngeal cavity

b. foreign bodies

c. secretions

d. tumors

e. trauma

f. edema (infections, allergic reactions)

g. acute laryngospasm

Signs of distress include:

a. changes in breathing patterns (e.g., gasping)

b. unusual sounds (e.g., stridor, gurgling, wheezing)

c. coughing

d. hand grasping throat (choking)

e. inability to make sound

f. cyanosis

g. loss of consciousness

Management:

a. Allow the patient to cough if he or she is trying to expel a foreign body.

b. Use finger to dislodge objects. Stabilize tongue and jaw with one hand and hook the finger of the other hand under the object.

c. The Heimlich Maneuver

d. Abdominal Chest thrust

e. Medical procedures such as alternative airways, manual resuscitation bags, and endotracheal tubes.

f. Cardiopulmonary Resuscitation

References:

American Red Cross Standard First Aid Workbook (1991). Washington, DC.

Lucente, F. E., & Sobol, S. M. (Eds.). (1993). *Essentials of otolaryngology* (3rd ed.). New York: Raven Press.

E-3. Clinician Information: The Passy-Muir Valve — Procedures for Use With Ventilator

Equipment:

007 Passy-Muir Tracheostomy Speaking Valve
10 cc syringe
suction equipment

Protocol:

1. The voice clinician (speech-language pathologist) assesses the patient's function to determine if the patient is a candidate for Passy-Muir Tracheostomy Speaking Valve (PMTSV) use.
2. Physician's order is obtained prior to assessment using valve.
3. Staff are made familiar with equipment and procedures.
4. Responsibilities are designated for transdisciplinary approach:
   a. Respiratory therapist (RT) assumes responsibility for operation and monitoring of ventilator, patient's respiratory status, and suctioning.
   b. Speech-language pathologist (SLP) assumes responsibility for patient assessment, attaching PMTSV, voice training, and cuff deflation and inflation.
5. When patient can tolerate use of valve for approximately 10 minutes, the equipment is placed permanently in the patient's room and a log and caution signs are provided.
6. Family and patient education by SLP. Includes training in cleaning valve.
7. Monitoring of patient use by SLP and designated trained personnel (e.g., nurses).

Fitting:

1. The PMTSV may be connected directly to the 15 mm hub of trach tube with vent tubing on other end of valve.
2. Alternatively, the PMSTV may be connected to a right-angle swivel adaptor then to vent tubing.
3. Suction patient.
4. Deflate cuff using syringe. When cuff is deflated the vent may alarm and vent parameters may need to be adjusted by the R.T. After cuff deflation

the patient may need to be suctioned again as secretions that were on the cuff may be mobilized.

5. Disconnect swivel elbow and flex tubing from ventilator circuit.
6. Connect end of flex tube containing PMTSV to the trach hub.
7. Connect other end of flex tube to ventilator wye.
8. Encourage patient to produce voice.
9. Monitor voice use, respiratory/ventilator status, and physical status. Oximetry, respiratory rate, color, etc., are used to monitor patient's tolerance of the valve, and ventilator compensations are made as needed.

Removal:

1. Reconnect swivel elbow with flex tubing.
2. Attach at ventilator wye. Return ventilator settings to the original settings once valve is no longer in place.
3. Reinflate cuff to required level.
4. Log amount of use and other relevant data.

Advantages of PMTSV:

1. Eliminates need for finger occlusion of stoma and thus aids in infection control.
2. Restores sense of smell and taste.
3. Improves swallowing.
4. Allows verbal communication of needs, health concerns, and so on.
5. Improves psychosocial adjustment.
6. Can be used with both adult and pediatric ventilator-dependent patients.

Cautions:

1. The Passy-Muir valve is designed as a one-way valve with a positive closure design. Therefore it stays closed and opens only during inspiration. The patient then exhales through the upper airway. Thus, secretions can be coughed up normally. However, it is critical that the patient *can* exhale normally with the tracheostomy tube in place. That is why cuffed tubes must always be deflated before the valve is used. Foam-cuffed tracheostomy tubes cannot be used with the Valve.

2. Upper airway obstruction must be carefully assessed to ensure that no narrowing or blocking of the airway prohibits exhalation. Trach tube size must also be assessed to ensure that the patient can exhale well enough around it. Fenestrated and nonfenestrated trachs can be used with the valve.

3. Thickness and amount of secretions must always be assessed. If secretions are thick and copious, the patient may not be able to tolerate the valve until the secretions are more manageable.

4. Patients with "end-stage" chronic pulmonary disease must be carefully assessed if use of the Valve is considered. When the lungs have lost elasticity to the extent that the patient cannot exhale, ventilator-dependent patients should not be fitted with the valve.

5. Swallowing status should be assessed by the SLP. The patient must be able to tolerate cuff deflation and be able to manage his or her own secretions. Valve use may facilitate swallow.

6. In pediatric patients, the airway is smaller and more vulnerable to obstruction. Careful assessment of the upper airway is critical before the valve is fitted. Sometimes a smaller tracheostomy tube may be needed. Children should be monitored exhaling with finger occlusion and trained to exhale during enjoyable blowing activities. The child's anxiety, behavioral problems, the possibility of infections and edema and rapid changes in medical status are important concerns when valves are used. However, the benefits of enhancing communication development by early fitting of a valve are obvious. Careful monitoring of children is essential to prevent airway compromise. Careful monitoring is also important with all patients, regardless of age.

Reference:

Mason, M. F. (1993). *Speech pathology for tracheostomized and ventilator-dependent patients.* Newport Beach, CA: Voicing!.

E-4. Handout: Information About Passy-Muir Valve for Families of Ventilator-Assisted Patients

A patient who is on a ventilator is on a breathing machine. The machine pushes air into the lungs through a trach tube placed in the neck hole (stoma) and air is then exhaled out through the tube in the neck. This means that the nose and mouth are no longer being used to breathe the air in and out of the lungs. Because the outgoing air exits through the neck hole, it is not passing through the voice box (larynx) which is situated higher in the neck. Thus, the patient is not able to make sound using the voice box. For voice to be produced, exhaled air must pass through the voice box.

Sometimes a special valve (The Passy-Muir valve) can be used to help the patient to talk using the voice box (larynx). The valve makes it possible to shunt the exhaled air upwards through the upper neck and mouth for talking. The valve is fitted to the tubing, but the patient's air supply from the ventilator is not limited. Ventilator compnsations may, however, be necessary to maintain appropriate ventilator parameters and ensure the patient is comfortable. The patient may be anxious initially, and there may be some coughing. This is to be expected. As secretions build up, they may be suctioned out to make sure breathing is not interrupted in any way. Also the cuff on the trach tube must always be *deflated* prior to and during valve placement.

It is important to *encourage* the patient *to try using this valve* for short periods of time so that communication is possible with family, physician, and staff. Even a few minutes of talking is helpful each day so that needs can be expressed. Since the patient may be anxious at first, a great deal of support and encouragement will be needed. Predictable patient fears are that the air supply to the lungs will be blocked by the valve or by a build up of secretions. The patient will be carefully monitored to ensure the valve is used safely at all times. We hope you will encourage the patient to try the use of this valve for short periods of time so that some talking is possible. Anxiety will usually decrease once the patient adjusts to the valve.

E-5. Handout: Information for Team Members on the Passy-Muir Valve

The Passy-Muir Valve is a oneway valve, attached inline to ventilator tubing. It is *always necessary to deflate the cuff before using the valve.* Suctioning should be performed, as needed, before and after the cuff is deflated. Ventilator adjustments (e.g., tidal volume, PEEP, etc.) may be needed. The cuff should be deflated slowly, then the valve should be attached and voicing elicited. Failure to deflate the cuff could cause the patient to be unable to exhale air with life-threatening effects. Use of the valve allows for communication and even very short periods of use are of great benefit to the patient, family, and staff. It is usual to try to gradually increase the patient's tolerance of the valve. Initially the patient may be anxious about use of the valve and may experience increased coughing and stress about safety. The patient should be reassured that increased coughing and need for suctioning are commonly experienced and that breathing will not be affected. The patient should be informed about which staff members are trained to fit the valve and monitor its use. Valve use must be monitored by trained personnel and careful documentation of use is essential.

Warning Signs of Problems:

Ventilator-related Changes

- High pressure alarms (triggered by occluded tubing, coughing, suctioning needed)
- Low pressure alarms (triggered by disconnections)
- Saturation levels drop suddenly (should remain at 88% or more). The physician and/or RT may provide specific guidelines on oximetry parameters based on patient condition, diagnosis, and so on.

Patient Changes

- Clammy skin and or blueness of lips and nails
- Rapid breaths per minute/shallow breathing
- Heart rate changes (e.g. decreases below 60 beats per minute or rapid increases) may also indicate problems.
- Pulse rate increases more than 20 beats above resting pulse
- Prolonged coughing

Patients vary with respect to the amount of time they can tolerate the valve. The speech pathologist and respiratory therapist will monitor the patient's progress with the valve and advise staff about each individual patient's tolerance level. The valve will be kept in a designated place in the patient's room once the patient has progressed to the stage where the patient has learned to use the valve. There will be a log with the valve so that all staff members can document times of use and reasons for removal. The following information should be provided.

- Names of staff trained to assist with valve
- Maximum time valve should be used
- Caution signs

  DO NOT USE WHEN SLEEPING

  DO NOT USE WITH INFLATED CUFF

  DO NOT USE WITH TRACH THAT HAS A FOAM-FILLED CUFF

  DO NOT USE IF RESPIRATION DETERIORATES

  SUCTIONING SHOULD BE DONE BEFORE AND AFTER CUFF IS DEFLATED

The valve will frequently enable the patient to cough secretions up through the mouth, thus reducing the need for suctioning. Also, with the valve in place, natural evaporation of secretions, due to airflow in the upper airway, can occur. This may also help reduce the need for suctioning.

Professionals who should receive this information, and have access to training in valve use, include nurses and nursing assistants, occupational, physical, and respiratory therapists.

Reference:

Passy-Muir Instruction Booklet (Available from Passy-Muir, Inc. 4521 Campus Drive, Suite 273, Irvine, California).

E-6. Clinician Information: Addresses of Suppliers of Equipment and Materials

Imaginart Communication Products
307 Arizona Street
Bisbee, AZ 85603
(800) 828-1376
FAX: (602) 432-5134

Broad selection of quality functional treatment materials for adults with aphasia, dysarthria, apraxia, head injury, dementia, laryngectomy, voice and swallowing disorders. Also AAC materials for adults.

National Sleep Foundation
122 S. Robertson Boulevard
Third Floor MM
Los Angeles, CA 90048

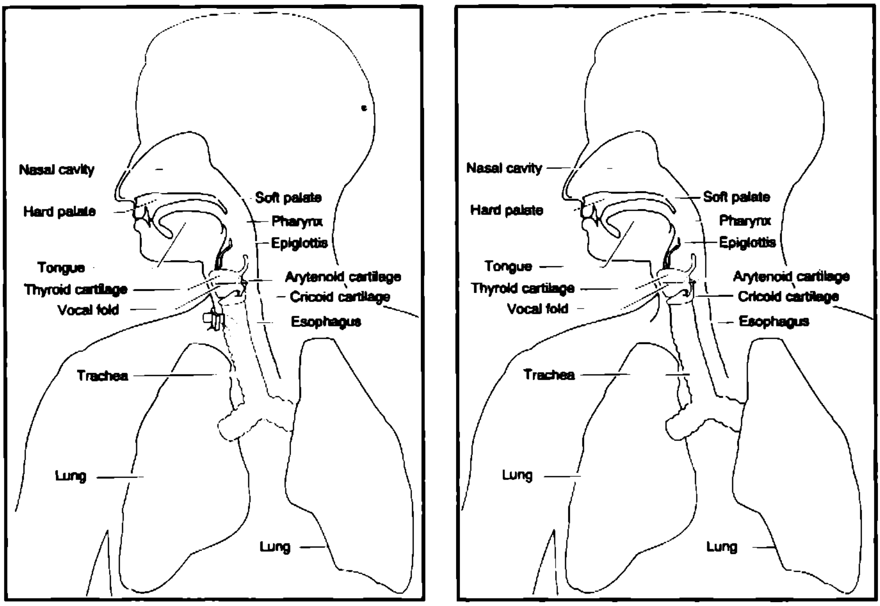
Free brochures on sleep apnea, insomnia, and sleep problems in the elderly.

Tracheoesophageal Supplies are available from:

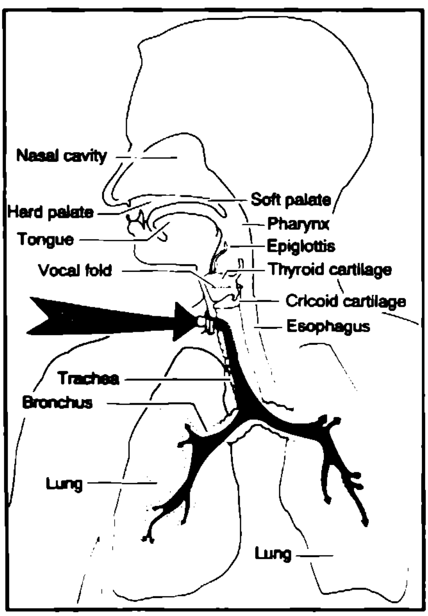
Bivona Inc.
5700 West 23rd Avenue
Gary, IN 46406
(800) 348-6064

In-Health
214 Santa Barbara Street
Santa Barbara, CA 93101
(800) 477-5969

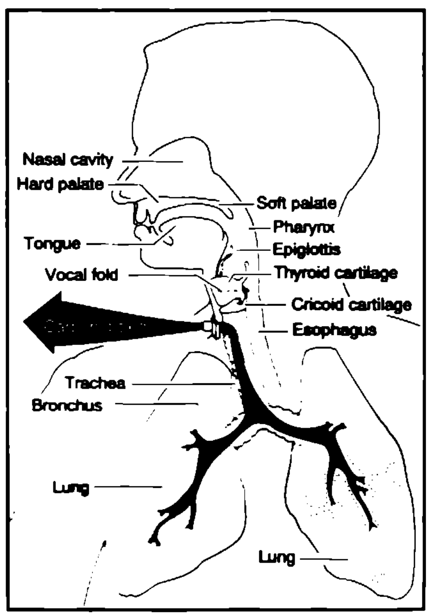
E-7. Handout: Illustrations of Ventilator-Dependent Patient



Ventilator-dependent patients. Figure A shows a patient with a tracheostomy. Figure B shows normal structures.



Inhalation



Exhalation

APPENDIX

F

Clinician Information and Materials for Psychosocial Disorders

CONTENTS

F-1. Clinician Information: Phobias

Phobias are irrational fears of people, places, and things. About 10% of the American population have phobias, and they can range from mild to incapacitating. A few individuals have severe phobias about speaking in public. Some examples of other phobias are:

Agoraphobia — fear of being in public places

Acrophobia — fear of heights

Social phobia — fear of being watched by others

Claustrophobia — fear of closed places

Patients exhibiting signs of phobia should be referred to a mental health professional.

Signs to watch for:

Feelings of fear or panic in harmless situations

Rapid heartbeat

Shortness of breath

Trembling

Overwhelming desire to flee situations

Avoidance of situations/activities/objects

Sweating

Reference:

Diagnostic and Statistical Manual of Mental Disorders (3rd ed. — Rev. [DSMIIIR]). (1987) Washington, DC: American Psychiatric Association.

F-2. Reading Passage: Happiness

When a group of people are asked what is the most important thing in life, about half of them usually reply that they believe it is being happy. Yet for millions of Americans, happiness appears to be elusive. Most studies show that 30 to 40 percent of Americans consider themselves to be unhappy. Some fall into the trap of believing that success, and financial success in particular, automatically lead to happiness. The acquisition of material things is one way that some actually define the achievement of happiness. Every day we are bombarded by advertising that tells us we need to drive a certain type of car or own a certain electronic toy, if we really want to be happy. Yet research has consistently shown that having more than enough money to meet one's needs doesn't guarantee more happiness. Actually, happiness seems to be influenced more by attitude and personal choice than by the amount of tangible assets. Sigmund Freud said that inner contentment depended on the presence of love and work that was satisfying to the individual. Others have noted the importance of personal relationships, a sense of purpose and accomplishment, an adventurous spirit, exercise and physical well being, and spirituality.

Some experts feel happiness results from a healthy, well balanced life. Others feel that it must be sought after and made a priority in life. Seeking happiness involves helping others as well as enjoying oneself, say many experts who have studied this question. Norman Vincent Peale, in his classic best seller "The Power of Positive Thinking," said that attitude was of paramount importance. Research has also shown that optimists are generally happier than pessimists, regardless of the circumstances of their lives. Pessimists are always fretting about their half-empty glass, while optimists are rejoicing that their's is half-full. This kind of optimism, undergirded by a healthy attitude of self-respect, may help a person remain happy despite adversity and faltering health.

F-3. Clinician Information: Bibliography of References Related to Gender

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F-4. Practice Materials: Feminine Gender Changes

Goal: To practice use of upward inflections and feminine intonation patterns.

Tag Questions:

It's marvelous, isn't it?
You went, didn't you?
It is, is it?
You'll come, won't you?
It's a shame, isn't it?
He can't, can he?
I love them, don't you?

Phrases/Sentences:

Oh maybe
Oh no
Yes I will
It's fabulous
She's here
I'm not sure
Terrible color
Wonderful outfit
No refunds?
You're kidding me
What a view
Another drink

I'd like a table by the window.
How much are these?
Do you have it in blue?
Is that correct?
Do you have the right change?
Could I have the fish broiled?
It's more than I wanted to pay.
You have no tickets for Monday evening?

Highlighting Words:

What a gorgeous day.
It's just so incredible.
I love you.
Wonderful food.
The display is lovely.
The decor is exquisite.
She's got wonderful flair.
She's a marvelous dancer.
Her gown is divine.
The limo is luxurious.
Lighten up will you?

F-5. Practice Materials: Gender and Communication Worksheet

Communication: Descriptors Sometimes Used in Relation to Gender Differences.

Masculine	**Feminine**
Confident statements	Tentative statements
Loud or strong	Light or breathy
Little variability	A lot of variability
Direct	Indirect
Pitch tunes go down	Pitch tunes go up/tag questions
Rough quality	Musical quality
Staccato phrasing	Legato phrasing
Assumes dominant role	Draws others out
Establishes place in hierarchy	Makes others feel comfortable
Interrupts	Listens well/listening responses used
Few gestures/less eye contact	More gestures and eye contact

Activities to contrast masculine/feminine styles:

1. Study the following sentences and then rework them in a more feminine style. Remember to add qualifiers, tag questions, descriptive adjectives, and polite phrases. Two examples follow.

a. Let's eat.	Would you care for something to eat?
b. What a movie.	That was the most amazing movie, wasn't it?

Just coffee.	Hop in.
Where's the Post Office?	She's nice enough.
It's hot out.	That dog's mean.
That's a good looking kid.	Gimme a hand with this.
What a great meal.	Where's the men's room?
Is that a new dress?	I need change.

2. Role-play some phone calls using a more feminine style. Remember to provide extra details rather than merely providing basic information. Focus on relationships rather than just factual questions and information. Two examples follow.

a. Ordering flowers . . . My sister is in the hospital and her favorite color is pink . . . she loves roses . . . something small and dainty for her bedside table . . .

b. What shall I wear to the wedding . . . I don't want to feel overdressed but it's a very wealthy family . . . do you think that my blue dress is too short? What are you wearing?

Call to ask directions.

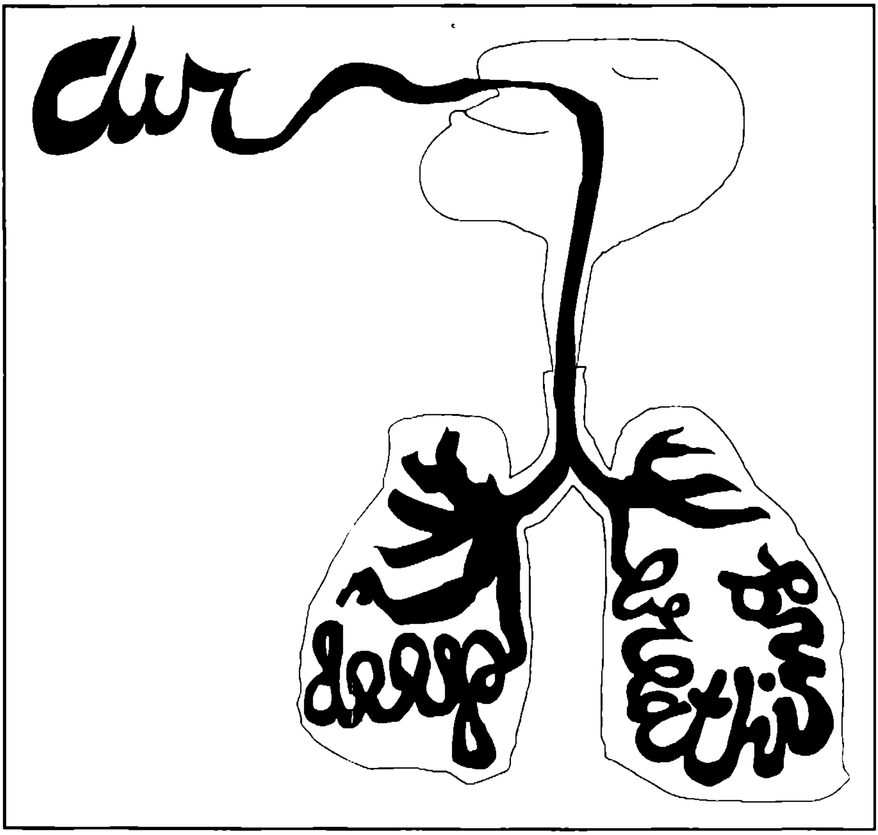
Call to ask about catalogue item.

Call to inquire about a friend's health.

Call to make reservations for a cruise.

Call a caterer about arranging a party.

F-6. Handout: Illustration of Deep Breathing



Geriatric patients frequently benefit from a discussion of breathing. Postural changes may be needed for wheelchair bound elders. The helpfulness of deep breathing to alleviate anxiety and stress may also be addressed.

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Moya L. Andrews

Moya L. Andrews is Professor of Speech and Hearing Sciences and Director of the Voice Clinic at Indiana University, Bloomington. Dr. Andrews was born in Australia and received her bachelor's degree from Queensland University in Brisbane. Her master's degree is from the University of California at Santa Barbara, and her doctorate is from Columbia University. She is a certified, licensed speech-language pathologist and a Fellow of the American Speech-Language-Hearing Association and of the Society of Ear, Nose and Throat Advances in Children. She has worked in schools, clinics, and hospitals in Australia, Great Britain, and the United States and is a popular presenter of workshops and seminars here and abroad. Her publications include *Voice Therapy for Children* and *Voice Therapy for Adolescents* (with Anne Summers), both published by Singular Publishing Group, Inc. She has also authored numerous journal articles and designed therapy materials, published by Communication Skill Builders, Tucson, Arizona. During the academic year 1991–1992, she was awarded a Lilly Foundation Open Faculty Fellowship to study the care of the professional voice.

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