SELECTED VOCAL EXERCISES AND THEIR RELATIONSHIP TO SPECIFIC LARYNGEAL CONDITIONS: A DESCRIPTION OF SEVEN CASE STUDIES

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Good vocal health is a vital concern for those people who use the voice in a professional capacity, such as teachers, singers, actors, clergymen, and lawyers. Research in the area of vocal health reveals the need to determine if specific exercises are beneficial to the voice and if exercises used to train the singing voice might be beneficial to alleviate pathological and/or dysfunctional voice disorders.

The purpose of this study was to describe the response of a variety of pathological voices to a selected set of singing exercises. Subjects were selected from the private practice of cooperating physicians who felt that the vocal instruction and exercise program might be helpful to the teachers, students, professional "pop" singers, and housewife-singers who were diagnosed to have muscle tension dysphonia, nodules, recurrent laryngeal nerve paralysis, or iatrogenic dysphonia.

Instrumentation for assessing conditions before, during, and after exercise included a brief case

history, subject interviews, attending physicians' medical charts, flexible fiberoptic video nasolaryngoscopy, video cassette recorder and video tape segments, three physician/observers, and a specific diagnostic procedure which provided a method of assessing organic, functional, and perceptual variables.

For the exercise program the researcher chose seven vocalises from the routine designed by Allan R. Lindquest, whose techniques combined those of the Italian school with those of Swedish studios which produced such singers as Flagstad and Bjoerling. The seven vocalises included a warm-up "massage" and exercises for separation and blending of the registers, vowel clarity and modification, tone focus, vocal attack, and flexibility.

Since all the subjects showed improvement after exercise in the vocal conditions observed in this study, these vocalises and technique may be helpful to alleviate pathological conditions and/or dysfunctional behavior in other subjects. The researcher further suggests that the voice profession investigate the efficiency of other techniques, exercises, and musical vocalises which might bring about positive changes in vocal conditions and behavior.

ACKNOWLEDGMENTS

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

CHAPTER 1

INTRODUCTION

General Problem

Good vocal health, of general interest to everyone, is a vital concern to the professional voice user. As the primary vehicle of communication, the human voice must last a lifetime, for the professional speaker, lawyer, clergyman, actor, salesman, teacher, or singer cannot exchange the voice when it wears out or becomes diseased. Thus the ability to speak and sing is a valuable possession and should be protected from disease, injury, and misuse. Those people whose occupations put extreme demands upon the vocal mechanism need to know what voice disorders may occur and how these abnormal health conditions can be diagnosed, treated, and prevented.

If the condition and function of the voice are normal, the professional voice user might logically expect to enjoy good vocal health and longevity. Although no absolute criteria for defining normal voice have been established, voice abnormalities or disorders are generally classified in three general areas: organic disorders, disorders of function, and psychogenic disorders. Organic disorders include such physical conditions as congenital deformity, inflammation, tumors, endocrine disease, trauma or accident,

and neurologic disease. Disorders of function include muscle tension dysphonia (hyperfunction) resulting in pathology such as nodules or contact ulcers; hyperfunction without secondary laryngeal pathology; and resonance abnormalities such as hypernasality. Psychogenic disorders are non-organic in nature and involve loss of normal voice due to emotional stress or conflict. Since any of these different types of vocal abnormalities may be present or can occur in a previously healthy larynx, it is important that the professional voice user seek complete and professional voice evaluations.

Voice evaluations usually involve three areas of diagnosis: a case history of the patient, a laryngologic examination, and a voice profile. In order to understand the patient with a voice disorder, it is necessary to acquire basic background information such as age, gender, and occupation. A complete case history also includes an assessment of previous vocal disorders as well as the onset and duration of the present problem.

A thorough laryngologic examination includes the head, neck, and chest areas. The otolaryngologist observes the nasal and pharyngeal cavities, and views the interior of the larynx by direct or indirect laryngoscopy. Indirect laryngoscopy draws its name from the method of viewing the larynx indirectly with a mirror reflecting the laryngeal

image. The laryngeal mirror examination is the oldest[1] and still most widely used technique for indirect laryngoscopy. It gives an adequate picture of the larynx and any possible pathology, but does not allow the otolaryngologist to observe laryngeal behavior in speech and singing. While the patient phonates the vowel [i], the examiner may observe glottal opening and closing, normalcy of tissue color, and presence of mass lesions or inflammation.[2] Similar assessments may be made with the right angle telescope during direct laryngoscopy. This instrument is inserted along the dorsum of the tongue, over the epiglottis, and down to the level of the vocal cords. Often requiring local or general anesthesia for the patient, this method provides the best picture of the larynx for diagnosis, biopsies, and surgical excisions.[3] A new diagnostic tool, the fiberoptic nasolaryngoscope, is now available in some clinics, offices, and hospitals. This flexible fiber optic bundle may be inserted through the nasal passage into the pharynx and down to the level of the vocal folds. While providing its own light source through two light bundles, it transmits a magnified laryngeal image. Unlike the laryngeal mirror and

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[1]Manuel Garcia, Hints on Singing (New York, 1894, 1982), Preface.

[2]Arnold Aronson, Ph.D., Clinical Voice Disorders, (New York, 1980), p. 172.

[3]Joseph Stemple, Clinical Voice Pathology, (Columbus, Ohio, 1984), p. 93.

the right angle telescope, this technique allows the patient to be viewed and photographed or video taped during normal speech or singing. Other investigative techniques for viewing the larynx include radiography (x-rays, still x-ray photography, and x-ray spot films), high-speed motion picture studies, stroboscopy for examination of the vibratory pattern of the folds, and videofluoroscopy or cinefluorography.[4]

Many otolaryngologists, clinicians, and speech pathologists use the psycho-acoustic voice profile as part of the diagnostic process. This voice evaluation involves subjective assessments of various aspects of the voice and vocal production, such as respiration, pitch, loudness, and quality. Although these evaluations are usually for the speaking voice, they are beneficial to singers, who often experience vocal problems because of poor speaking habits.[5] Voice evaluation includes the clinician's acoustical perception of the voice and sometimes data from instrumentation devices such as the wet spirometer (for respiratory function measurements), the visi-pitch voice analyzer, the Kay Visi-Pitch (for loudness measurement), and

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[4]Aronson, p. 10.

[5]Morton Cooper, "Vocal Suicide of the Speaking Voice in Singers," Music Educators Journal, Vol. 57, No. 1 (September, 1970), p. 52.

spectographs and electroglottographs for measuring voice quality.[6] The clinician's acoustical assessment of voice attempts to rate the observed voice in relationship to normal expectations. These voice profiles are part of a regular routine in initial and subsequent visits to a speech pathologist. They generally include perceptual judgments of pitch, resonance, intensity, vocal range, and adduction of the vocal folds.[7]

Various clinical techniques are available for determining pathology as well as various aspects of a normal larynx. Comparisons are then possible between the normal and abnormal voice. Electromyography measures intrinsic muscular activity and has been used to investigate vocal cord paralysis and other disorders of function. Aerodynamic tests measure air flow rate, phonation efficiency, and subglottal pressure. These tests have been used to investigate laryngeal paralysis, laryngitis, nodule and polypoid swelling, tumor, granuloma, spastic dysphonia, carcinoma, and functional dysphonias. Procedures which measure vocal fold vibration include stroboscopy, ultra high speed photography, photo-electric glottography,

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[6]James L. Case, Ph.D., Clinical Management of Voice Disorders, (Rockville, Maryland, 1984), pp. 71-86.

[7]Frank B. Wilson, Ph.D. and Mabel Rice, Voice Disorders: A Programmed Approach to Voice Therapy, (Hingham, Massachusetts, 1977).

electroglottography, and ultrasound glottography. Data from these tests include glottal width and area, fundamental frequency of vibration, opening-closing phases, amplitude, and contact area of the vocal fold. Acoustical analysis techniques provide assessments of pitch, intensity, spectral harmonics, and turbulent air noise.[8]

Professional voice users may attempt to diagnose their own vocal conditions through differences in perceptual quality, sensations, or changes in activity. Symptoms perceived by the patient may subsequently have several possible diagnoses when reported to the otolaryngologist. Robert Sataloff, M.D., offers possible diagnoses for symptoms frequently reported by patients who are singers. Actual "hoarseness" is usually associated with an abnormality in the vocal folds. The condition could be laryngitis from infection or inflammation caused by over-use. Dehydration, mass lesions (such as nodules), or a hemorrhage in the vocal fold may also cause hoarseness. A feeling of hoarseness could be vocal fatigue caused by improper or prolonged use of the voice, or a neurological illness. Volume disturbances can be due to technical error or limitations, or may indicate hormonal changes, neurological disease, nerve paralysis, or aging. Sataloff

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[8]Minoru Hirano, M.D., Clinical Examination of Voice (New York, 1981).

believes that the requirement of a prolonged warm-up time may indicate the presence of reflux laryngitis (stomach acid escaping into the esophagus and throat). Breathiness may be the result of improper technique or development, but can be a symptom of a pathological condition such as vocal cord paralysis, nodules, arthritis of the cricoarytenoid joints, arytenoid dislocation, or senile vocal cord atrophy. A tickling or choking sensation can be caused by laryngitis or vocal abuse. Pain in the neck area is most commonly a result of excessive muscular activity. It may also be caused by vocal cord lesions, laryngeal joint arthritis, or infection or irritation of the arytenoids.[9] These many possible causes for the same or similar vocal "symptoms" reveal the need to seek professional help when any abnormality in sensation or sound persists. Proper treatment can then be prescribed.

Treatment for laryngeal health problems may involve surgery, drugs, and/or therapy. Surgical and medicinal treatments are recommended by the qualified otolaryngologist. Voice therapy is often required in relation to laryngeal health problems and often includes a wide scope of technical approaches. These techniques address the issues of pitch, tone focus, voice quality,

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[9]Robert T. Sataloff, M.D., "Vocal Problems: Not Always 'Hoarseness'," The NATS Bulletin, Vol. 42, No. 2 (November/December 1984), pp. 31-32.

volume, breath support, vibrato, resonance imbalance, and hypo-hyper-functional aspects. General voice therapy approaches usually involve auditory training, respiratory control, relaxation, instruction in proper vocal attack and optimum pitch, mandible and tongue adjustments, and occasionally specific exercises such as warm-ups, massage, or yawn-sighs.

Exercise as treatment or training for the voice is neither new nor limited to this modern age. Therapeutic exercise for the body has been in use since at least 1000 B.C.,[10] and vocal exercise may be traced from ancient times in the writings of Hippocrates and Galen through the Renaissance and into the nineteenth century.[11] Extensive physical training of the singing voice was evident in the Bel Canto Age,[12] and similar exercises may be traced from subsequent centuries to the present time through singers and teachings of voice teachers such as Nava, Lamperti, Garcia, Marchesi, Witherspoon, Wilcox, Vennard, and Lindquest. Although singers and teachers of singing may attest to the auditory benefit of vocal exercise, the actual physiological

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[10]Sidney Licht, M.D., Rehabilitation and Medicine (New Haven, Connecticut, 1968), p. 1.

[11]Gretchen Finney, "Medical Theories of Vocal Exercise and Health," Bulletin of the History of Medicine, Vol. XL (September-October, 1966), p. 395-406.

[12]Victor Rangel-Ribeiro, Baroque Music (New York, 1981).

benefits of vocal exercise have been difficult to assess without recourse to equipment to monitor visually the functioning larynx. Since the larynx consists of muscles, cartilages, and soft tissue, it seems logical to expect the voice to respond to therapeutic exercise much the same as do other parts of the body.

After being assessed as to the type of voice disorder, its diagnosis and treatment, the professional voice user may wish to address the issue of prevention: how best to avoid vocal health problems. The majority of voice disorders may be related to improper use of the vocal mechanism.[13] Activities such as yelling, screaming, or excessive throat clearing; or using hard glottal attacks, or inappropriate pitch and intensity levels are all examples of vocal abuse. These types of excessive voice efforts are called hyperfunctional voice behaviors or disorders. Excessive muscular force in respiration, phonation, or resonance may be included in the general classification of hyperfunction.[14] Common symptoms or conditions among those who suffer vocal strain or excessive muscular activity (muscle tension dysphonia) include incorrect breathing, an imbalance in management of the breath or in glottic

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[13]Daniel R. Boone, The Voice and Voice Therapy (Englewood Cliffs, New Jersey, 1983), p. 1.

[14]Ibid, p. 4.

resistance and air flow, poor use of resonance, and excessive tension in the larynx.[15] When these dimensions of vocal misuse or hyperfunction occur over a period of time, one of two conditions, or perhaps both may develop. In the first the larynx will be found to have a normal appearance, but the voice tires or becomes hoarse with prolonged use. In the second, certain pathological conditions may be present, such as edema (generalized swelling). There may also be localized swellings, as in polyps, or nodules. Otolaryngologists and speech pathologists generally agree that these benign growths on the vocal cords are a direct result of inappropriate or excessive vocal use. Detection of excessive muscular tension in the larynx has in the past been limited to a psycho-acoustical evaluation or assumed from a diagnosis of pathology already present. With present technology, the use of the fiberoptic laryngoscope, and a professional assessment of excessive muscular activity in the posture of the functioning larynx, an early diagnosis of hyperfunction or muscle tension dysphonia and prevention of resulting pathology may be possible.

Although preventive medicine is a controversial subject, the reviewed sources offer the following

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[15]Margaret Greene, The Voice and its Disorders (Philadelphia, 1980), p. 115; Donald F. Proctor, Breathing, Speech, and Song (New York, 1980), p. 147.

recommendations for good laryngeal health:

General rules of good health

Voice training and exercise

Proper speaking techniques

Good vocal habits (avoidance of yelling, throat clearing, etc.)

Attention to allergies and hormone balance

Prompt and professional care for respiratory infection and laryngitis

Knowledge of and attention to environmental factors

Reasonable use of voice with regard to time and vocal demand

Periodic re-assessment of speaking and singing techniques

For professional voice users the recommendations to periodically re-assess vocal technique, to obtain proper training, and to engage in healthy vocal exercise would also suggest a need for additional, reliable methods of vocal evaluation, technique, and exercise.

Purpose

There is a need to determine if specific exercises are beneficial to the voice. There is a further need to determine if exercises used to train the singing voice might be beneficial to the pathological and/or dysfunctional larynx. This study will attempt to determine if there is a

relationship between the use of a specially designed set of vocal exercises used to train the singing voice and any change in the physiological and/or functional condition of voices in selected case studies.

Research Problems

Specific problems will be:

1. To describe the laryngeal conditions of patients diagnosed to have vocal disorders such as muscle tension dysphonia (or laryngeal hyperfunction), nodules, recurrent laryngeal nerve paralysis, or iatrogenic dysphonia.

2. To describe laryngeal conditions after vocal exercise prescribed for patients with vocal disorders such as muscle tenion dysphonia, nodules, recurrent laryngeal nerve paralysis, or iatrogenic dysphonia.

Definition of Terms

1. Muscle tension dysphonia (laryngeal hyperfunction) refers to a voice disorder caused by excessive muscular activity in the larynx.

2. Nodule refers to a localized thickening of the surface on the free margin of the vocal fold.

3. Recurrent laryngeal nerve paralysis refers to the interruption of innervation from the recurrent (inferior)

branch of the laryngeal nerve resulting in paralysis of the vocal fold.

4. Iatrogenic dysphonia refers to vocal impairment brought about by medical treatment or surgery.

Limitations

1. This study will be limited to individual subjects with specific problems.

2. This study will be limited to subjects who have demonstrated the ability to match and reproduce musical pitch.

3. This study will provide data on the response(s) of each individual to an applied therapy.

4. No assumption may be made that other subjects will respond in the same manner.

5. No assumption may be made that other exercises will encourage the same or different responses.

CHAPTER II

RELATED LITERATURE (Part I)

Definition and Classification of Voice Disorders

The voice professions have established neither absolute criteria for defining normal or abnormal voice nor a unified system of classification for voice disorders. This lack of criteria and classification system possibly contributes to misunderstandings of terms and procedures used by physicians and speech or voice specialists. Cooperation and mutual comprehension among all those concerned with voice evaluation and treatment would greatly contribute to education and research as well as to a more efficient recovery for those people with voice disorders.

According to most speech pathologists, a voice disorder may be said to exist when pitch, loudness, quality, or flexibility differs from other voices of the same age, gender, and cultural group. Nevertheless, as Aronson points out, defining abnormal voice has been one of the most difficult tasks of the speech-language clinician, as "voice variety is limitless and standards for voice adequacy are broad";[1] and as Jensen reminds us, what may sound "breathy" to one speech pathologist may be described as "hoarseness"

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[1]Arnold E. Aronson, Clinical Voice Disorders, (New York, 1980), p. 5.

by another, as "harshness" by yet a third.[2] Thus the definition of abnormal voice currently depends on a judgment made by the person whose voice is in question or by the professional clinician whom the patient has consulted, as Moore observes:

> It is apparent that the voice is abnormal for a particular individual when he judges it to be so. Judgment implies a set of standards that are learned through experience and that are related to the judge's own aesthetic and cultural criteria. Judgment also implies that standards are not fixed, that there is opportunity for more than one conclusion. This flexibility in determining the defectiveness of voices does not alter the validity of the basic definition of voice disorders, but it does underscore the observation that vocal standards are culturally based and environmentally determined.[3]

General standards for normal voice have been set with the perceptual parameters of quality, pitch, loudness, and flexibility. An early source[4] stated that quality should be pleasant and musical; pitch level, adequate and appropriate for the age and sex of the speaker. Moreover, Johnson said that the voice should be easily heard but should not draw undesirable attention to that aspect, and that flexibility should be adequate enough to enable the speaker to provide

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[2]P. J. Jensen, "Adequacy of terminology for clinical judgement of voice quality deviation," Eye, Ear, Nose, and Throat Monthly, Vol. 44, (1965), pp. 77-82.

[3]George Paul Moore, "Voice Disorders Organically Based," Handbook of Speech Pathology and Audiology, ed. Lee E. Travis, (New York, 1971), p. 535.

[4]Wendell Johnson and others, Speech Handicapped School Children, (New York, 1956), p. 174.

subtleties in expression and feeling.[5] Other sources after Johnson also include these same perceptual parameters in voice evaluations, and generally concur that when the patient or professional clinician determines that some type of voice disorder exists, differences in these parameters are abnormal.

Just as there are subjective criteria for judging voice disorders, there are also widely different classifications of them. Richard Luchsinger and Godfrey Arnold, whose general source book was one of the most complete and widely used for twenty years, provide eleven classifications and subdivisions of vocal dysfunctions. These classifications include (1) vocal disorders of constitutional origin or dysplastic dysphonia (laryngeal malformations and congenital dysphonia, and vocal-cord sulcus and double vocal cords); (2) primary dysphonia and secondary laryngitis or vocal nodules and polyps; (3) vocal disorders of endocrine origin or endocrine dysphonia (disorders of the gonads, vocal disorders resulting from thyroid disease, vocal disorders and disease of the parathyroid glands, vocal disorders with adrenal disease, and vocal disorders from pituitary disease); (4) vocal disorders from laryngeal paralysis or paralytic dysphonia (paralysis of the superior laryngeal nerve and paralysis of the inferior laryngeal nerve);

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[5]Ibid.

(5) vocal disorders of central origin or dysarthric dysphonia (cerebral diseases affecting the voice); (6) vocal disorders of myopathic origin or myopathic dysphonia (paralysis of the laterial cricoarytenoid muscle, lesions of the sternothyroid muscle, and myasthenia gravis pseudoparalytica); (7) the influence of the neurovegetative system on the voice (vasomotor monochorditis and contact ulcer of the larynx); (8) vocal disorders following laryngeal injury or traumatic dysphonia (injuries of the laryngeal skeleton, injuries of the laryngeal articulations, lesions of the extrinsic laryngeal musculature, and lesions of the vocal cords); (9) voice without larynx or alaryngeal dysphonia (esophageal voice, artificial larynx, and parabuccal voice); (10) vocal disorders of habitual origin or habitual dysphonia (habitual hyperkinetic dysphonia, habitual hypokinetic dysphonia, habitual dysphonia in speakers and teachers, rhesasthenia, and phonation with false cords or ventricular dysphonia); and (11) vocal disorders of emotional origin or psychogenic dysphonia (hypokinetic and hyperkinetic psychogenic dysphonia; vocal anxiety or phonophobia; and spastic dysphonia).[6]

More recently James L. Case has organized voice disorders in these fewer and more generally inclusive

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[6]Richard Luchsinger, M.D. and Godfrey E. Arnold, M.D., Voice-Speech-Language, (Belmont, California, 1965).

categories: disorders from vocal abuse resulting in nodules and contact ulcers; disorders of neurogenic origin including laryngeal nerve paralysis, central nervous system lesions, parkinsonism, amyotrophic lateral sclerosis, multiple sclerosis, and spastic dysphonia; disorders with a psychogenic or nonorganic cause, such as conversion aphonia and dysphonia, puberphonia or mutational falsetto, and transsexual disorder; disorders of alaryngeal phonation (voice without larynx due to cancer or trauma); and other disorders including hypernasality and hyponasality.[7]

Another recent source, Arnold Aronson, provides a logical organization of voice disorders which he classifies as perceptual, kinesiologic and etiologic. Aronson's perceptual category uses such acoustical terms as pitch, loudness, quality, and flexibility, to identify characteristics noticed by the listener. The kinesiologic category refers to voice disorders such as hyperfunction or hypofunction and emphasizes the adduction of the vocal folds rather than the possible multiple causes of vocal defects. Aronson's etiological category, which has to do with the study of theory or cause, is the main category he discusses, as he believes it to give the best understanding of

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[7]James L. Case, Ph.D., Clinical Management of Voice Disorders, (Rockville, Maryland, 1984).

dysphonia. Etiology moves logically to kinesiologic and perceptual evaluations, as he explains:

> . . .a neurologic disease, such as trauma to one recurrent laryngeal nerve, is the etiology of a voice disorder. It causes a pathophysiologic condition, unilateral vocal fold paralysis, which in turn causes the abnormal voice signs of breathiness, hoarseness, reduced loudness, diplophonia, and reduced variability.[8]

Under Etiology of Voice Disorders Aronson includes Organic Voice Disorders (Congenital disorders, Inflammation, Tumors, Endocrine disorders, Trauma, and Neurologic disease); Psychogenic Voice Disorders, such as Emotional stress--musculoskeletal tension (Voice disorders without secondary pathology and Voice disorders with secondary pathology) and Psychoneurosis (Conversion reaction, Psychosexual conflict, and Iatrogenic); and Voice Disorders of Indeterminate Etiology, such as Spastic dysphonia (Adductor, Abductor, or Mixed adductor-abductor types).[9]

Like Aronson, Joseph Stemple also organizes his discussion of voice disorders into etiological correlates and laryngeal pathologies. When discussing etiology, or causes of disorders, he lists the major categories of vocal misuse, medically related etiologies, primary disorder etiologies, and personality-related etiologies. The

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[8]Arnold E. Aronson, Ph.D., Clinical Voice Disorders, (New York, 1980), p. 9.

[9]Ibid, pp. 10-11.

etiologies of vocal misuse include vocally abusive behaviors such as shouting, loud talking, screaming, coughing, and throat clearing; and inappropriate vocal properties in the areas of respiration, phonation, resonation, pitch, loudness, rate, and larnygeal area muscle strength and tone. Medically related etiologies include surgical trauma (direct surgery such as laryngectomy or mandibulectomy; and indirect surgery such as thyroidectomy or hysterectomy) and chronic illnesses and disorders (sinus, frequent colds, hormonal disorder, arthritis, alcohol abuse, smoking). Primary disorder etiologies include cleft palate, velopharyngeal insufficiency, deafness, cerebral palsy, neurological disorders, and trauma. Personality-related etiologies include environmental stress, conversion behaviors, and identity conflict.

When discussing laryngeal pathologies, Stemple categorizes according to their cause, of either organic or functional origin. Organic pathologies include papilloma, congenital web, congenital subglottic stenosis, laryngomalacia, congenital cysts, croup, vocal fold paralysis, acute laryngitis, leukoplakia and hyperkeratosis, cancer of the larynx, and spastic dysphonia. Concerning disorders of function and resulting pathologies, Stemple lists chronic laryngitis, vocal nodules, vocal polyps and polypoid degeneration, contact ulcers, ventricular phonation, conversion aphonia and dysphonia, functional

falsetto and juvenile voice, and functional problems without pathologies.[10]

Some speech pathologists classify voice disorders according to therapy approaches necessary for rehabilitation. Daniel R. Boone believes that the majority of voice disorders result from abuse and misuse of vocal mechanisms. Thus his therapy seeks to change abusive vocal habits and excessive muscular activity in the areas of respiration, resonance, and phonation.[11] Disorders of phonation, as a result of mass-size changes in the vocal folds or vocal fold approximation problems, may be either functional or organic, but therapy approaches remain the same.[12] Margaret Greene also includes in her categories of voice disorders those of vocal strain, vocal abuse, pitch, and resonance and provides general and specific therapy procedures as treatment for them.[13]

When dealing with singing disorders, voice teachers also assess and train the different areas of the vocal mechanism. Teachers of singing often classify vocal

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[10]Joseph C. Stemple, Clinical Voice Pathology, (Columbus, Ohio, 1984).

[11]Daniel R. Boone, The Voice and Voice Therapy, (Englewood Cliffs, New Jersey, 1983), p. 2-10.

[12]Ibid, p. 43.

[13]Margaret Greene, The Voice and its Disorders, (Philadelphia, 1980).

problems within the parameters of respiration, phonation, registration, resonation, and articulation. Attention is given to vocal strain, abuse, excessive muscular tension, and any suspected medical problem. Sundberg states that although there are disorders of articulation affecting resonance and quality, most voice disorders are phonatory in nature. He lists two types of phonatory disorders: organic, including acute laryngitis, Reinke-edema (chronic edema of the mucosa of the vocal folds), polyps, nodules, tumors, and recurrent laryngeal nerve paralysis; and functional, describing disorders of misuse and phonasthenia (phonatory fatigue).[14]

A classification system which allows evaluation in terms of etiologic, kinesiologic, and perceptual categories would seem to give the most complete picture of the voice problem and possible treatment. Where time, skill, and equipment exist for this type evaluation, patients then receive assessments in all these areas: organic or physiologic condition of the laryngeal area; functional aspects of the speaking/singing voice; and perceptual conditions such as pitch, intensity, quality, and flexibility.

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[14]Johan Sundberg, The Science of the Singing Voice, (Dekalb, 1987), pp. 182-184.

Specific Disorders Related to this Study

Since the majority of vocal disorders may be the result of improper use, the diagnosis and treatment of hypofunction or hyperfunction should be of great importance to the voice profession. For the singer, actor, speaker, teacher, and other professional voice user the presence of inefficient or excessive muscular activity can mar the beauty or effectiveness of delivery and can eventually affect the health and longevity of the voice.

Thus a discussion of muscular activity in the larynx might well begin with Zemlin's comments on the matter. According to him, the relationship between muscular contraction and laryngeal behavior is the subject of much speculation, although because of data gathered from mechanical models of the larynx, electromyography, and high-speed photography, we do have a better understanding of internal laryngeal activity. Zemlin goes on to say that we also can better understand gross muscle function from knowledge of the muscle attachments and general architecture of the structures involved. Nevertheless, Zemlin contends:

> It is crucial, however, that we weigh such information very carefully, because rarely, if ever, do individual muscles act to execute a movement. Rather, they normally work in pairs and groups, so that contraction of any one muscle is usually accompanied by contraction of companion muscles. It is important to remember that a subtle, delicate interplay of the

> various muscle actions produces the appropriate movement.[15]

Zemlin's ideas have particular relevance to the adduction of the vocal folds, a point in which both Case and Daniloff agree. For normal phonation to occur the vocal folds should approximate with just enough medial compression to impede the flow of breath and to cause vibration along the length of the folds. Too much tension in the approximation of the folds contributes to a tense or hyperfunctional voice, while too little approximation will produce a breathy or hypofunctional voice.[16] Daniloff states that in normal phonation the folds appear to be relatively relaxed, "neither excessively stiff nor excessively soft."[17] He further states, though, that normal voice can be produced with the vocal folds in a relaxed state or in a tense condition. Thus he describes the hypofunctional voice as breathy phonation and the hyperfunctional voice as creaky voice, characterized by

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[15]Willard R. Zemlin, Speech and Hearing Science: Anatomy and Physiology, (Englewood Cliffs, New Jersey, 1968), p. 181.

[16]James L. Case, Ph.D., Clinical Management of Voice Disorders, (Rockville, Maryland, 1984), p. 77.

[17]Raymond Daniloff, Gordon Schuckers and Lawrence Reth, The Physiology of Speech and Hearing, (Englewood Cliffs, New Jersey, 1980), p. 175.

greater constriction and more tension in the vocal folds and surrounding musculature.[18]

Case states that extreme conditions of hypofunction and hyperfunction often occur. A condition named aphonia is one in which no voice sound is present, thus being the most extreme type of hypofunction. On the other end of the spectrum is a condition of voice quality so tense that the tightly closed vocal folds periodically prevent airflow from the lungs, causing spasticity. Between these two extremes are various types of laryngeal vibration which can cause a corresponding change in voice quality. One of these qualities, whisper voice, has the same vocal quality used by everyone on occasions calling for a whisper; however, people who can only whisper have a serious voice disorder, which may be caused by organic or psychological problems. A second quality is breathiness, a condition of excessive air loss during phonation, which can range from a near whisper to an almost normal sound. Causes of this condition are varied and relate directly to organic, functional, and/or psychological factors. On the hyperfunctional side of phonation is the voice quality perceived as excessive tension, which is caused by overadduction or medial compression of the vocal folds. Just as breathiness exists in degrees of severity, so tension ranges from slight to an

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[18]Ibid.

extreme degree in which the vocal folds cease to vibrate.[19] As Tucker points out in his discussion of the problem, vocal characteristics which may be present in muscle tension dysphonia are harshness, roughness, and restricted pitch and volume range. After long-term muscle tension dysphonia where vocal cord bowing has occurred, then breathiness may also be present.[20]

In some conditions of hyperfunction, the muscle tension in the laryngeal area is such that the ventricular folds (false folds) approximate during phonation. Stemple states that these false folds should remain quiet during normal voice production. He further states that although this functional behavior may be caused by physical and emotional tension, ventricular phonation is used "as a compensatory voice when other serious pathologies make it difficult to phonate using the true vocal folds."[21] Stemple lists harshness and hoarseness as vocal qualities typical of this hyperfunctional condition which ranges from moderate to severe dysphonia,[22] and Case lists ventricular phonation as

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[19]James L. Case, Ph.D., Clinical Management of Voice Disorders, (Rockville, Maryland, 1984), pp. 77-81.

[20]Harvey M. Tucker, M.D., The Larynx, (New York, 1987), p. 150.

[21]Joseph C. Stemple, Clinical Voice Pathology, (Columbus, Ohio, 1984), p. 84.

[22]Ibid, pp. 83-84.

a possible reason for another vocal disorder called diplophonia in which the simultaneous vibration of the false folds with the true folds causes the production of two pitches at the same time.[23]

If excessive muscular force is present in respiration, phonation, or resonance, the condition of hyperfunction exists.[24] In 1943, Froeschels first described hyperfunction and listed six different types or locations for excessive muscular activity. He stated that the most frequent combinations of excessive muscular tension were those of the first and second locations or at the level of the glottis and the area just above.[25] Froeschels also believed that a state of hypofunction (characterized by relaxation of the muscles closing the glottis and producing breathy, inefficient phonation) develops from an original state of hyperfunction, as in Tucker's previously mentioned "bowing of the folds" (p. 26). In the cases where a phonation disorder begins as hypofunctional, it is pschogenic or organic and not the result of voice misuse.[26]

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[23]Case, p. 82.

[24]Daniel R. Boone, The Voice and Voice Therapy, (Englewood Cliffs New Jersey, 1983), p. 4.

[25]Emil Froeschels, Selected Papers of Emil Froeschels, (Amsterdam, 1894, 1982), p. 150.

[26]Ibid, p. 151.

Greene lists three common etiologic factors in people who suffer from excessive muscular activity: incorrect breathing, an imbalance in management of the breath or in glottic resistance and air flow, and excessive tension in the larynx.[27] Proctor states that excessively high subglottic pressures, application of the breath during phonation, and poor uses of resonance are main causes of chronic laryngitis or hoarse voice.[28] According to him, "The early stages of such injury will not produce visible changes in the larynx. In these individuals relief from the problem must come from the voice teacher."[29]

William H. Perkins believes that two dimensions are crucially involved in vocal abuse: constriction and vertical focus. Of the two, Perkins considers vertical focus as the more important:

> Minimal constriction facilitates a high focus and reduces the required subglottal pressure to maintain loudness. As loudness is reduced, vibratory impact of the cords lessens, thereby reducing risk of tissue damage. Another method of softening cord impact is by increasing breathiness, but this also results in reduced loudness, so vocal effort generally rises in an attempt to compensate. Admittedly, vertical focus is the most difficult dimension for the uninitiated to recognize, but this does not alter its importance for vocal survival. Anyone who uses voice frequently,

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[27]Margaret Greene, The Voice and its Disorders, (Philadelphia, 1972), p. 112.

[28]Donald F. Proctor, Breathing, Speech, and Song, (New York, 1980), p. 147.

[29]Ibid.

> especially at high loudness levels, must use a relatively high focus to avoid vocal abuse.[30]

Although there may be no empirical evidence to support the above statement, Morton Cooper also lists tone focus, pitch, quality, volume, rate of speaking, and breath support as factors in determining proper or improper voice usage during speech. He particulary emphasizes that wrong pitch level and lack of tone focus are vital aspects frequently present in patients suffering from vocal misuse.[31]

Boone states that vocal abuses such as yelling or excessive throat clearing can lead to temporary voice problems. When these abusive habits are stopped, normal voice may return. He further states that the larynx is usually resistant to occasional abuse, but may develop dysphonia or tissue damage after continuous and recurring misuse.[32]

Luchsinger and Arnold discuss vocal disorders of habitual origin as habitual hyperkinetic dysphonia. This condition results from improper use and faulty habits and is characterized by excessive contraction of all the muscles

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[30]William H. Perkins, Ph.D., "Mechanisms of Vocal Abuse," The Voice Foundation Seventh Symposium, Part II (1978), p. 115.

[31]Morton Cooper, Ph.D., "Be Good to Your Voice," Prevention, (May, 1979), p. 143.

[32]Daniel R. Boone, The Voice and Voice Therapy, (Englewood Cliffs, New Jersey, 1977), p. 1.

involved in phonation. One or more of several factors may be the basis for the development of hyperkinetic (hyperfunctional) dysphonia. An inborn asymmetry or weakness of the larynx, endocrine disorders, an impulsive personality, a vocally demanding occupation, or emotional trauma may contribute to the development of hyperkinetic voice conditions.[33]

In relation to this dysphonia, Friedrich Brodnitz, M.D., has said:

> The mechanism of hyperfunction can be started in many ways. To begin with, we live in a tense century. Our civilization which stresses the spirit of competition as a guiding force transforms our lives into a constant battle for success. The general tensing-up which so many of us share can be traced in all parts of the body. It creates a kind of predisposition of all muscle groups for tenseness and tightening, including those of the vocal organs. The professional of the speaking or singing voice is an easy victim to vocal hypertension.[34]

Regardless of the reasons for the development of hyperfunction, this behavior subsequently can cause phonasthenia (fatigue or functional weakness), dysphonia, and/or organic changes in the structure of the larynx. Patients complaining of vocal fatigue and intermittent dysphonia will sometimes show no apparent organic or perceptual problems when evaluated by the otolaryngologist

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[33]Richard Luchsinger, M.D. and Godfrey Arnold, M.D., Voice-Speech-Language, (Belmont, California, 1965), p. 303.

[34]Freidrich S. Brodnitz, M.D., Keep Your Voice Healthy, (New York, 1953), pp. 174-175.

or speech pathologist. Nevertheless, as Stemple states, "If a person says there is a problem, there is a problem, even if one is not visible and cannot be recognized auditorily by others."[35] Sundberg writes that inappropriate voice use is the origin of phonasthenia,[36] and Sataloff also lists improper use of musculature as one reason for this vocal fatigue in singers.[37] Thus, people who suffer unreasonable vocal fatique should seek to correct hyperfunctional habits in speaking or singing.

In addition to causing fatigue and the dysphonias discussed earlier, inappropriate use of the voice may lead to organic changes such as chronic laryngitis, contact ulcers, vocal polyps, and vocal nodules. Chronic laryngitis is "a condition of long-standing laryngeal mucosa inflammation,"[38] characterized by vasodilation (dilatation of the blood vessels) and edema (swelling) of the vocal folds.[39] The causes of this condition are believed to be

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[35]Joseph C. Stemple, Clinical Voice Pathology,, (Columbus, Ohio, 1984), p. 86.

[36]Johan Sundberg, The Science of the Singing Voice, (Dekalb, 1987), p. 184.

[37]Robert T. Sataloff, M.D., "Vocal Problems: Not Always 'Hoarseness'," The NATS Bulletin, Vol. 41, No. 2 (November/December 1984), p. 31.

[38]Stemple, p. 79.

[39]Arnold E. Aronson, Ph.D., Clinical Voice Disorders, (New York, 1980), p. 61.

vocal misuse, cigarette smoking, alcohol, and air pollution. Treatment for this condition is to ascertain and remove the cause.[40] Contact ulcers are ulcerations or mucosa erosions which develop on the tips of the vocal processes of the arytenoid cartilages. These ulcers may occur unilaterally or bilaterally and are usually caused by inappropriate pitch and intensity levels, hard glottal attacks, and "generalized musculoskeletal tension."[41] Reflux of stomach acid or traumatic laryngeal intubation can also cause these ulcers, which on occasion develop a secondary formation of granulation tissue called a granuloma. Treatment may often require surgical removal and then therapy techniques to prevent recurrence of the pathology.[42]

Vocal polyps and vocal nodules are probably the most common laryngeal pathologies related to vocal abuse. Luchsinger and Arnold provide the following description of nodules and polyps:

> Vocal nodules represent a benign new growth at the margin of one or both cords. Varying in size, they have a pointed or rounded shape, while their color ranges from white to red.
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> The term polyp is a purely clinical description, which refers to a benign new growth at the margin of one or both cords. Like the nodule, it varies greatly

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[40]Arnold E. Aronson, Ph.D., Clinical Voice Disorders, (New York, 1980), p. 139; Joseph C. Stemple, Clinical Voice Pathology, (Columbus, Ohio, 1984), p. 79.

[41]Aronson, p. 139.

[42]Stemple, pp. 82-83.

> in size, shape, and color. Some polyps are round, circumscribed, or even pedunculate. Others are broad and more diffuse, affecting varying portions of the cords.[43]

From this it is clear that Luchsinger and Arnold considered the terms polyp and nodule to be interchangeable. Later sources indicate that now the terms represent different conditions, as Aronson's description indicates:

> Simple chronic laryngitis is manifested by hoarseness, an urge to clear the throat, diffusely red or pink mucosa, rounded rather than sharp vocal fold margins, and strands of mucus bridging the glottis from one vocal fold to the other. Submucosal edema eventually loosens the mucosa from the underlying vocal ligament. In the diffuse form, this change is called polypoid degeneration. If its occurrence is limited to the midpoint of the membranous vocal fold, it is called a vocal nodule. If the localized form becomes so voluminous that the mass is larger than its base, it is called a vocal fold polyp.[44]

The development of a distinction between the terms polyp and nodule is possibly related to the supposed etiology and eventual treatment of the condition. Stemple believes that polyps are caused by a sudden violent incident of abuse, such as shouting, and that polypoid degeneration is brought about by continuous misuse and/or smoking and alcohol abuse. Although therapy is recommended for both conditions, surgery is often required for removal of the

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[43]Richard Luchsinger, M.D. and Godfrey E. Arnold, M.D., Voice-Speech-Language, (Belmont, California, 1965), p. 176.

[44]Aronson, p. 62.

polyp.[45] Wilson attributes airborne irritants (smoking, inhalation of toxic fumes), medications, and ideopathic causes to the etiology of polyps. Listing diplophonia, breathiness, low pitch, intermittent aphonia, and hoarseness as their symptoms, he recommends surgery, post-op voice rest and therapy as treatment for polyps.[46]

Other factors involved in determining the existence of a nodule rather than a polpy are location and appearance. Sources generally agree that polyps are usually unilateral and that nodules are bilateral. But Stemple explains the occasional diagnosis of a unilateral nodule: "If a unilateral nodule is identified, it may be assumed that it is newly developed and that development of its counterpart is only a matter of time."[47]

The different appearances of a nodule, which may resemble a polyp, are explained by Case's description of the development stages of nodules: acute and chronic. "The acute nodules are soft, reddish, vascular, edematous in nature, and resemble laryngeal hematomas. They often are surrounded by generalized edema of the entire vocal fold

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[45]Joseph C. Stemple, Clinical Voice Pathology, (Columbus, Ohio, 1984), p. 81.

[46]Frank B. Wilson, Ph.D., Speech course presented when visiting professor, North Texas State University, Denton, Texas, Spring, 1985.

[47]Stemple, p. 81.

tissues and the entire glottis appears erythemic (reddish)." In the chronic or more developed stage, "the nodules are hard, white, thickened, and fibrosed but contain little edema in the nodule or in the surrounding tissue."[48]

Although differing in appearance and ranging in size from pinpoint to in excess of six millimeters, nodules typically form in the same area of the vocal fold.[49] This is explained by noting the structure and vibratory pattern of the vocal folds. The posterior third of each fold is made of the cartilaginous portion, or the vocal process which provides close approximation of posterior attachments and airtight closure of nonvibratory parts of the larynx. The anterior two thirds, the membranous or ligamentous portion, is the vibrating segment of the vocal fold. It is in the middle of this segment, where the vibrations have the widest amplitude and the greatest mechanical impact occurs, that nodules develop.[50]

Nodules alter voice qualities dramatically. Case reports the most common complaint of those suffering from nodules to be a hoarse, raspy, and breathy voice.

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[48]James L. Case, Ph.D., Clinical Management of Voice Disorders, (Rockville, Maryland, 1984), p. 100.

[49]Wilson, course.

[50]Richard Luchsinger, M.D. and Godfrey E. Arnold, M.D., Voice-Speech-Language, (Belmont, California, 1965), pp. 181-182.

Perceptual qualities of both tension and breathiness are typically present. Additionally, asymmetrical vocal fold vibration and diplophonia can occur as a result of differences in the mass of the two folds. People with nodules generally experience problems with pitch control and stability, often experiencing pitch breaks and generally a lower pitch in the speaking voice.[51]

Singers, too, often experience such dramatic alterations in voice quality, and in 1935, Nadoleczny described ten vocal disorders commonly present in singers with nodules. The first five disorders he noted were an unclear or breathy vocal attack, faulty pitch control, tremolo (after an increasing weakness of the musculature), diplophonia, and hoarseness. As the remaining five disorders he listed disturbed register transitions, loss of high tones and soft singing, vocal fatigue, and the urge to clear the throat.[52]

Although experts generally agree that these benign growths on the vocal cords are a direct result of inappropriate or excessive vocal use, in addition to the mechanical irritation caused by improper function,

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[51]Case, pp. 102-104.

[52]Richard Luchsinger, M.D. and Godfrey E. Arnold, M.D., Voice-Speech-Language, (Belmont, California, 1965), p. 183, citing M. Nadoleczny, "Wodurch Kann eine Chronsiche Heiserkeit bedingt sien?" Munch. Med. Wochenschr, No. 1 (1935), p. 13.

Luchsinger and Arnold also believe there are predisposing, precipitating, and aggravating causes for their development. Under predisposing causes Luchsinger and Arnold list physical constitution (nodules often present in athletic body types but rarely in asthenic persons); personality structure (nodules more often present in aggressive types); and vocal structure (nodules less likely to appear in voices with resonating chamber, symmetrical components, wide-open vestibule, and flat, erectile epiglottis). Under precipitating causes, they include allergic tendencies and thyroid imbalance; and they cite tobacco and alcohol as aggravating causes.[53]

Personality characteristics, daily habits, and singing or other strenuous vocal activity are factors in the development of nodes. Aronson believes that the intrinsic and extrinsic laryngeal muscles are highly sensitive to emotional stress and interpersonal problems. Consequently, he states that although the correspondence between vocal abuse and emotional stress is different in each patient with vocal nodules, both factors are usually present. Aronson mentions that special cases of nodules in adults occur in the culture of the pop singer, where extreme demands are put

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[53]Luchsinger and Arnold, pp. 176-178.

upon the voice and problems of emotional stress may or may not exist.[54]

Other writers have discussed singer's nodes. Proctor, for example, states that the majority of patients he treats for nodules are singers who have not had formal training rather than trained singers who have learned to avoid the type of misuse of the voice which causes this injury.[55] Baker concurs that the development of vocal nodules or a polyp in the trained singer, who is pursuing a successful career, is unusual. He also states that vocal nodules may cause the end of a singing career.[56]

The professional popular singer is in one of the most vocally demanding professions and often performs in a potentially aggravating environment. It is common for such a singer to rehearse and perform from four to six hours daily. Even with amplification, the singer must often sing very loudly to be heard over the accompaniment. Club owners and promoters often demand that the performer mingle with the crowd during breaks when the larynx actually needs time to rest and recuperate. The atmosphere, often smoke-filled

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[54]Arnold E. Aronson, Ph.D., Clinical Voice Disorders, (New York, 1980), pp. 136-138.

[55]Donald F. Proctor, Breathing, Speech, and Song, (New York, 1980), pp. 149-150.

[56]Daniel C. Baker, Jr., M.D., "Laryngeal Problems in Singers," Laryngoscope, (July, 1962), p. 905.

and dry, further adds to laryngeal irritation. If the singer has not had adequate training or warm-up before performances and adds vocal abuses such as hard glottal attacks and singing out of range, the risk of vocal injury is high.[57]

Occupational demand is thus a noteworthy factor in the development of nodules or other voice disorders. In a survey of one thousand patients with vocal disorders, Cooper most often discovered them to be involved in the following list of twenty occupations: housewives, teachers, students, salespeople, owner-managers, executives, singers, clerks, lawyers, engineers, actors and actresses, theologians, secretaries, accountants, doctors, researchers, writers, public relations personnel, newscasters and announcers, and telephone operators.[58] In a similar study, Greene lists teachers, lecturers, preachers, singers, actors, and salesmen as being most likely to suffer vocal strain.[59] Any occupation which makes severe demands upon the voice would naturally tend to collect individuals who would eventually show signs of vocal strain and pathology. For those

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[57]James L. Case, Ph.D., Clinical Management of Voice Disorders, (Rockville, Maryland, 1984), pp. 106-107.

[58]Morton Cooper, Ph.D., Modern Techniques of Vocal Rehabilitation, (Springfield, 1973), p. 274.

[59]Margaret Greene, The Voice and its Disorders, (Philadelphia, 1980), p. 115.

persons in high-risk occupations or with any additional physical or personality characteristics common to vocal disorders, an annual check-up with an otolaryngologist and a reliable judgment of laryngeal function from a qualified voice specialist would be beneficial.

Vocal fold paralysis has various etiologies and produces various symptoms. Four kinds of paralysis are possible: unilaterial or bilaterial abduction (opening of the folds), and unilaterial and bilateral adduction (closing of the folds). In bilateral abductor paralysis, the vocal folds are fixed in a position near the midline and are unable to open, thus causing serious obstruction of the airway. When unilateral abductor paralysis occurs, one vocal fold is fixed at or near midline while the other functions normally. Thus although voice quality is sometimes normal, victims often complain of voice fatigue and shortness of breath. The singing voice is also likely to suffer impairment as a result of the compromised airway and from the subject's increased efforts to phonate. Bilateral adductor paralysis results in both folds fixed in an open position and an inability to close the glottis. Dysphonia is naturally present but more serious is the danger of aspiration. In unilateral adductor paralysis, the most common form of vocal fold paralysis, the fold on the paralyzed side is fixed in a position away from the midline, while the other fold attempts to approximate in a normal

fashion. Voice quality is breathy, and volume range is reduced.[60]

Paralysis or weakness of the laryngeal muscles and resultant dysphonias are caused by lesions of the vagus nerve. "The extent of weakness, the position of vocal fold fixation, the unilaterality or bilaterality of weakness, and the degree of voice impairment depend upon the location of the lesion along the pathway of the nerve and whether one or both nerves of the pair have been damaged."[61] If the lesion occurs above the origin of the pharyngeal, superior laryngeal, and recurrent laryngeal branches, then the muscles of the soft palate and the pharynx, the cricothyroid muscle, all the intrinsic muscles of the larynx, and additional sensory and membranous tissues are affected. When the lesion occurs below the pharyngeal nerve but above the origin of the superior laryngeal and recurrent laryngeal nerves, the muscles of the pharynx and soft palate are not affected; and if the lesion occurs below the superior laryngeal branch, the cricothyroid muscle is not affected. With paralysis above the pharyngeal branch, voice qualities range from breathy to whispered or aphonic and include reduced loudness, restricted pitch range, and hypernasality.

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[60]Joseph C. Stemple, Clinical Voice Pathology, (Columbus, Ohio, 1984), pp. 71-74.

[61]Arnold E. Aronson, Ph.D., Clinical Voice Disorders, (New York, 1980), pp. 83-84.

Paralysis of the superior laryngeal nerve causes breathiness, hoarseness, and reduced loudness and pitch range.[62] This pathology causes vocal fatigue and the inability to sing.[63] Recurrent laryngeal nerve paralysis generally causes a breathy, hoarse voice and reduced loudness. In some cases diplophonia is present.[64]

Luchsinger and Arnold describe various conditions that result from the different positions of the paralyzed fold. Inferior (recurrent) laryngeal nerve paralysis with median position of one fold may cause only slight dysphonia or perhaps none at all. Higher vocal functions such as artistic singing, calling aloud, and prolonged public speaking may be affected by reduced frequency and amplitude of vibration in the affected cord. Paramedian position generally causes vocal disability such as air waste, shortened phonation time, diplophonia, breathiness, reduction of vocal range, loss of volume, and loss of all higher vocal functions. Occasionally the voice may sound clear if adequate compensation by the healthy cord takes place. Intermediate position indicates combined paralysis of both the superior and recurrent laryngeal nerves causing an extremely breathy, hoarse, noisy voice with vocal range

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[62]Ibid, pp. 82-83.

[63]Stemple, p. 74.

[64]Aronson, p. 82.

reduced to one or two tones. Better vocal quality may be achieved by compensatory overadduction of the healthy vocal cord.[65]

Many etiologies of vocal fold paralysis are possible. Among these are surgical trauma such as thyroidectomy and heart, lung, and breast surgeries which may involve laryngeal nerves. Other causes include neurological and cardiovascular diseases, accidental trauma, and infections. About one third of all vocal fold paralyses are idiopathic, or, in other words, defy diagnosis, and a specific etiology cannot be found.[66]

Iatrogenic voice disorders are dysphonias which are caused or worsened by medical treatment or surgery. Direct surgery to the structures responsible for phonation or resonation can result in a voice disorder requiring special therapeutic procedure. These surgeries include laryngectomy, partial laryngectomy, mandibulectomy, palatal surgery, and other excisions in the head and neck area. "Vocal rehabilitation is essential following these surgeries."[67]

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[65]Richard Luchsinger, M.D. and Godfrey E. Arnold, M.D., Voice-Speech-Language, (Belmont, California, 1965), pp. 224-235.

[66]Joseph C. Stemple, Clinical Voice Pathology, (Columbus, Ohio, 1984), p. 71; Arnold E. Aronson, Clinical Voice Disorders, (New York, 1980), pp. 84, 85, 87, and 89.

[67]Stemple, p. 60.

Surgeries in other areas of the body, such as the thyroid, heart, lungs, and neck arteries, may cause or contribute to the development of a vocal disorder. Because of the anatomical relationship of these structures to the laryngeal nerve supply, surgery in these areas may result in vocal fold weakness or paralysis and loss of sensory innervation of the larynx. Hysterectomy may indirectly contribute to the development of a voice disorder, as hormonal changes can cause a temporary or permanent lowering of vocal pitch. The patient then may use excessive muscular efforts to raise the pitch to normal level, thus experiencing vocal strain and other characteristics of hyperfunction.[68]

Any surgery which requires intubation involves the chance of vocal trauma. Tucker states, "Even when performed under optimal conditions, intubation carries the risk of transient or permanent laryngeal injury."[69] The most common injuries resulting from intubation are intubation granuloma, cricoarytenoid fibrosis, and acquired subglottic stenosis.[70]

Surgery on the vocal folds may result in additional voice problems for the patient. Permanent injury to the

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[68]Ibid.

[69]Harvey M. Tucker, M.D., The Larynx, (New York, 1987), p. 195.

[70]Ibid.

vocal cords can result when excessive excision of vocal-cord tissue occurs during surgery for benign growths,[71] for surgical "removal of even the most minute portion of the anterior vocal cord may result in permanent hoarseness."[72] As Case points out, little research has been reported on surgical removal of vocal nodules, but it is a widely accepted and recommended procedure.[73] Therapy is often attempted first and should be included as a post-operative measure as well, since all the reviewed sources agree that without removal of the cause, nodules frequently return. Some otolaryngologists and other professional clinicians do not recommend surgery for benign growths due to functional misuse, especially for singers. Lawrence, for example, feels that nodules are never an emergency. He recommends a few days voice rest and conservative voice use; then if the nodules are still present, six to eight weeks voice and/or speech therapy.[74] In regard to surgery for nodules and/or polyps, Lawrence says, "Beware. Be very

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[71]Richard Luchsinger, M.D. and Godfrey E. Arnold, M.D., Voice-Speech-Language, (Belmont, California, 1965), p. 281.

[72]Donald F. Proctor, Breathing, Speech, and Song, (New York, 1980), p. 150.

[73]James L. Case, Ph.D., Clinical Management of Voice Disorders, (Rockville, Maryland, 1984), p. 135.

[74]Van L. Lawrence, M.D., "Nodules and Other Things that Go Bump in the Night," The NATS Bulletin, Vol. 38, No. 2 (November/December 1981), p. 30.

twitchy about this one. Get a second opinion for sure. . . if you're a singer, don't have any surgery done on your vocal tract unless it's unavoidable."[75] Other sources also warn of potential scarring and permanent injury from surgery on nodules or polyps.[76] In the layer of the vocal fold called Reinke's space, the loose pliable portion between the outer layer and the vocal ligament, the stiffness of scar tissue alters and produces deterioration in normal vibration. As Hirano states: "Scar tissue is much stiffer than normal tissue in Reinke's space, and it obviously interferes with normal vibration. Therefore, even though the vocal fold looks normal in gross appearance, usually such injury can be detected under stroboscopic light."[77]

A controversial treatment in voice management is the prescription for voice rest. While agreeing that some surgeries require a short postoperative rest, Aronson believes that complete voice rest for weeks or months is the most detrimental treatment for an organic or psychogenic voice disorder. Since the voice is exceptionally suggestible and responsive to anxiety, Aronson contends, the

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[75]Van L. Lawrence, M.D., "Singers and Surgery (Part II), " The NATS Bulletin, Vol. 38, No. 5 (May/June 1982), p. 21.

[76]Wilbur James Gould and others, "Surgical Management of Voice Diorders," Journal of Voice, Vol. 1, No. 3 (September 1987), pp. 293-294.

[77]Ibid, p. 293.

patient suffers fear that the ability to phonate is lost and thus develops a secondary psychogenic voice disorder.[78] Clarence Sasaki, M.D., shares Aronson's skepticism of extended voice rest, offering the following evidence to support his view:

> With respect to the question about voice rest, when I was a resident, we carried out a small study in which we viewed patients and followed patients who were placed on voice rest preoperatively and who were put on voice rest for varying lengths of time postoperatively. I recall no difference. I think it is reasonable postoperatively to encourage patients to use voice rest for 48 h and that is as much as I persist in that recommendation.[79]

Another side effect of extended voice rest is loss of muscle tone in the vocal folds and other intrinsic muscles of the larynx. Lawrence believes that voice rest is helpful for those patients with nodules or those who have had surgery to remove nodules but that vocal habits which caused the nodules must be changed or "back they'll come." He further states:

> Another thing about simple voice rest---as long as you confine it to about two weeks as a maximum, no quarrel. Longer than that, I feel you begin to become flabby. You may lose some of your nerve-muscle coordination and muscle tone and agility that has been so hard-won with vocal training.[80]

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[78]Arnold E. Aronson, Ph.D., Clinical Voice Disorders, (New York, 1980), p. 149.

[79]Gould, p. 295.

[80]Van L. Lawrence, M.D., "Nodules and Other Things that Go Bump in the Night," The NATS Bulletin, Vol. 38, No. 2 (November/December 1981), p. 30.

A situation which does call for voice rest is acute vocal cord hemorrhage. This condition, characterized by an irregular collection of blood under the membrane surface of the vocal fold, is a very serious problem for singers and other professional voice users. The causes of hemorrhage and of blood vessel rupture may be difficult to ascertain but can include abuse in singing or speaking, coughing, premenstrual or menopausal hormonal changes, allergies, the effects of aspirin or other anticoagulant medication, vocal fatigue, neurological changes, or normal aging. Strenuous vocal efforts such as singing or public speaking may result in mucosal scarring and permanent alterations in vocal fold function if the hemorrhage is not first allowed to heal adequately. Thus treatment will sometimes include total voice rest for a short period of time, and in most instances will involve restricted voice use for two to four weeks.[81]

Professional voice users may experience undesirable side effects from over-the-counter or prescribed medications. Proctor advises against frequent or regular use of nose drops or sprays, antihistamines, steroids, nocturnal sedation, "mood modifying" drugs, amphetamines,

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[81]Neva J. Bailey and Larry L. Bailey, M.D., "Vocal Hemorrhage: A Serious Problem for Singers," The NATS Bulletin, Vol. 38, No. 2 (November/December 1981), p. 30.

and "tranquilizers."[82] Although helpful in relieving symptoms of nasal congestion, nose drops and sprays can cause chronic nasal congestion to remain when the original allergy or infection is gone. To avoid becoming "addicted" Lawrence advises their use for no more than three to five days.[83] Antihistamines, which may be used to treat allergies, cause dryness which can be more harmful to the voice than the allergy. This adverse effect is lessened by combining their use with a moistening agent such as iodinated glycerol.[84] With the exception of mild nasal sprays (xylometazoline 0.05% solution), Proctor believes that steroids should play no role in the management of problems related to the voice. While bringing temporary relief to various problems, nocturnal sedations, amphetamines, and mood modifying drugs may cause less sensitive performance and can lead to drug dependency.[85] Lawrence also objects to the "dulling of senses" by tranquilizers and the resultant lack-luster performance. He reminds performers of an important side effect of sleep

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[82]Donald F. Proctor, Breathing, Speech, and Song, (New York, 1980), pp. 156-158.

[83]Van L. Lawrence, M.D., "Nose Drops," The NATS Bulletin, Vol. 39, No. 5 (May/June 1983), p. 26.

[84]Robert T. Sataloff, M.D., "Professional Singers: The Science an Art of Clinical Care," American Journal of Otolaryngology, Vol. 2, No. 3 (August 1981), p. 264.

[85]Proctor, pp. 157-158.

medications: dryness. Many of these sleep medications contain preparations well known for that side-effect. Sataloff discourages use of aspirin and other analgesics while singing, as they raise the risk of vocal cord hemorrhage. Sataloff also cautions against the use of diuretics without careful monitoring of their effects on the voice. When diuretics are used during the premenstrual period, fluid in the laryngeal tissues is not effectively remobilized. The diuretics may dehydrate the patient adding thickened secretions and decreased lubrication to already swollen vocal folds.[86]

Singers and other professional voice users should also be aware of the possible adverse side effects from oral contraceptives and other hormones, and medication prescribed for hypertension or disturbances of the endocrine system.[87] Birth control pills which are predominantly progestin are reported to have a masculinizing effect on the female larynx, thus causing a lowering of pitch or decreasing the high range of the singing voice. When the prescription of this hormone is necessary for endometriosis or dysmenorrhea, the patient should be aware of its probable effects on the voice. Possible side effects from blood pressure pills such as Inderal (also used for performance anxiety or

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[86]Sataloff, pp. 264-265.

[87]Proctor, p. 158.

stagefright) include short-term memory loss and a general feeling of weakness or disorientation.[88] People whose occupations require extensive or competitive voice use will want to be well informed about all possible vocal side effects from their medications, for thus physician and patient can arrive at the best treatment.

Professional voice users need to discuss all therapy, surgery, medications, and other treatments thoroughly with their physician and/or clinician. Only then can an educated decision be made concerning treatment techniques and possible side effects. In life threatening situations, usually those involving a sudden airway collapse, delicate and considerate treatment of the vocal tract cannot always be considered; however, in all other instances it is essential that those whose livelihoods depend completely or in part upon the voice must be totally involved in any medical decision which may affect it.

Diagnostic Techniques

Diagnostic procedures for voice disorder seek to identify vocal characteristics which are abnormal and to determine the extent and causes of the condition. According to Hirano, the diagnostic process has five purposes:

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[88]Van L. Lawrence, M.D., "When All Else Fails, Read the Instructions (or even the Fine Print)," The NATS Bulletin, Vol. 39, No. 3 (January/February 1983), p. 18.

> (1) to determine the cause of a voice disorder,
> (2) to determine the degree and extent of the causative disease,
> (3) to evaluate the degree of disturbance in phonatory function,
> (4) to determine the prognosis of the voice disorder as well as that of cause of the disorder, and
> (5) to establish a therapeutic programme.[89]

As secondary determinants of the diagnostic evaluation, Stemple lists education and motivation of the patient and establishment of credibility and trust in the clinician. Most people have little knowledge of the normal voice, much less understanding of voice disorders. If patients are given simple explanations in these areas, they will be more helpful in answering specific questions which are important and are usually more highly motivated to follow therapeutic procedures. Thus, in discussing the relationship between patient and speech pathologist, Stemple advises the pathologist to project a casual yet confident and professional demeanor in order to reduce the patient's anxieties and to provide an atmosphere for easy discussion. He further cautions the pathologist to remember that although the pathologist's job is to find the causes, plan the management, and provide guidance for the patient, the patient with the voice problem is ultimately responsible for

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[89]Minoru Hirano, M.D., Clinical Examination of Voice, (New York, 1981), p. 9.

resolving the problem.[90] Several of the reviewed sources, such as Cleveland,[91] recommend a team of otolaryngologist, speech pathologist, and voice teacher working in concert during diagnostic sessions, thus providing all possible avenues of discussion, understanding, and treatment for the patient. This appears to be an optimal approach.

Evaluation of the voice and its possible abnormality may begin with the otolaryngologist or with the speech or voice professional. Whereas the otolaryngologist provides a diagnosis of the physical condition and function, the qualified voice professional evaluates the voice within the parameters of function and sound. The evaluation process is difficult in that some parameters are not determined easily or objectively. Physical condition, pitch, loudness, resonance balance, articulation, inflection and flexibility, and laryngeal valving functions are all factors in total voice evaluation. Some factors can be identified and described objectively with proper equipment; others are not easily analyzed, and are often assessed by perceptual judgments. "Therefore, the state of the art in voice

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[90]Joseph C. Stemple, Clinical Voice Pathology, (Columbus, Ohio, 1984), p. 91.

[91]Thomas F. Cleveland, "Viewing the Voice: 'A Picture is Worth a Thousand Words'," The NATS Journal, Vol. 45, No. 2 (November/December 1988), p. 32.

therapy remains a combination of science and perceptual judgment."[92]

The initial diagnosis usually involves the taking of a case history. Basic data include name and address, age, gender, education, occupation, marital and/or family status, physician, and referring professional or agency. Information is sought concerning the patient's general medical history, social and family activities, and occupational demands, as well as a thorough history of the voice problem. Sources offer various recommendations for gaining thorough knowledge of the specific voice problem. For example, Boone suggests taking information in these general areas: description of the problem and cause, onset and duration of the problem, variability of the problem, description of vocal use, and health history of the patient.[93] Case asks for specific areas of investigation in any voice disorder case history:

> . . .nature of concern regarding the voice; date of onset of the disorder; known etiology; progression of the disorder since onset; treatment(s) sought; success of previous treatments; nature of general health and history of previous illnesses; association of onset with any physical ailments, emotional stress, or psychological disturbance; variation of vocal parameters throughout the day; voice fatigue factors;

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[92]Ibid.

[93]Daniel R. Boone, The Voice and Voice Therapy, (Englewood Cliffs, New Jersey, 1983), pp. 79-84.

> vocal habits during typical day; leisure time vocal habits; stability of vocational, social, and familial background; significant aspects of stress in vocational, social, familial, and marital life; history of significant medicine usage, including current usage; history of tobacco and alcohol consumption; litigation procedures pertaining to the disorder; pain associated with the voice disorder; voice disorder effect on vocational, social, familial, and marital life; aspects of voice most distressing: pitch, loudness, quality, durability, stability; and other considerations not specifically covered that the client feels might be important.[94]

Sataloff offers suggestions for organizing information about voice disorders in a special questionnaire for singers entitled "Patient History: Singers." Published for singing teachers, singers seeking care for voice problems, and physicians who care for professional singers, this document asks for information concerning the present voice problem, past and present voice training, career goals, types of music sung, performance situations, practice and performance habits, specific technical difficulties, pertinent medical facts, and tobacco, drug and alcohol usage.[95]

Following the case history interview, the physician and/or clinician evaluates the voice for the presence of possible pathological, functional, or perceptual abnormalities. Vocal properties assessed include physical structures, respiration, phonation, resonation, pitch,

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[94]Case, pp. 67-68.

[95]Robert T. Sataloff, M.D., "Organizing Information About Voice Disorders," The NATS Journal, Vol. 44, No. 4 (March/April 1988), pp. 24-25.

loudness, duration, flexibility, and abusive habits, such as hypertension and throat-clearing. The clinician's perceptual assessment of voice attempts to rate the observed voice in relationship to normal expectations. These voice assessment documents or profiles are sometimes used by voice teachers and are part of a routine in initial and subsequent visits to a speech pathologist.

A good example of a frequently used voice profile is that designed by Frank B. Wilson entitled the "Voice Profile."[96] This profile asks for assessments in three major parameters (laryngeal opening, pitch, and resonance) and two minor areas (intensity and vocal range). The rating for laryngeal opening relates to hyper and hypo functions of the vocal folds. The perceptual judgment ranges from "closed" (adduction) to "open" (abduction). The rating scale for this parameter includes (1) for normal; (+2), (+3) to indicate hyperfunction; and (-2), (-3) for hypofunction. Pitch assessments are made as to the appropriateness for gender and age. The scale includes (1) for normal and (+2), (+3) and (-2), (-3) to indicate a pitch too high or too low. Resonance judgments rate normal (1), assimilation nasality (+2), nasality in all vowels (+3), nasality in all vowels plus emission of air (+4), and

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[96]Frank B. Wilson, Ph.D. and Mabel Rice, Voice Disorders: A Programmed Approach to Voice Therapy, (Hingham, Massachusetts, 1977).

hyponasality (-2). Intensity and pitch variability are assessed individually with normal (1); soft, monotone (-2); and too loud, unusual variation (+2). The Wilson profile also describes the voice in relationship to the severity of the problem(s). This rating scale asks for an assessment from (1) to (7) to indicate a barely perceptible condition to one which significantly interferes with communication.

Another voice assessment document, the "Buffalo Voice Profile,"[97] asks for a rating from (1) to (7), again indicating severity of the problem, in each of these twelve vocal parameters: laryngeal tone, laryngeal tension, vocal abuse, loudness, pitch, vocal inflections, pitch breaks, diplophonia, resonance, nasal emission, rate, and overall voice efficiency. In yet another voice assessment profile, designed specifically for college student singers, Rachel Lebon recommends that both speaking voice and singing voice be assessed. The students are asked to do several speech and singing tasks and then rated from 0: normal, to 5: severe, in these areas: voice characteristics (pitch, resonance, loudness, quality), respiration, posture and tension areas, articulation, and singing voice

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[97]D. Kenneth Wilson, Ph.D., Voice Problems of Children, 2nd ed., (Baltimore, 1979), p. 68.

(classification, range, register shifts, flexibility, breath support, and projection).[98]

Complete evaluation of the voice requires a medical examination and sometimes additional measurement techniques. A thorough laryngologic evaluation includes evaluation of the head, neck, and chest; the oral, nasal, and pharyngeal cavities; and the interior of the larynx. The most common method of examining the interior of the larynx is by indirect laryngoscopy, a technique whereby the larynx is viewed indirectly with a mirror or some other optical instrument rather than with the naked eye.[99] In addition to this method of voice evaluation, other techniques include electromyography, aerodynamic tests, vocal fold vibration examinations, acoustic analysis, and phonatory ability measurements. The first technique, electromyography, measures intrinsic muscular activity in the larynx and has been used to investigate vocal fold paralysis and disorders of function.

A second type of technique, the use of aerodynamic tests, uses instruments which measure air flow rate including the spirometer, pneumotachograph, and hot-wire

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[98]Rachel L. Lebon, "The Development of a Voice Assessment Profile (Designed for Use at College Level)," The NATS Journal, Vol. 42, No. 5 (May/June 1986), p. 21.

[99]Arnold E. Aronson, Ph.D., Clinical Voice Disorders, (New York, 1980), p. 171.

anemometer. These instruments show variations in vocal intensity and vocal register and have investigated conditions such as recurrent laryngeal paralysis, sulcus vocalis, laryngitis, nodule and polypoid swelling, tumor, contact granuloma, and spastic dysphonia. Another aerodynamic test is one called phonation quotient (PQ), which is defined as the value of vital capacity divided by maximum phonation time. High PQ values exist in conditions of recurrent laryngeal paralysis and mass lesions. Subglottal pressure measurement techniques include tracheal puncture, transglottal catheter, tracheostoma, esophageal balloon, and a transducer of ultra-miniature type. Subglottal pressure measures higher in conditions of carcinoma, nerve paralysis, and functional dysphonia.

A third technique, the measurement of vocal fold vibration, includes stroboscopy, ultra high speed photography, photo-electric glottography, electroglottography, and ultrasound glottography. Thirteen parameters have been assessed by these various methods including glottal width and area, fundamental frequency of vibration, opening-closing phases, amplitude, and contact area of the vocal folds. Acoustic analysis techniques include oral-output, pre-tracheal vibration, inverse filtering, and Sondhi's Tube. Parameters of assessment include pitch, intensity, spectral harmonics, and turbulent air noise. Finally, phonatory ability tests measure maximum

phonation time in the normal and pathologic larynx. The maximum phonation time is especially decreased in voices with nodules and paralytic vocal fold. These tests also measure frequency range and indicate that the highest tone is lower in all voice disorders; that the lowest tone is higher in laryngeal paralysis and sulcus vocalis; and that the lowest tone is lowered with polypoid swelling.[100]

An instrument described in chapter one for examining and evaluating the voice warrants further discussion. Use of this instrument, the flexible fiberoptic laryngoscope (or nasolaryngoscope), is presently the only technique by which the physician or clinician may view the vocal folds while the patient is speaking and/or singing.[101] It permits a closer range view than is possible with mirror examination and "with less invasiveness than using direct laryngoscopy with anesthetic."[102] It makes possible the examination of patients who were inaccessible by mirror examination because of young age, excessive gag reflex, or unusual structure.[103] In addition to these advantages, equipment may be attached

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[100]Minoru Hirano, M.D., Clinical Examination of Voice, (New York, 1981), Chapters 2 - 7.

[101]Aronson, p. 173.

[102]Janina K. Casper, David W. Brewer, and Raymond H. Colton, "Pitfalls and Problems in Flexible Fiberoptic Videolaryngoscopy," Journal of Voice, Vol. 1, No. 4 (December 1987), p. 347.

[103]Ibid.

to the fiberoptic laryngoscope, thereby allowing either photography or video taping and thus producing visual aids to teaching, patient management, and research.[104] Cantarella offers the following comments about the advantages of his use of the flexible laryngoscopy in evaluating 315 patients during the course of three years:

> In all cases the videolaryngoscopic recording represented an objective evaluation of the evolution of an organic or functional problem.
>
> Each video recording could also be used for personal review and for consultation with colleagues. Furthermore, this material is very important for sharing experience with colleagues and speech therapists.
>
> Among the patients examined, many adults and children accepted flexible endoscopy more willingly than mirror examination and participated enthusiastically in the videotape replay. Each time a videorecording was obtained, it was replayed immediately in the presence of the patient. We found this type of involvement very important from a psychological point of view because it allows a greater understanding of the rationale of the treatment planned and therefore better acceptance of surgical and/or speech therapy.[105]

Disadvantages in fiberoptic videolaryngoscopy include lack of image definition, low color fidelity, and wide-angle distortion.[106] Problems, such as fogging of the tip of the

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[104]Frank B. Wilson, William H. Kudryk, and John A. Sych, "The Development of Flexible Fiberoptic Video Nasendoscopy (FFVN)," American Speech-Language-Hearing Association, November, 1986, p. 25.

[105]Giovanna Cantarella, "Value of Flexible Videolaryngoscopy in the Study of Laryngeal Morphology and Functions," Journal of Voice, Vol. 1, No. 4 (December, 1987), p. 358.

[106]Ibid.

scope, movement of the scope following the patient's swallow, twisting of the scope, and lack of camera focus, may occur during an examination with this diagnostic technique. Lack of an absolute distance marker, the high degree of variability in movement of the scope as well as patient anatomy and physiology, and the lack of consistency of the structures in view also impede objective measurement.[107] Although recognizing the limitations of using this technique, all the sources reviewed attest to its value in training, diagnosis, patient feedbeck, counseling, and clinical research, and Wilson provides a good summary of its value:

> The present generation of FFN has somewhat reduced light delivery and image retrieval properties as compared to that of the rigid telescope; we look forward to technical changes in the near future which will eliminate that problem. The difference notwithstanding, if diagnosis is to go beyond description of the static structure of the vocal folds to include movement during speech and singing, then FFVN should be the technique of choice. We see FFVN as a giant step on the road toward better understanding of voice and the living larynx. Our regular clinical use of FFVN has markedly improved techniques for management of structural deviations of voice and resonance.[108]

For the professional voice user a thorough diagnostic examination should include a case history, a voice profile, and a medical examination. Instruments which help assess the physiological condition of the larynx and its functional

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[107]Casper, Brewer, and Colton, pp. 348-349.

[108]Wilson, Kudryk, and Sych, p. 30.

aspects while speaking or singing would seem to be extremely beneficial, especially for singers, teachers, actors, and speakers. A situation allowing the use of such instruments, as well as a way to provide data and feedback to patient, physician, and voice specialists about physical and functional aspects of the voice as well as perceptual qualities, seems ideal. To date, flexible fiberoptic video nasolaryngoscopy best provides this situation.

CHAPTER III

RELATED LITERATURE (PART II)

Treatment

Surgery, medication, therapy procedures, and suggestions for prevention are all treatment techniques for vocal illnesses and disorders. Each illness or disorder, like each patient, requires individual consideration and treatment; however, general therapy techniques are often successful when applied to many of the voice disorders. Aronson states that voice therapy should occur on two planes: a specific one that provides techniques appropriate for a certain voice disorder type, and a general one that uses universally applicable methods. Using this musical analogy he explains that: "if the specific therapy is the melody played with the right hand, general therapy is the bass played with the left. They are complementary."[1] Aronson recommends these general therapy techniques: auditory training, respiratory control, relaxation, optimum pitch, and trial-and-error methodology.[2]

In regard to functional voice problems, Boone says that a different therapy approach is not needed for each voice

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[1]Arnold E. Aronson, Ph.D., Clinical Voice Disorders (New York, 1980), p. 195.

[2]Ibid, pp. 195-198.

disorder. "Rather, our therapy might be more effective and relevant if, after analyzing the voice disorder along the dimensions of pitch, loudness, and quality, we then applied a therapy appropriate to those dimensions."[3] David McClosky believes that the training of the healthy voice for speaking or singing and the treatment of the voice which has been abused or impaired are basically the same. "Therefore," he claims, "apart from a few specialized problems, therapy for the ailing voice and basic technique for the singer or speaker are. . .one and the same."[4] Basic vocal techniques in McClosky's therapy address the areas of relaxation, posture, and breathing, and include exercises for phonation and articulation.[5] Cooper says that direct vocal rehabilitation, which alleviates or eliminates functional and organic dysphonias by vocal retraining, involves three aspects: retraining of a patient's voice in the vocal variables of pitch, tone focus, quality, volume, breath support, and rate; understanding and restructuring the vocal

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[3]Daniel R. Boone, The Voice and Voice Therapy, (Englewood Cliffs, New Jersey, 1983), p. 107.

[4]David Blair McClosky, "General Techniques And Specific Procedures For Certain Voice Problems," Approaches to Vocal Rehabilitaton, eds., Morton Cooper, Ph.D. and Marcia Harting Cooper, (Springfield, 1977), p. 138.

[5]Ibid, pp. 139-145.

image; and carry-over of the patient's new voice into all situations.[6]

If the goal of any kind of voice therapy is to return the structure and function of the individual voice as near as possible to its normal state, then general techniques must be applied in a very individual fashion. Stemple states that this individual approach applies not only to the patient but to the therapist as well. He advises the pathologist, "Pick and choose the techniques with which you are confident and modify them to suit individual patient's needs. Your own sensitivity and interpersonal skills in presenting management techniques will often determine the success or failure of your therapeutic approach."[7]

Specific treatment techniques are available for the voice disorders directly related to this study: muscle tension dysphonia (hyperfunction), nodules, and paralyzed vocal fold. Surgery and/or medications are not generally used to treat hyperfunction. One exception is a surgical procedure introduced by Dedo in 1976 for intractable spastic dysphonia, whose etiology is unknown but includes symptoms of extreme hyperfunction. The severe characteristics of

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[6]Morton Cooper, Ph.D., "Direct Vocal Rehabilitation," Approaches to Vocal Rehabilitation, eds. Morton Cooper and Marcia Harting Cooper, (Springfield, 1977), p. 22.

[7]Joseph C. Stemple, Clinical Voice Pathology, Columbus, Ohio, 1984), p. 105.

this disorder --hoarseness and a strained, spasmodic quality --are alleviated by severing one recurrent laryngeal nerve and thus paralyzing one of the vocal folds.[8] Medications to relax hypertensive nerves and muscles may be prescribed but are not recommended as a permanent solution to hyperfunction, or even as a temporary solution for stage fright, especially for singers and other professional voice users.[9] Thus the treatment for muscle tension dysphonia is instruction and therapy. The first steps are to identify the misuse and abuse of the voice and resultant effects, to help the patient become aware of specific occurrences of the abuse, and to change the behavior.

Aronson believes that all people with voice disorders should be tested for the presence of vocal hyperfunction either as a primary or secondary cause of their dysphonia. He gives basic principles for therapy to alleviate excessive musculoskeletal tension associated with vocal hyperfunction:

1. Extrinsic and instrinsic laryngeal muscle cramping is responsible for the abnormal voice. Reducing musculoskeletal tension releases the inherent capability of the larynx to produce normal voice.
2. When gently rubbed or kneaded, muscles relax and become less painful.

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[8]Harvey M. Tucker, M.D., The Larynx, (New York, 1987), p. 153.

[9]Robert T. Sataloff, M.D., "A 'First Aid Kit' for Singers," The NATS Journal, Vol. 43, No. 4 (March/April 1987), p. 29.

3. Lowering laryngeal position in the neck permits more normal phonation.[10]

Many of the reviewed sources mention the need for relaxation techniques to alleviate hyperfunction. Greene, for example, states that since "vocal strain is the result of both mental and physical tension, vocal re-education will fail unless it achieves physical and mental relaxation."[11] She describes exercises which help the patient achieve relaxation through a supine position (muscles of the arms, legs, head, and neck are relaxed while lying on the back); through suggestion (mental imagery of peaceful scenes or situations); and through more active situations of sitting and standing while relaxing head, neck, arms, and torso.[12] As another example, Boone states that a certain amount of psychic tension and muscle tonus is normal and healthy, but that for those voice problems where excessive tension is a contributing factor, direct work on relaxing tension in arms, chest, neck, and oral and pharyngeal cavities may be helpful.[13]

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[10]Arnold E. Aronson, Ph.D., Clinical Voice Disorders, (New York, 1980), pp. 198-199.

[11]Margaret Greene, The Voice and its Disorders, (Philadelphia, 1980), p. 158.

[12]Ibid, pp. 159-162.

[13]Daniel R. Boone, The Voice and Voice Therapy, (Englewood Cliffs, New Jersey, 1983), p. 171.

Other sources suggest techniques and exercises for hyperfunction. Cooper indicates that the fundamental cause of vocal abuse is the vocal image that is adopted. Influenced by mass media and cultural norms, people choose a sound which is not always healthy for their individual voices. He recommends an appropriate pitch level, tone focus and resonance balance, and proper breathing techniques. To locate the correct pitch level and proper tone focus, one is to say um-hum spontaneously with an upward inflection as if agreeing with someone. When done correctly, the individual is supposed to experience a tingle or buzz about the lips or around the "mask" area, thus finding the correct pitch level and acquiring a good resonance balance.[14] Cooper advocates midsection or central breath support rather than upper chest breathing for a comfortable and durable voice.[15]

In treating singers with vocal complaints but no physical or architectural pathology (about two thirds of his patients), Lawrence states that almost all are guilty of abuse of the speaking voice. More specifically, "the great majority of them show specific problems with pitch" and usually "a speaking voice habitual pitch which is

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[14]Morton Cooper, Ph.D., Modern Techniques of Vocal Rehabilitation, (Springfield, 1973), p. 27.

[15]Ibid, p. 28.

inappropriately low to the laryngeal architecture concerned."[16] Lawrence's technique of diagnosis of "optimal" or "ideal" pitch and other vocal properties is discussed in Chapter Four of this study.

Other sources offer management strategies and exercises for inappropriate vocal parameters often related to hyperfunction and/or hypofunction. Reich recommends chewing (Froeschels), the yawn-sigh (Vennard), exercises for easy attack, massage, warm-ups (Lessac and Vennard), and mandibular and airway adjustments.[17] Stemple addresses the vocal properties of respiration, phonation, resonation, pitch, loudness, rate, and laryngeal muscle tone. Although little need exists for formal training of breathing for speech, sometimes modifications of respiratory habits aid in the treatment of voice disorder. This is most common in those who try to speak on residual air (air that is left after normal expiration) or in public speakers whose demand on the voice may require more breath support than for normal

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[16]Van L. Lawrence, M.D., "Habitual Pitch of Speaking Voice and the Singer," The NATS Journal, Vol. 44, No. 1 (September/October 1987), p. 25.

[17]Alan R. Reich, Ph.D., "Evaluating and Preventing Dysphonia in the Vocal Artist/Athlete," Short Course presented at Annual Convention of American Speech-Language-Hearing Association, Toronto, November, 1982, pp. 11-12.

conversation.[18] Singing, on the other hand, may at times require the whole of the vital lung capacity,[19] thus making respiratory control a vital issue in the training of the singing voice or in the rehabilitation of a voice disorder in the singer.

Stemple offers suggestions and exercises to alleviate phonation problems such as the hard glottal attack (beginning words and phrases with the aspirate [h]); glottal fry (raising the speaking pitch); and breathy phonation (using a more precise articulation, increasing intensity, or using a glottal attack). Hypernasality is treated with articulation therapy, pitch and loudness modification, nonspeech sounds such as animal and engine noises, practicing in a voice with "head cold," and practicing using both voices, the old hypernasal voice and the new one with normal resonance. Hyponasality may be modified by utilizing the normal nasal sounds of [m], [n], [ŋ]; trying hypernasal resonance; and using practice similar to the hypernasality techniques, but with an opposite approach. Counseling is used for pitch and loudness levels that are either too high or too low and for a speaking rate that is too fast. Laryngeal muscle weakness may be present as an aftereffect

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[18]Joseph C. Stemple, Clinical Voice Pathology, (Columbus, Ohio, 1984), p. 117.

[19]Donald F. Proctor, Breathing, Speech, and Song, (New York, 1980), p. 78.

of phonasthenia. When this condition exists, treatment must include techniques to help strengthen weak muscles.[20]

Boone presents twenty-five therapy techniques for treating hyperfunctional voice disorders. As to the application of each technique, he states:

> It should be noted that some techniques are applicable for facilitating both mass-size changes and approximation of the vocal folds. Others appear to be used primarily for promoting mass-size changes, and still others primarily for better vocal fold approximation. Similarly, certain approaches have greater facilitating effects on loudness, others on pitch, and others on quality. Some techniques, such as number 25 (the yawn-sigh approach), appear applicable to most problems. Many techniques may be used in combination with one another, and the basic rule of application (when to apply) is to use the approach that works best with the individual patient.[21]

His techniques include altering tongue position, to correct excessively posterior or anterior carriage of the tongue; chewing approach, relaxing the jaw and other components of the vocal tract to aid relaxation of phonatory function; digital manipulation, used to lower pitch or minimize upward-downward movement of the larynx during speech and singing; elimination of hard glottal attack; establishing a new pitch; open-mouth approach, improving the resonance and loudness; place the voice, transfers the patient's focus from the larynx to the upper vocal tract; and yawn-sigh

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[20]Stemple, pp. 117-130.

[21]Daniel R. Boone, The Voice and Voice Therapy (Englewood Cliffs, New Jersey, 1983), pp. 115-116.

approach, to encourage an open but relaxed oral pharynx and easy onset of phonation.[22]

As general therapy techniques for hyperfunction, the sources reviewed use theories and exercises which alleviate excessive tension in respiration, phonation, and resonation. The sources address the parameters of breath volume and control, pitch, intensity, vocal attack, approximation of vocal folds, quality, and articulation. Therapy techniques aid relaxation in extrinsic and intrinsic muscles of the larynx and improve breathing habits and postures of the body, face, and pharyngeal and laryngeal areas. Sources also give attention to psychological factors such as vocal image, aggressive personality traits, and emotional stress. Patient and clinician seek to identify and relieve additional contributing factors such as abusive vocal habits and unreasonable occupational demands.

The treatment for vocal nodules is one of the most controversial issues in the management of voice disorders. Proctor says, "Some physicians recommend prolonged voice rest (three to six months) while others suggest modified voice rest combined with cautious voice training."[23] Others recommend surgical removal. Proctor, among this latter

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[22]Ibid, pp. 116-182.

[23]Proctor, p. 150.

group, gives reasons for his preference for surgery and offers suggestions for procedure:

> Direct laryngoscopy should invariably be done. This is the only way in many instances to be certain of the diagnosis, and, indeed, to rule out very early laryngeal cancer. . . .An appropriate size forceps is used to seize the lesion, being cautious to stay outside the normal line of the fold itself. . . Why do I feel so strongly as to this course of therapy, especially since voice rest and training will end in resolution of the lesion in some patients? First, because the patient is ordinarily restored to talking or singing much more rapidly (within two to six weeks). Second, because it enables one to be certain of the diagnosis. It is important to explain to the patient that the nodule resulted from vocal abuse, identify its nature, and see that it is corrected. After removal of the nodule some recommend no resumption of singing for six to ten months. My instructions are for two weeks only of absolute voice rest. In the public speaker I suggest gradual resumption of talking after that time. In the singer I suggest very brief periods of vocal exercise (mezza voce, middle register) during the third week, cautious but steady increase in the number and duration of exercises during the fourth week, and resumption of full singing about the fifth to sixth week.[24]

Proctor's recommendation for surgery in order to be sure of the diagnosis indicates the possibility of early laryngeal cancer in a growth which looks similar to a nodule. In discussing medical management of vocal nodules, Teter states, "One of the common misconceptions associated with vocal nodules is that they might become malignant. This never occurs. Vocal nodules are benign extensions of the

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[24]Ibid, pp. 151-152.

vocal cord coverings, and as such are never life-threatening."[25] Sources agree that nodules are benign, but the problem lies in diagnosing the growth. Case reports an instance where a patient, whose removed tissue was clinically diagnosed as nodule, was later found with malignant cells under several layers of benign tissue, thus requiring him to have a laryngectomy.[26] Such an instance further cautions the professional voice user to seek a second opinion for diagnosis and treatment of growths on the vocal folds.

Tucker advises conservative, nonsurgical treatment for vocal nodules in all children and in adults who respond to therapy. For children and adults therapy involves reduction of vocal abuses, development of appropriate methods of voice production, and resolution of emotional stress. Tucker further states that surgical removal of nodules in adults may be necessary if behavioral methods are not completely successful, a particular possibility if the nodules are fibrotic. Adequate preoperative and postoperative voice

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[25]Darrel L. Teter, "Vocal Nodules: Their Cause and Treatment," Music Educators Journal, Vol. 64, No. 2, (October 1977), p. 40.

[26]D. E. Mowrer and James L. Case, Clinical Management of Speech Disorders, (Rockville, Maryland, 1982), pp. 208-209.

therapy should allow the return of normal voice within six to eight weeks.[27]

Earlier sources give these indications for surgery: large nodes of long standing in adults (Brodnitz, 1958); all unilateral affliction, despite seemingly benign appearance (Jackson, 1941); polyps with any localization on the cord (Tarneaud, 1935); diffuse polypous degeneration of one or both cords (Lore, 1934); and all cordal lesions in patients beyond middle age (Friedberg et al, 1961).[28] Brodnitz, while indicating that surgery is sometimes necessary to remove large and solidified nodes, also cautions about the danger of removing too much or of creating a small scar that interferes with the voice in artistic speaking or singing.[29] More recent sources seem to be cautious about surgery for vocal nodes. In addition to the iatrogenic possibilities discussed earlier in this chapter, Lawrence and Sataloff offer further advice about surgery for nodules. In Lawrence's view:

> If there is no suspicion in your laryngologist's mind about tumor, then I recommend six to eight weeks

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[27]Harvey M. Tucker, M.D., The Larynx, (New York, 1987), p. 149.

[28]Richard Luchsinger, M.D. and Godfrey E. Arnold, M.D., Voice-Speech-Language, (Belmont, California, 1965), p. 185.

[29]Friedrich S. Brodnitz, M.D., "Voice Problems Of The Actor And Singer," Journal of Speech and Hearing Disorders, Vol. 19, No. 3 (September 1954), p. 323.

> of voice and/or speech therapy and another look-see and another listen. If nodes remain but the voice is good (and one of our very well-known Met singers has dandy nodes), leave things alone. If there is no option, then careful surgical excision under a microscope with either sharp dissection or laser surgery is in order. . . .Probably the message in all this harangue is that if you're a singer, don't have any surgery done on your vocal tract unless it's unavoidable. If it is unavoidable, be forewarned that it will probably alter the resonant characteristics of your individual instrument, and you probably will have to put in some time becoming reacquainted with the fine-tuning of the new voice.[30]

Sataloff also offers reservations about surgery for professional voice users:

> Surgery for vocal nodules should be avoided whenever possible and should almost never be performed without an adequate trial of expert voice therapy, including patient compliance with therapeutic suggestions. A minimum of 6-12 weeks of observation should be allowed while the patient is using therapeutically modified voice techniques under the supervision of a speech pathologist and possibly a singing teacher. Proper voice use rather than voice rest (silence) is correct therapy. The surgeon should not perform surgery prematurely for vocal nodules under pressure from the patient for a "quick cure" and early return to performance. Permanent destruction of voice quality is a very real complication. . . .
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> When surgery is indicated for vocal cord lesions, it should be limited as strictly as possible to the area of pathology. There is virtually no place for "vocal cord stripping" in professional voice users with benign disease.
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> . . .The use of lasers is controversial at present. There is considerable anecdotal evidence suggesting that healing time is longer and the incidence of adynamic segment formation higher with the

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[30]Van L. Lawrence, M.D., "Singers and Surgery, Part I," The NATS Bulletin, Vol. 38, No. 5 (May/June 1982), p. 21.

> laser than with traditional instruments; and two recent studies (Abitbol, Tapia) raise serious concerns about dysphonia following laser surgery.[31]

Regardless of the decision which physician and patient may reach regarding surgery for nodules, voice instruction and therapy are a necessary part of treatment. The first step in the management of a nodular condition is often to identify abusive habits. Case lists and discusses specific types of vocal abuse and related situations which should be considered as probable factors: yelling and screaming, making a hard glottal attack, singing in an abusive manner (as a professional or an amateur); speaking in a noisy environment; coughing and excessive throat clearing; grunting as in exercising and weight lifting; calling others, such as friends, children, or pets, from a distance; using inappropriate pitch levels in speaking or singing; speaking in an abusive or excessive manner during menstrual periods, allergy attacks, or with upper respiratory infections; vocalizing excessively or under conditions of muscular tension; smoking excessively or speaking in a smoky environment; vocalizing excessively while taking aspirin; cheerleading and pep club activities; vocalizing toy and animal noises; engaging in athletic activity involving yelling, such as in coaching or quarterbacking a football

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[31]Robert T. Sataloff, M.D., "The Professional Voice: Part III. Common Diagnoses and Treatments," Journal of Voice, Vol. 1, No. 3 (September 1987), pp. 289-291.

team; arguing with peers, siblings, and others; reversing phonation; and talking in night clubs or arcades.[32] Once patients reduce or eliminate abusive habits, such as shouting or any activities similar to those listed above, the voice can then begin to heal. Sometimes the patient cannot completely eliminate a causative factor either for professional or personal reasons, such as an athletic coach who must shout commands or an aggressive personality type who must talk loudly and often. These persons must learn to develop projection techniques in place of shouting. Cooper believes that a healthy projected voice is one which stresses oral and nasal resonance (with emphasis upon nasal resonance for carrying power) and makes use of optimal pitch range and midsection breath support.[33]

Finding optimal pitch range as treatment for nodules is a frequent and controversial technique. Some voice specialists state that most of their patients need to raise the pitch,[34] while some advocate reducing the pitch level of

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[32]James L. Case, Ph.D., Clinical Management of Voice Disorders, (Rockville, Maryland, 1984), pp. 104-120.

[33]Morton Cooper, Ph.D., Modern Techniques of Vocal Rehabilitation, (Springfield, 1973), p. 36.

[34]Van L. Lawrence, M.D., "Habitual Pitch of Speaking Voice and the Singer," The NATS Journal, Vol. 44, No. 1 (September/October 1987), p. 25.

the voice.[35] Aronson states that the location of optimum pitch is impossible to find in someone who has a lesion of the vocal folds causing the latter to vibrate abnormally; therefore, the clinician should help the patient find a comfortable pitch level. He recommends Cooper's um-hum method.[36] A recent study[37] further illustrates the problem in assessing the relationship of a nodular or polypoid condition to that of pitch frequency. In this study, fundamental frequency during stroboscopic examination was compared among adult patients with nodules and polyps. Pre-operatively, females with nodules had a higher fundamental frequency than did patients with polyps. With this data alone one cannot determine if pitch is a cause or a result or whether the pathology is the cause or result. Two conflicting conclusions are possible: vocal folds with a nodule vibrate at a higher fundamental frequency than those with a polyp; or stress during habitual high pitch phonation is likely to cause nodules, and stress during low pitch phonation is likely to cause polyps. Post-surgical results revealed that fundamental frequency was still higher

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[35]Arnold E. Aronson, Ph.D., Clinical Voice Disorders, (New York, 1980), p. 205.

[36]Ibid.

[37]Minoru Hirano, M.D. and others, "Laryngeal Tissue Reaction To Stress," The Voice Foundation Ninth Symposium, Part II (1980), pp. 10-20.

in patients who had had nodules and lower in those who had had polpys. The study suggests, therefore, that "stress during high-pitched phonation is apt to cause nodules, whereas stress during low-pitched phonation is likelier to produce polyps."[38] This theory is supported by sources who state that more women than men develop nodules.[39] However, this theory contradicts some clinical findings (Vaughn,[40] Case[41]) in which patients with nodules have a habitual speaking pitch which is too low.[42] This contradiction indicates a need to do further research in this area and to seek a reliable method of determining optimum pitch for the individual patient.

In addition to eliminating abusive habits and changing improper vocal production, sources recommend addressing possible emotional problems and stressful situations which may have developed at the same time as the nodular condition. Aronson states, "Many patients develop nodules even though they have not changed their singing or speaking habits. What often emerges during a thorough voice

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[38]Ibid, p. 15.

[39]Joseph C. Stemple, Clinical Voice Pathology, (Columbus, Ohio, 1984), p. 80.

[40]Hirano and others, p. 20.

[41]James L. Case, Ph.D., Clinical Management of Voice Disorders, (Rockville, Maryland, 1984), p. 103.

[42]Hirano and others, p. 20.

evaluation is that they have experienced an emotional upset in their lives that increases their musculoskeletal tension to the point of adding enough frictional trauma to the vocal folds to produce nodules."[43] The problems may be relatively minor and temporary or more severe, in which case the patient might benefit from a referral for psychologic or psychiatric consultation.[44] Although his treatment techniques for nodules do not differ from those for general vocal abuse, Stemple also emphasizes counseling for the patient with nodules, especially in regard to their effect on a professional career. According to him, "Often, the anxiety level expressed by the patient as a result of the pathology is much higher than the pathology warrants. With the complete cooperation of the patient, nodules may often be resolved quickly and effectively with minimal career interruption."[45] Stemple further states that voice examination may occasionally fail to reveal causes for the development of nodules, especially in singers. In this situation, the singer is referred to a vocal coach for assessment of singing techniques and training.[46]

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[43]Arnold E. Aronson, Ph.D., Clinical Voice Disorders, (New York, 1980), p. 204.

[44]Ibid.

[45]Stemple, p. 162.

[46]Ibid.

Boone offers specific techniques for the treatment of nodules. These therapy approaches, discussed in the treatment of hyperfunction (pp. 72-73), are recommended for patients with nodules: chewing approach, place the voice approach, and yawn-sigh approach. In addition to these techniques, Boone often recommends the following: biofeedback (using various equipment to assess biological systems involved in the vocal process, such as EEG or EMG in monitoring relaxation); change of loudness (helping the patient to acquire an appropriate intensity level through counseling, changing pitch level, improving breathing habits, and practicing the new intensity); ear training (improving phonation and resonance by teaching the patient to evaluate sound by careful listening); elimination of abuses (identifying and reducing vocal abuses by plotting their daily frequency on a graph); explanation of problem (motivating improvement through education of the patient concerning vocal functions and pathology); and hierarchy analysis (analyzing situations in which the patient becomes more anxious and more dysphonic and then applying the better voice used in less stressful instances to all levels of hierarchy). This final method is also recommended by Case[47]

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[47]James L. Case, Ph.D., Clinical Management of Voice Disorders, (Rockville, Maryland, 1984), p. 129.

as a way of identifying the situations which are easiest to correct and then moving on to the more difficult ones.

As further techniques for the treatment of nodules, Boone suggests masking (concealing the vocal sound from the patient who over-monitors the voice and has lost a naturalness of production); negative practice (intentionally using a previously incorrect response in order to help carry over the new voice patterns to everyday situations); pitch inflections (increasing pitch variability in a monotonic voice in order to increase vocal relaxation); relaxation (using different techniques to teach relaxation, such as differential relations, in which the patient concentrates on a particular body site; head rotation to relax the vocal tract; yawning to feel an open throat; and mental images of relaxing events and places); and voice rest (temporary measure to be used only when absolutely necessary in order to reduce the amount of phonation when overuse is a factor).[48]

Treatment for nodules involves general therapy techniques for improving vocal production, for relieving unnecessary tension in all vocal parameters, and eliminating or reducing abusive habits. Patients are taught exercises which aid them in achieving these goals. Possible parallel

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[48]Daniel R. Boone, The Voice and Voice Therapy, (Englewood Cliffs, New Jersey, 1983), pp. 115-182.

emotional upsets are investigated as well as unusual occupational demands.

Treatment for unilateral or bilaterial paralysis of vocal folds may involve medical techniques and/or therapy. Management for unilateral paralysis, which rarely causes significant airway obstruction or aspiration, seeks to restore voice strength and quality. Tucker says that surgery should not be selected as treatment for such an impaired voice for six months to one year to first allow for spontaneous recovery of nerve function or compensation by the other fold.[49] Lawrence advises waiting twelve to eighteen months.[50] Although early surgical intervention could be indicated under certain circumstances, such as aspiration, insufficient ventilation, psychological inability to wait, or professional or financial factors, Tucker states that, "Even under these circumstances, nothing irreversible should be carried out that might interfere with spontaneous recovery if it should be destined to take place."[51] When recovery has not occurred or compensation is not sufficient, approaches to rehabilitation attempt to maximize compensation or to displace the paralyzed vocal

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[49]Harvey M. Tucker, M.D., The Larynx, (New York, 1987), p. 242.

[50]Letter from Van L. Lawrence, M.D., McGregor Medical Association, Houston, Texas, May 26, 1988.

[51]Tucker, p. 242.

fold from paramedian position to or near midline. Medical procedures which accomplish midline or near midline position include the following: Teflon or Gelfoam paste injection (inserted into the muscle bulk of the vocal fold, thus increasing the size and displacing the fold closer to midline); surgical medialization (placing the fold nearer midline when the folds have wide gaps between them and when the arytenoid cartilage is fixed rather than just immobilized by paralysis of the attached musculature); and reinnervation (a surgical technique which provides nerve restoration by suturing a nerve-muscle pedicle from one of the strap muscles in the neck to the lateral thyroarytenoid muscle.[52] In regard to this reinnervation procedure Tucker states:

> All voices are "valuable," of course, but there are some patients (such as professional singer, actor, clergyman, orator, teacher) whose livelihood requires not only a satisfactory voice, but one that can be relied on to project or otherwise be used under stressful conditions. Such patients may find it worthwhile to accept the greater cost, hospitalization, and the approximately 6-month delay in rehabilitation that are inherent in reinnervation of the unilaterrally paralyzed vocal fold in order to realize the potentially superior voice result this procedure can provide.[53]

In bilateral vocal fold paralysis the folds are usually in a position near midline, thus causing airway obstruction but

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[52]Ibid, pp. 242-248.

[53]Ibid, p. 245.

little effect on voice quality. Medical management to restore the airway may include tracheotomy, vocal fold lateralization, or vocal fold reinnervation.[54]

Occasionally, other problems, such as sensory loss or compromise of the swallowing mechanism, combine with vocal fold paralysis to cause aspiration, pneumonia, or decreasing pulmonary function. When this occurs, medical intervention may be necessary in the form of a nasogastric tube, a tracheotomy, a Gelfoam or Teflon injection, or more drastic techniques such as laryngeal diversion or even laryngectomy.[55]

Voice therapy is often the preferred treatment for dysphonia related to vocal fold paralysis. Such therapy may be used as the only technique or as a supplement to medical management. In unilateral and bilateral adductor vocal fold paralysis therapy is based on the patient's potential to compensate by utilizing the primitive muscle reflex mechanisms of the larynx. Stronger glottic closure is accomplished through effort closure activities such as grunting, coughing, laughing, pushing, and lifting. Nevertheless, voice recovery is dependent on the type of

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[54]Ibid, p. 248.

[55]Harvey M. Tucker, M.D., The Larynx, (New York, 1987), p. 257; James L. Case, Ph.D., Clinical Management of Voice Disorders, (Rockville, Maryland, 1984), p. 264.

paralysis and the position of the fold(s).[56] Voice therapy does little for bilateral paralysis unless the paralysis itself diminishes; then whisper voice may be strengthened by pushing exercises.[57] The goal of therapy for unilateral paralysis is to strengthen the normal fold so that it will overadduct across the midline to meet the paralyzed fold. The exercise most often employed toward this goal is a pushing exercise first advocated by Froeschels, Kastein, and Weiss in 1955.[58] This exercise initially combines simple phonation with various activities, such as linking the fingers and pulling while voicing the [i] vowel, pushing against a table, or pulling up on a chair. Then the exercise progresses toward other vowels, words, and eventually sentences.

Aronson recommends singing and humming, as well as practicing vowels with a hard glottal attack. He suggests looking for and eliminating excessive musculoskeletal tension which sometimes develops as a secondary reaction.[59]

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[56]Arnold E. Aronson, Ph.D., Clinical Voice Disorders, (New York, 1980), p. 225.

[57]Daniel R. Boone, The Voice and Voice Therapy, (Englewood Cliffs, New Jersey, 1983), p. 200.

[58]Emil Froeschels, S. Kastein, and D. A. Weiss, "A method of therapy for paralytic conditions of the mechanisms of phonation, respiration, and glutination," Journal of Speech and Hearing Disorders, Vol. 20 (1955), p. 365.

[59]Aronson, p. 226.

Stemple also mentions the effectiveness of using hard glottal attack exercises. He attests to the helpfulness of turning the head to one side or the other and digital manipulation of the thyroid cartilage as exercises to increase tension on the paralyzed fold.[60]

Boone states that the best voice possible with unilateral adductor paralysis is achieved in therapy that focuses on increasing breath control, on deliberately increasing hard glottal attack, and on practicing pushing exercises. Improved breath control increases the air-flow rate and thus produces a greater vibration of the paralyzed but still mobile cord. Boone says this change results in a slightly better-sounding voice.[61] Wilson suggests these approaches to tension increase for vocal folds paralysis: ear training (stressing the difference between the voice when relaxed and when pushing); decreasing general physical stress and increasing extra laryngeal stress; improving specific laryngeal muscle control; general vocal hygiene; and improving respiratory function.[62]

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[60]Joseph C. Stemple, Clinical Voice Pathology, (Columbus, Ohio, 1984), p. 135.

[61]Boone, p. 200.

[62]Frank B. Wilson, Ph.D., Speech course presented when visiting professor, North Texas State University, Denton, Texas, Spring, 1985.

General therapy techniques used by speech therapists for improving the voice with a paralyzed vocal cord include pushing exercises, hard glottal attacks, improving respiratory control, reducing unnecessary tension elsewhere in the body, increasing vocal fold tension, and attending to general vocal hygiene. Some of these techniques are used when training the healthy singing voice (improving respiratory function and control, improving specific laryngeal muscle control, decreasing general physical stress, and acquiring ideal vocal fold closure); thus indicating the possibility that a paralyzed vocal fold might very well respond to singing efforts. Although hard glottal attacks are unnecessary and even harmful for the healthy voice, the goal is the same for the singer and the voice with paralyzed vocal fold: to achieve an easy but non-breathy, efficient onset of sound. Because of this and other parallels listed above, it would seem logical to expect a patient with a paralyzed vocal cord to respond to techniques and exercises proven successful in training the singing voice.

Sources who discuss treatment for iatrogenic vocal disorders are almost non-existent, and data-base search for the iatrogenic factor turns up no listings as far back as 1967. One possible exception is the therapy and rehabilitation techniques for patients with partial or total laryngectomy. It is even questionable whether this

exception should be considered an iatrogenic disorder, as the life threatening condition of laryngeal cancer demands medical management which can produce partial or complete loss of the larynx. A discussion of rehabilitation therapy techniques is out of the scope of this study, as surgical and therapeutical procedures are highly specialized and include physical, psychological, and social factors.[63]

Aronson addresses the iatrogenic factor but offers no special techniques for treatment. He states that psychogenic voice disorders resulting from anxiety after surgery or unconscious hostility toward the surgeon are possible and particularly berates the results which often follow the recommendation for prolonged voice rest. He implies that therapy for these iatrogenic disorders would be the same as for similar psychogenic voice disorders resulting from different etiologies.[64]

Sataloff comments on an iatrogenic situation which directly relates to the concerns of this study:

> Too often, the laryngologist is confronted with a desperate singer whose voice has been "ruined" following vocal cord surgery, recurrent or superior laryngeal nerve paralysis, trauma, or some other

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[63]Joseph C. Stemple, Clinical Voice Pathology, (Columbus, Ohio, 1984), Chapter 9; James L. Case, Ph.D., Clinical Management of Voice Disorders, (Rockville, Maryland, 1984), Chapter 7.

[64]Arnold E. Aronson, Ph.D., Clinical Voice Disorders, (New York, 1980), pp. 149-151.

> tragedy. Occasionally, the cause is as simple as a dislocated arytenoid that can be reduced. However, if the problem is an adynamic segment, decreased bulk of one vocal cord following "stripping," bowing caused by superior laryngeal nerve paralysis, or some other serious complication in a mobile vocal cord, great conservatism should be exercised. None of the available surgical procedures for these conditions is consistently effective. If surgery is considered at all, it should be presented to the patient realistically and pessimistically. The patient must understand that the chances of returning the voice to professional quality are very slim, and that there is a chance of making it worse.[65]

If surgical prognosis is this negative, any therapy or training techniques which might prove partially or totally effective for these types of disorders would seem to be highly desirable for the voice professional who has suffered loss through inept surgery or other tragedy.

The final treatment technique, prevention, is the most important aspect of vocal hygiene. In addition to the general recommendations for prevention listed in chapter one, experts offer more detailed suggestions for maintaining good vocal health. Stemple states that people who make professional use of their voice must take special care to avoid risks to general health of the entire body as well as to the laryngeal mechanism, for the well-being of the voice is dependent on the well-being of the whole body.[66]

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[65]Robert T. Sataloff, M.D., "Vocal Problems: Part III. Common Diagnoses and Treatments," Journal of Voice, Vol. 1, No. 3 (September 1987), p. 291.

[66]Joseph C. Stemple, Clinical Voice Pathology, (Columbus, Ohio, 1984), p. 158.

Brodnitz believes that among professional voice users the singer, above all, must practice intelligent hygiene, for the singer's profession requires the highest degree of specialization in the use of the voice.[67] Unfortunately, as Stemple states, "the life-styles of many professional voice users are not compatible with the maintenance of a healthy larynx. Not only may these life-styles create vocal abuse and emotional stress, but they may also lead to less than adequate physical health."[68] Luchsinger and Arnold further advise the professional actor or singer that psychological and physical conditions which concern everyone affect them to an even greater extent; and that singers, whose occupation requires a major form of physical activity, should preserve their health through temperance in every respect.[69] The reviewed sources agree that professional voice users must attend to physical fitness and nutrition, prevention and prompt care of illnesses and allergies, environmental conditions, and speaking and singing habits.

Physical exercise and proper nutrition help keep bodies and voices healthy. Brodnitz states that the mucous membranes prefer a diet with limited starches, thus

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[67]Friedrich S. Brodnitz, Keep Your Voice Healthy, (New York, 1953), p. 88.

[68]Stemple, p. 158.

[69]Richard Luchsinger, M.D. and Godfrey E. Arnold, M.D., Voice-Speech-Language, (Belmont, California, 1965), p. 157.

discouraging the overproduction of phlegm which interferes with free nasal breathing and clarity of the voice.[70] The tendancy to overindulge in starches and the lack of enough physical exercise often cause a corresponding tendancy toward obesity, a condition associated with high blood pressure, higher levels of cholesterol, sugar diabetes, heart disease, and respiratory problems.[71] Unhealthy for anyone, obesity is certainly detrimental for the professional voice user who must have a healthy respiratory tract; and, as Sataloff points out, obesity has significant disadvantages for the professional singer:

> Today, most people involved in voice education and singing recognize that singing is athletic. As such, it requires good abdominal and respiratory conditioning, physical strength, and endurance. All of these are undermined by significant obesity. . . Even a moderate degree of obesity may adversely affect the respiratory system, undermining support.[72]

Bunch cautions against obesity but reminds singers that a good diet should include protein to combat wear and tear of tissues, and vitamins, minerals, carbohydrates and fat to insure vitality and energy as well as good

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[70]Brodnitz, p. 94.

[71]Dalia Sataloff and Robert T. Sataloff, M.D., "Obesity and the Professional Singer," The NATS Bulletin, Vol. 44, No. 5 (May/June 1988), pp. 26-27.

[72]Ibid.

health.[73] Bunch also recommends physical activity which involves free movement and increased depth of breathing such as dancing, jogging, walking, calisthenics, tennis, and swimming. She states, though, that singers should refrain from diving and underwater swimming to avoid possible risks of nasal congestion and ear trouble, and further advises against weightlifting which tends to overdevelop the muscles of the neck and the adductors of the vocal folds.[74]

Prompt attention to and care for illnesses, especially those affecting the upper respiratory tract, is important in the prevention of more lasting vocal disorders. The common cold, which may begin with a tickle in the throat, congestion, and/or sneezing, can lead to more serious infections of the sinuses, bronchial tubes, or lungs. Unfortunately, as Lawrence points out, the cold, or the URI (upper respiratory infection), "is a fever-producing, sudden-onset illness that attacks the respiratory tract, and which lasts about a week with treatment and about a week without treatment."[75] About all one can do when the cold strikes is to rest, increase fluid intake, and provide some relief for the affected tissues. Lawrence recommends steam

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[73]Meribeth Bunch, Dynamics of the Singing Voice, (New York, 1982), pp. 110-111.

[74]Ibid, p. 111.

[75]Van L. Lawrence, M.D., "U.R.I.'s," The NATS Bulletin, Vol. 37, No. 4 (March/April 1981), p. 41.

inhalations, a decongestant, and antihistamine for the first few wet days; however, he cautions singers about the drying effects of antihistamine if used past the "pouring hot water" stages of the cold.[76] Professional voice users should speak and/or sing as little as possible while under the effects of the cold and should avoid violent coughing or throat clearing, all of which may cause hoarseness long after other symptoms have abated. The best cold "medicine" is to avoid catching the virus in the first place, as some sources suggest. Lawrence believes that the best way to avoid a URI during the cold season is to wash hands often and to avoid touching objects which have been in contact with someone infected with a cold.[77] Many sources recommend keeping the mucuous membranes hydrated and keeping the atmosphere in homes and buildings at a high relative humidity level to help deter the spread of viruses.

Suggestions for adequate environmental and body hydration appear often as a preventive vocal health measure. Lawrence explains that water is extremely important in the normal functioning of the respiratory tract and of the vocal tract in particular. He advises the professional voice user to carefully monitor body water levels by noting the condition of one's urine: when well hydrated, urine is very

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[76]Ibid, p. 42.

[77]Ibid.

dilute, nonodorous and almost invariably the color of tap water.[78] Loeding advises vocal performers to avoid habits which dry out mucous membrane linings of the nose and throat, such as smoking and drinking alcoholic beverages, to drink eight to nine glasses of water a day, and to keep the air moist by using a vaporizer or turning on the hot shower.[79] When outside temperature and humidity levels are uncomfortable, efforts to provide a healthy environment which contains a minimum humidity level of forty percent[80] should often include running a vaporizer, humidifier, steamer, or hot shower, especially in homes or buildings which are centrally heated or air conditioned the year around. When outside humidity levels are too high, Stemple contends that the mucus of the respiratory tract may thin out, causing excessive drainage leading to throat clearing and coughing. He further states, though, that the presence of mucous drainage, or "postnasal drip," is a normal and natural function which should not be changed with over-the-counter "sinus" medicines which dehydrate the

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[78]Van L. Lawrence, M.D., "Sermon on Hydration (The Evils of Dry)," The NATS Journal, Vol. 42, No. 4 (March/April 1986), p. 23.

[79]Rosalie Loeding, Loeding's Ten Commandments For Vocal Health, "Vocal Stress," workshop presented at Delta Omicron 1987 Triennial Conference, Jefferson City, Tennessee, August 1, 1987.

[80]Lawrence, p. 23.

mucosal lining.[81] Lawrence explains that normal mucus, which is watery, thin, and liquid, is rarely, if ever, perceived as being present. If overly aware of drainage, one is usually suffering from dehydration, although the thicker secretion can be the accompaniment of a problem such as sinusitis, upper respiratory infection, or a nasal allergy.[82]

Nasal allergies or sinus problems can make life miserable for the professional voice user, for these conditions can cause swelling of the tissues in the throat and larynx eventually leading to hoarseness.[83] Severe or chronic allergies need specialized medical attention; however, if attacks are infrequent and mild and if problems are minimal, Sataloff advises the use of a mild antihistamine and/or decongestant. The drying effects of the antihistamine may be counteracted by mucolytic medications such as Entex, Organidin, Robitussin, or Humibid, which increase or thin upper respiratory

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[81]Joseph C. Stemple, Clinical Voice Pathology, (Columbus, Ohio, 1984), p. 159.

[82]Van L. Lawrence, M.D., "Post-Nasal Drip," The NATS Bulletin, Vol. 39, No. 1 (September/October 1982), p. 27.

[83]Meribeth Bunch, Dynamics of the Singing Voice, (New York, 1982), p. 112.

secretions. These medications also help dryness caused by atmospheric conditions and overuse of the voice.[84]

Closely related to allergic reactions and general health of the laryngeal tissues is the unhealthy reaction of the voice to irritants such as tobacco, alcohol, and other recreational drugs. Almost without exception, voice experts advise against the habitual use of tobacco, marijuana, alcoholic beverages, cocaine, and other mood and mind altering drugs. Symptoms from habitual use are twofold: direct physical changes in the larynx and respiratory tract, and results brought about by changes in the sensory mechanisms. Sataloff warns that smoking not only may have eventual health consequences such as cancer, emphysema, and heart disease, but that the heat and consequent irritation of smoking also have an immediate effect on the larynx and the linings of the respiratory tract, producing inflammation that alters the vocal folds.[85] Lawrence describes the effects of tobacco and marijuana ("weed" or "pot") smoking:

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[84]Robert T. Sataloff, M.D., "A 'First Aid Kit' For Singers," The NATS Journal, Vol. 43, No. 4 (March/April 1987), p. 28.

[85]Robert T. Sataloff, M.D., "Ten More Good Ways to Abuse Your Voice: A Singer's Guide to a Short Career (Part II)," The NATS Journal, Vol. 43, No. 1 (September/October 1986), p. 22.

> The hard palate is reddened. The soft palate and the uvula have that whitened surface look you see when you drop egg-white into hot water and the protein first begins to coagulate. The edges of the vocal folds are reddened, and there is a slightly dry, non-productive cough. . . .Pack-a-day smokers of tobacco will sometimes show those findings after a few months, but those on weed will be unmistakably there after a very short time. And the voice loses its brilliance and its cutting edge.[86]

Sataloff explains that marijuana smoke is particulary harsh, hot, and unfiltered and may alter sensorium thus interfering with intellectual awareness and fine motor control.[87] In a later article Lawrence offers further concerns about marijuana usage and resultant attitudes and disregard for ethics. He states that excellent singing requires physical and mental discipline and daily practice and exercise, but that the "lovely, eased-out languid feeling of a marihuana high makes this so much less urgent, so much less agreeable to do. . . .I find pot eroding the work ethic, at least among several of my university voice majors."[88]

The professional voice user should carefully consider the consumption of alcoholic beverages. Wilson warns of these possible effects: excessive vascularization, a drop

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[86]Van L. Lawrence, M.D., "Cigareets and Whiskey and Wild, Wild Women," The NATS Bulletin, Vol. 38, No. 3 (January/February 1982), p. 27.

[87]Sataloff, p. 23.

[88]Van L. Lawrence, M.D., "Marihuana and Cocaine," The NATS Journal, Vol. 43, No. 2 (November/December 1986), p. 27.

in fundamental frequency, and hoarseness.[89] Sataloff reminds singers that alcohol opens up blood vessels and alters mucosal secretions while also altering awareness and fine motor control. He states that while very small amounts do not pose a major problem for people who are accustomed to drinking, singers who are not routine drinkers should be careful to avoid alcohol on the day of a performance.[90] Bunch explains, though, that the habitual use of alcohol can affect the voice in several ways. As a depressant and muscle relaxant, alcohol may impair the control of the vocal folds and sensitivity of the throat, and the drying effect of alcohol can cause irritation in the tissues of the vocal tract eventually causing a raspy or hoarse voice.[91]

Like alcohol, other recreational drugs change the sensory mechanisms of the body, a pertinent fact for the serious voice professional who wishes to maintain good vocal technique at all times. Sataloff explains to singers the decreased awareness and impairment of accurate analytic abilities caused by "street" drugs:

> They not only prevent a singer from making the instantaneous modifications that are intrinsic to

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[89]Frank B. Wilson, Ph.D., Speech course presented when visiting professor, North Texas State University, Denton, Texas, Spring, 1985.

[90]Sataloff, p. 23.

[91]Bunch, p. 117.

> good singing, but some street drugs also interfere with reaction time and motor control directly. In some cases, they may also decrease feeling (particularly narcotics) and allow a singer to injure himself without feeling pain. This can result in serious or permanent vocal fold damage as the singer continues to use his voice, perhaps remaining oblivious to the problem until the next day. Certain street drugs, particularly "uppers," may also cause a tremor that can be heard in the singing voice.[92]

Lawrence offers additional concerns about a particular recreational drug, cocaine, and its effects on singers:

> As a laryngologist I see the residuals of the chemical and thermal burns of the vocal tract surfaces, and I'll hear the air escape during phonation, the harshness and breathiness, the loss of clarity of voice, the loss of high range voice.[93]

Lawrence also attests to the personality changes which may come about as a result of cocaine. The user most often experiences mood swings, from a sense of euphoria accompanied by a speeding up of thought processes and a tongue that cannot keep pace with mental activity, to the down phases, which can include attitudes of dejection, despair, and depression. Eventually true paranoia may result.[94] The professional voice user may conclude from the opinions stated here that avoidance of smoking, alcohol, and recreational drugs will increase the chances for maintaining good vocal health and technique.

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[92]Sataloff, p. 23.

[93]Lawrence, p. 27.

[94]Ibid.

Another important factor in preventing serious vocal problems is sensible use of the voice in regard to time and demand. Unfortunately, many people who use their voices professionally are in job situations which require exhausting schedules of preparation, performance, promotion, and travel. These kinds of demands create tired bodies and tired voices. Lawrence feels that total voice use time should be a major consideration in vocal health and that vocal abuse may be a matter of "too much, too loud, and too hard."[95] He further states:

> I would say to any singer, to any voice user, that no larynx is infinite. None of us is made of cast iron or stainless steel. Each of us has a definite, a finite amount of vocal coin to spend. We should consider our priorities and then literally put our money where our mouths are.[96]

Sundberg advises singers and other people who rely heavily on their voices to note an important fact: the endurance of the vocal mechanism varies considerably among individuals. Even when using the voice economically and well, some people cannot perform as long as others. Endurance is affected by factors other than individuality, such as a cold, alcohol consumption, or dry air. What is harmless under normal conditions may be twice too much under

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[95]Van L. Lawrence, M.D., "Handy Household Hints: To Sing or Not to Sing," The NATS Bulletin, Vol. 37, No. 3 (January/February 1981), p. 25.

[96]Ibid.

unusual circumstances. Sundberg concludes this idea by stating that the more the voice is used, the more wisely and economically it must be used, and, that the risk of developing a voice disorder using one's normal vocal technique increases during adverse conditions such as a cold.[97] Thus, if it is up to the individual to discover his own vocal limits in regard to time and demand without experiencing health problems, then the professional or future professional voice user should know recommendations from experts along these lines. In 1894 Manuel Garcia advised his students that the "practice of singing three or four hours a day will ruin the most robust organ;" and he recommended three half hours a day at long intervals as the maximum of study.[98] Coffin also tells us that the master teachers of singing recommended four practice sessions of thirty minutes a day for "the most robust vocal organs." Coffin also cautions singers about the demands from opera and chorus conductors, and places the responsibility for limiting rehearsal and performance hours on the singer, who must "protect himself by any guise."[99]

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[97]Johan Sundberg, The Science of the Singing Voice, (Dekalb, Illinois, 1987), p. 185.

[98]Manuel Garcia, Hints on Singing, (New York, 1894, 1982), p. 18.

[99]Berton Coffin, Coffin's Sounds of Singing, 2nd ed., (Metuchen, New Jersey, 1987), p. 220.

Luchsinger and Arnold advise the professional singer to rest the voice at regular periods and, as a general rule, to limit major performances to three per week.[100] Sataloff reminds singers that just as the eyes burn and get "bloodshot" after staying up too late, similar changes in mucosal lubrication and irritability occur throughout the vocal tract: "When we wear ourselves out, we interfere with the body's ability to repair, replenish and balance the components of our vocal mechanisms."[101] Sataloff and Roberts further advise singers, who must deal with both the physical and psychological stress of performance, that rest periods are essential for muscle recovery, and that it is essential to condition and build up strength and endurance before rehearsing long hours prior to a performance.[102] Tucker supports this advice, and he lists singing for excessively lengthy time periods as one factor sometimes associated with vocal dysfunction. He also states that even the well-trained singer may experience alteration

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[100]Richard Luchsinger, M.D. and Godfrey E. Arnold, M.D., Voice-Speech-Language, (Belmont, California, 1965), p. 157.

[101]Robert T. Sataloff, M.D. "Ten Good Ways to Abuse Your Voice: A Singer's Guide to a Short Career (Part I)," The NATS Journal, Vol. 42, No. 1 (September/October 1985), p. 24.

[102]Robert T. Sataloff, M.D. and Barbara-Ruth Roberts, "Stress in Singers," The NATS Journal, Vol. 42, No. 3 (January/February 1986), p. 26.

of the voice during peak points of a career due to behavioral factors such as stress, extensive rehearsal, and the need for precise control and exquisite conditioning.[103]

This need for precise control, exquisite conditioning, and athletic endurance is another aspect in prevention of vocal disorders, as the professional voice user must certainly attend to speaking and singing habits and techniques to avoid vocal health problems. Speaking techniques have been discussed earlier in the chapter, but sources do offer hints for prevention. In his vocal hygiene program for professional voice users, Boone lists twelve "common-sense application" steps, among which are the following speaking habits or techniques: identify and reduce or eliminate vocal abuse and misuse; develop an easy glottal attack; use an appropriate speaking level; keep the speaking voice at the lower end of the loudness range; take an easy, relaxed breath; reduce vocal demand as much as possible; avoid talking in loud settings; and avoid making odd sounds with the voice.[104] Cooper agrees that one should talk with moderate volume, even in noisy situations. He

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[103]Harvey M. Tucker, M.D., The Larynx, (New York, 1987), p. 156.

[104]Daniel R. Boone, The Voice and Voice Therapy, (Englewood Cliffs, New Jersey, 1983), p. 206.

also warns against habitual cheering and yelling.[105] In her ten commandments for vocal health, however, Loeding says one should never scream, not at a basketball or football game, not even for joy. She also warns against overuse of the voice, speaking too rapidly, and speaking or singing in the wrong tessitura or pitch range.[106]

Most sources agree that vocal efficiency and excellence are related to fine control in certain vocal areas as listed by Reich, who offers ways to prevent dysphonia in vocal artists involved in performance speech and concert singing. He believes that vocal efficiency relates to control in the areas of intensity (regulation of pulmonary flow and glottal resistance), fundamental frequency (isometric "tension" tuning of vocal folds), vibrato (frequency modulation accompanied by some amplitude modulation), tone quality (noise-free phonation with lots of energy in the higher harmonic frequencies), respiration (maximum utilization of lung capacity and precise control of expiratory muscles), and resonance (low laryngeal position, pharyngeal dilation, lots of energy in the 2800-3200 Hz range, some nasal

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[105]Morton Cooper, Ph.D., "Be Good to Your Voice," Prevention, (May, 1979), pp. 142-144.

[106]Rosalie Loeding, Loeding's Ten Commandments For Vocal Health, "Vocal Stress", workshop presented at Delta Omicron 1987 Triennial Conference, Jefferson City, Tennessee, August 1, 1987.

resonance, and lots of jaw opening at high frequencies).[107] Further, George Antolik III feels that hyperfunction of the singing voice may be prevented by using correct techniques of posture, breathing, vocal attack, registration, and resonance. However, he does not seem to agree with other sources reviewed earlier in the chapter, such as Boone and McClosky, that once hyperfunction occurs it can be removed with the same techniques, as demonstrated by the following statement:

> Since few laryngologists, singing teachers, or speech therapists are qualified to formulate techniques successful in removing vocal hyperfunction, it seems that its prevention offers a more logical approach to both singer and teacher. It should also be noted that once the laryngeal muscles are damaged, the prognosis for a complete recovery of the singing voice is extremely guarded."[108]

Evidently some sources agree that, although cures for vocal faults are possible, they are never absolutely certain, and prevention through proper training is infinitely more vital. In 1894, Garcia, for example, offered corrections for vocal faults such as guttural or nasal sounds, tremolo, and slurring the attack of a sound;

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[107]Alan R. Reich, Ph.D., "Evaluating and Preventing Dysphonia in the Vocal Artist/Athlete," Short Course presented at Annual Convention of American Speech-Language-Hearing Association, Toronto, November, 1982, pp. 9-10.

[108]George Antolik III, "The Prevention of Vocal Hyperfunction in Singers," Doctoral Dissertation, Louisiana State University, School of Music, August, 1978, p. 88.

however, he stated that some of the faults are distressing and extremely difficult to correct.[109] Today, according to Bunch, the prognosis is still not good for "restoring battered vocal folds to normal function."[110] If a singer suffers severe muscular fatigue, a condition she thinks is the most diffcult to detect or remedy, or hoarseness after every practice or performance, it is a clear sign that the voice is improperly used or that something else is seriously wrong. Bunch believes that hoarseness caused by misuse is usually one of two things: putting excessive air pressure on the vocal folds or using too much muscular effort in the larynx to produce sound. When this type of misuse continues until muscles have had more strain than they can take, sometimes the voice stops working "overnight" and thus surprises the singer who has probably abused the voice for months or even years.[111]

All people in the voice professions would agree that prevention of vocal disorders through proper training and techniques is desirable, and many would agree that therapy is the most important treatment for vocal problems. Unfortunately, as Sundberg states, "The dispute among

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[109]Manuel Garcia, Hints on Singing, (New York, 1894, 1982), pp. 17-19 and editor's note, p. 18.

[110]Meribeth Bunch, Dynamics of the Singing Voice, (New York, 1982), p. 116.

[111]Ibid, pp. 113-116.

singing teachers and other voice experts as to what is the best method or therapy and what is the best vocal technique has gone on over the centuries, and probably there is little hope that the issue will be resolved in the near future. . ."[112] He goes on to say that although it is difficult to judge what is a good method or technique, objective measurements on voice characteristics should help; and even though one method probably could not suit all voice types or musical styles, he prefers a method which is in close agreement with physiology. Sundberg believes that it is easier for the majority of students to understand instructions that reflect what is actually happening within their bodies.[113] Perhaps Luchsinger and Arnold best summarize good vocal hygiene and preventive measures by stating that good vocal hygiene is based upon knowledge of the physiology and pathology of voice production; and two types of measures may be taken to avoid vocal disease: promotion of physical health and prevention of vocal misuse or overexertion.[114]

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[112]Johan Sundberg, The Science of the Singing Voice, (Dekalb, Illinois, 1987), p. 193.

[113]Ibid, p. 194.

[114]Richard Luchsinger, M.D. and Godfrey E. Arnold, M.D., Voice-Speech-Language, (Belmont, California, 1965), p. 156.

Vocal Exercise

The need for professional voice users to acquire precise control and athletic conditioning and endurance has encouraged the development of various exercises for the voice both as a training device and as therapy. Therapeutic exercise for the body is not a new concept, historians have traced its use from ancient times to the present,[115] and general theories and basic principles for therapeutic exercises have developed for its use. Vocal exercise also stems from earlier centuries as a beneficial activity for general body hygiene and good health,[116] and has developed as a training and therapy technique for the speaking/singing voice. Singing exercise as therapy for the voice is also not a new concept but has not been widely used for various voice disorders; nevertheless, sources do attest to the benefits of singing in relationship to vocal and general body health. For voice professionals to understand fully the principles and benefits of good vocal exercise, it is necessary for them to have knowledge of general exercise theories, the structure and function of the vocal folds and other parts of the larynx, the development and character of

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[115]Sidney Licht, "History," Therapeutic Exercises, ed. John V. Basmajian (Baltimore, 1978), p. 1.

[116]Gretchen Finney, "Medical Theories of Vocal Exercise and Health", Bulletin of the History of Medicine, Vol. XL, No. 5 (September 1966), pp. 395-396.

various exercise routines, and results from the exercises on the physiological and functional properties of the voice.

The goal of good vocal exercise might well follow the definition of general therapeutic exercise that Licht presents: "therapeutic exercise is motion of the body or its parts to relieve symptoms or to improve function."[117] Kottke defines therapeutic exercise as the prescription of bodily movement in order to correct impairment, improve musculoskeletal function, or maintain a state of well-being, and further states that it may vary from highly selected activities for specific muscles to general activities for restoring a patient's peak physical condition.[118] Specific exercises are active movements whose design seeks to restore function by strengthening particular muscle groups, mobilizing certain joints, or re-educating neuromuscular coordination. Colson and Collison, experts in progressive exercise therapy, believe that this type of exercise is of great value in the treatment of injuries and disorders of the locomotor system where certain muscular groups and joints are affected and the rest are comparatively normal. They state that all types of specific exercises must conform to three basic principles:

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[117]Licht, p. 1.

[118]Frederic J. Kottke, "Therapeutic Exercise," Handbook of Physical Medicine and Rehabilitation, ed. Frank Krusen, M.D., (Philadelphia, 1971), p. 385.

1. They must be performed in a smooth and rhythmical manner, so that they do not subject muscles and joints to sudden unexpected stresses and strains.
2. They must be based on sound starting positions.
3. They must provide smooth progression from the stage of extreme weakness to the stage of full use against the stresses of normal working conditions.

In addition, all exercises that aim to strengthen weak muscles should provide as wide a range of movement as possible.[119]

Writing about sports medicine, Allman agrees that effective exercise which builds strength and flexibility must include as wide a range of movement as possible, and further states that, "Prevention of injury is most likely when the muscles have been strengthened in every position and over full range of possible movement."[120] Rehabilitative exercises, on the other hand, should begin with little or no movement and progress to wider ranges of movement, just as the duration and intensity of the rehabilitative exercises will be adjusted to the relative condition of the muscles and joints in question. Allman further states that in the beginning phases of a rehabilitation program, it is important to teach effort-relaxation cycles so that the muscle does not remain

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[119]John H. C. Colson and Frank W. Collison, Progressive Exercise Therapy, (Boston, 1983), pp. 3-4.

[120]Allman, Fred L., "Exercise in Sports Medicine," Therapeutic Exercises, ed. John V. Basmajian (Baltimore, 1978), p. 456.

in a state of constant tension.[121] He believes that many exercises in each of the two exercise classifications in sports medicine, conditioning or rehabilitative, may be the same--the biggest difference being in the intensity of the exercise.[122] Knuttgen offers these principles for therapeutic and conditioning exercise:

> Physical fitness is not a general quality; specific capacities set limits on specific types of physical activity. In order to improve a particular physical performance, the specific capacities must be identified and stressed with appropriate exercise. The greater the level of appropriate stress, the greater the improvement of the level of fitness for a particular physical performance.[123]

He summarizes the benefit of appropriate exercise by stating that ". . .a simple exercise session of any intensity elicits physiological responses from people no matter what their level of physical training. . ."[124]

The benefits of therapeutic and conditioning exercise have been well established in fields such as medicine and sports and, to a certain extent, in the voice professions; however, sources in vocal fields seem to disagree about the benefits of various techniques and the extent to which

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[121]Ibid, p. 463.

[122]Ibid, p. 451.

[123]Howard G. Knuttgen, ed., Neuromuscular Mechanisms For Therapeutic and Conditioning Exercise, (Baltimore, 1976), p. 115.

[124]Ibid, p. 94.

exercise is beneficial to the voice. For example, Norman Punt, a physician, believes that no singing technique can strengthen the voice;[125] yet, for centuries singing techniques and exercises have sought to build a stronger as well as more beautiful voice;[126] and Perkins points out that Wagnerian tenors and sopranos, who are required to produce tones of extreme loudness at high pitches, logically should become hoarse within minutes. He says:

> Most of us do not achieve such volumes or pitches when we yell at football games, and you can observe for yourself how long you can survive vocally when performing at the top of your voice. Yet professional vocalists, whether singers or actors, not only survive but may conclude long performances vocally as strong as when they started.[127]

Perhaps, then, the voice <u>can</u> be conditioned, strengthened, and rehabilitated in much the same way as other parts of the body through technique and exercise.

A discussion of vocal fold structure and muscle function within the larynx lends credence to the above contention. The vocal folds have a layered structure and are intricately controlled by the laryngeal muscles, thus enabling humans to produce vast differences in pitch,

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[125]Norman A. Punt, <u>Journal of Laryngology and Otolaryngology</u>, Supp. No. 6, London, Invicta Press, July, 1983.

[126]Weldon Whitlock, <u>Bel Canto For The Twentieth Century</u>, (Champaign, Illinois, 1968), p. x.

[127]William H. Perkins, Ph.D., "Mechanisms of Vocal Abuse," <u>The Voice Foundation Seventh Symposium</u>, Part II (1978), p. 107.

intensity, and quality. Hirano classifies the five layers of the vocal fold (the epithelium, the three layers of the lamina propria, and the vocalis muscle) into three mechanical sections: the cover, consisting of the epithelium and the superficial layer of the lamina propria; the transition, consisting of the intermediate and deep layers of the lamina propria; and the body or vocalis muscle. He contends that this layered structure of the vocal folds is of great significance, in that each layer has a different mechanical property, the outer four layers are controlled passively, the innermost layer is regulated actively and passively, and almost all pathologies of the vocal folds originate from a specific layer.

Hirano explains the control of the vocal folds by describing the function of the five major intrinsic laryngeal muscles--the cricothyroid muscle, the vocalis muscle, the lateral and posterior cricoarytenoid muscles, and the interarytenoid muscle. When the cricothyroid muscle contracts, the vocal folds are brought into a paramedian position, the level of the vocal fold within the larynx is lowered, the entire vocal fold is stretched, elongated, and thinned, and all layers are passively stiffened. When the vocalis muscle is activated and stiffened, the vocal folds are adducted (closed), lowered, shortened, and thickened, and the outer cover and transition layers are passively slackened. The action of the lateral cricoarytenoid muscle

adducts and lowers the tip of the vocal process of the arytenoid cartilage thereby adducting, lowering, elongating, and thinning the vocal fold, whereas the posterior cricoarytenoid muscle abducts (opens) and elevates the tip of the vocal process thereby abducting and elevating the vocal fold. The interarytenoid muscle adducts the vocal fold mainly at the cartilaginous portion, thereby controlling the position of the vocal fold but not affecting significantly its mechanical property. The combined activity of all these muscles controls the vocal fold during phonation.[128] The intricate and complicated coordination necessary for such a process implies the need for conditioning and practice (and perhaps even strengthening) when the demands of the professional voice user are placed on the mechnanism. When physiological and/or functional disorders occur, electromyographic investigations show changes in the muscular actions,[129] thus indicating a need for muscle re-training or compensation where possible.

The voice professions must then decide which exercises and techniques will best fit the intricate muscular actions of the larynx. Most of the reviewed souces in athletic, medical, and therapeutic fields advocate warm-up exercises,

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[128]Minoru Hirano, M.D., Clinical Examination of Voice, (New York, 1981), p. 4-9.

[129]Ibid, pp. 17-22.

and some, such as Tucker, feel that the lack of proper warm-up procedures may contribute to vocal dysfunction in singers.[130] Sataloff also lists lack of warm-up and lack of exercise as ways to abuse the voice and guarantee a singer a short career.[131] Sundberg states that when many singers do not warm up, their voices will not function as readily as otherwise, and that poorly warmed-up voices are less durable than the appropriately warmed-up voice. Warm-up procedures differ greatly and, as Sundberg contends, the warm-up is a poorly understood process:

> What happens to the vocal folds during the warm-up? The vocal folds contain muscle tissues as a major component. As is the case with other muscles, the vocal folds depend on efficient blood circulation in order to retain good function and viscosity. It seems likely that good circulation is stimulated by an appropriate warm-up procedure. Other people who depend on perfect muscle function, like ballet dancers and athletes, tend to warm up their muscles in advance. This warming-up is realized by movements or massage. It is difficult to give massage directly to one's vocal folds, but perhaps the same effect is reached if we can use them for a gentle phonation instead. Let us hope that research will soon start to pay attention to this important but very poorly understood issue![132]

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[130]Harvey M. Tucker, M.D., The Larynx, (New York, 1987), p. 156.

[131]Robert T. Sataloff, M.D., "Ten Good Ways to Abuse Your Voice: A Singer's Guide to a Short Career (Part I)," The NATS Journal, Vol. 42, No. 1 (September/October 1985), pp. 23-24.

[132]Johan Sundberg, The Science of the Singing Voice, (Dekalb, Illinois, 1987), p. 193.

In addition to warm-up exercises, singers and other professional voice users often employ more vigorous exercises to train and condition the voice. One example of vigorous training and exercise for singers is found in the Italian school of singing, and a survey of the history of Italian techniques and exercises by this author[133] reveals that some voice teachers from the seventeenth to the twentieth centuries have employed a few of the same basic exercises. Earlier teachers such as Mancini (1777), Nava (1870?), Lamperti, F. (1875 or 1877), Lamperti, G. B. (1893), Garcia (1894), and Marchesi (about 1905) provided exercises to aid the student in blending the different vocal registers, acquiring flexibility and agility, mastering intensity levels, and improving breath control, articulation, and resonance. In the twentieth century, singing teachers such as Witherspoon (1925), Wilcox (1945), Vennard (1973), Lindquest (1971, 1983), and Coffin (1987) have developed and/or borrowed similar exercises to accomplish the same goals.

Because he developed a specific lesson design and practice routine which includes a set of exercises, Lindquest warrants further discussion. Born in 1891, Karl Albert Lindquest was educated in the public schools of

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[133]Barbara A. Mathis Thomas, A History of Instruction in "Bel Canto" Singing, a research study for MUED 5500, North Texas State University, Denton, Texas, 1984.

Chicago, studied violin as a child, and sang in church choirs. His voice teachers were Boroff, William C. Hall, Theodore Harrison, Herbert Witherspoon, Vilonat, Sidney Dietsch, William S. Brady, Joseph Hislop, and Ingegjart-Isene. Sometime during his career as "a successful concert-tenor with many orchestra and choral societies,"[134] Lindquest became associated with Vaudeville as Allan Rogers, and eventually changed his professional name to Allan Rogers Lindquest. In 1917 and 1918, Lindquest made some of the first recordings for Edison, and the length alone of his listing in Edison Re-Creations shows in part the esteem and respect paid him by his contemporaries:

> LINDQUEST, ALBERT, Tenor, RE-CREATIONS by
>
> This tenor, by birth and by training thoroughly American, has an enviable record of achievement. Discovered while a student at the University of Chicago, by the well known Bonci, he assiduously devoted himself to study of voice and music which has well equipped him for both concert and recital. A mere reference to his engagements tells how appealing must be his singing and how fine his musicianship. As soloist he has appeared with the Philadelphia, New York and Minneapolis Symphony Orchestras. With the last mentioned his performances total one hundred and seventy-five. The New York Oratorio Society has three times engaged him for such works as "Elijah" and many of the important choral societies outside of that city have recognized his prominence and featured him as their soloist. Through his own song recitals, the whole country has become enamored of his lovely voice,

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[134]Grove, Dictionary of Music and Musicians, American Supplement, (6th vol., 1920), p. 103.

> which appeals not only to the natural lover of music, but also to the trained and watchful artist.[135]

In addition to having a successful singing career, Lindquest taught singing and enjoyed a teaching career which spanned nearly six decades. In a paper he presented at a meeting of the American Academy of Teachers of Singing, Lindquest set forth his opinions of singing and teaching:

> I am reminded today of a statement made by a famous singer of the last generation. I refer to the fabulous baritone, Battistini, who at the age of 74, on his death-bed, said, "How I wish I had another life in which to further study the glorious art of singing. There is so much more to learn." That is exactly how I feel at the same age as that master singer.
>
> We are going to say that singing basicly is a gentle athletic exercise combined with an emotional state--an exalted feeling because of our urge to express.
>
> In my own experience in teaching, I have found that fine results come from working for functional freedom of the entire singing instrument. The fundamental laws regarding singing with functional freedom are based on the correct posture, freedom in breathing, freedom in primary vibration of the vocal cords, freedom from tension in the root of the tongue, freedom in articulation, all resulting in technical proficiency and vocal freedom.
>
> The famous Italian master, Lamperti, made a most interesting observation. He said, "Don't sing until you'd die if you didn't." The development of this desire to sing for the sheer joy of singing is the primal motivating factor and should be encouraged by teacher and student alike. The control of the voice consists in the release of the voice. The development of the voice as an instrument depends upon our willingness to call to our aid the spiritual and

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[135]Thomas A. Edison, Edison Re-Creations, (Orange, New Jersey, 1922), pp. 224-225.

> emotional stimuli of inspiration, joy, enthusiasm, and love. This mental and spiritual attitude is the wellspring from which all good singing stems.[136]

Technically, Lindquest combined the principles of the Italian school with those gained from the studio of a Swedish throat surgeon, professional singer, and voice teacher, G. W. Bratt,[137] whose studio produced Joseph Hislop, Ingebjart-Isene, Kirsten Flagstad, and Jussi Bjoerling. Lindquest conducted his voice lessons with these objectives governing the design and resultant exercises: separation and development of the vocal registers, coordination and blending of the registers, vowel clarity and modification, the "perfect" vocal attack, and flexibility. Students received instruction in body and facial posture, breathing techniques, relaxation, and exercises to help accomplish these goals. Some of his most frequently used exercises appear in musical notation on pp. 124-126 of the present discussion. Lindquest was quick to say that no one should attempt to learn a technique or exercise without proper instruction in its execution; however, a brief description and discussion of the exercises are included below:

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[136]Allan R. Lindquest, paper read at the meeting of March 11, 1974, by John Powell, American Academy of Teachers of Singing.

[137]G. W. Bratt, Talrostens Fysiologi, (Stockholm, 1908).

A. The warm-up "massage" (gentle stretching)

1. Yawn-sigh
2. Siren

B. Separation and blending of the registers

1. Coperto
2. Alleluia

C. Co-ordinating vocalises (for B and D)

1. Nng-ah
2. Nierri tu mi chiania bella
3. Ying, yang, yoong
4. Eh-oo-eh [e-u-e]

D. Vowel clarity and modification, attack, and flexibility

1. Eh [e] with alterations [ɛ , œ]
2. Ee [i] plus four vowels [e, a, o, u]
3. Steam engine
4. All vowels with alterations

E. Advanced exercises

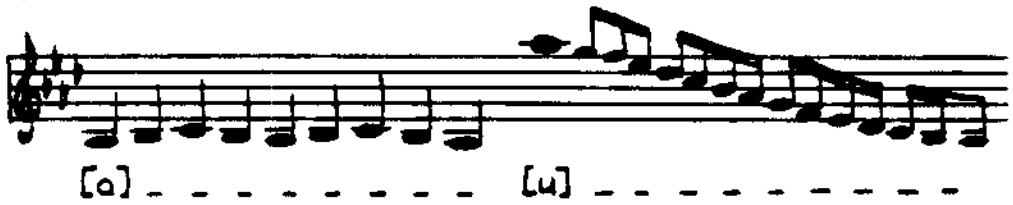
1. Flexibility
2. Great Scale
3. Messa di voce

Yawn-Sigh

Siren

Fig. 1. Lindquest Exercises: Yawn-Sigh, Siren

Coperto



Alleluia

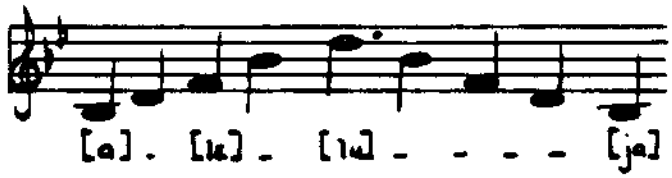
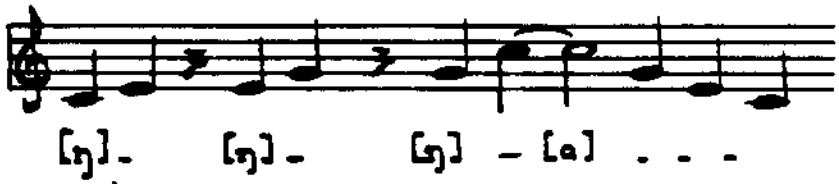


Fig. 2. Lindquest Exercises: Coperto, Alleluia

Nng-ah



Nierri tu mi
chiania bella

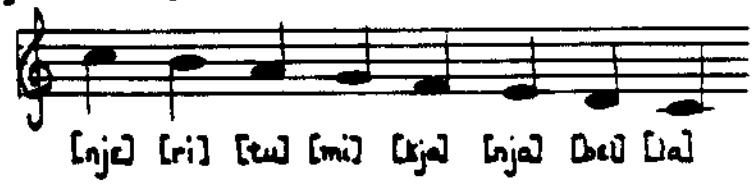
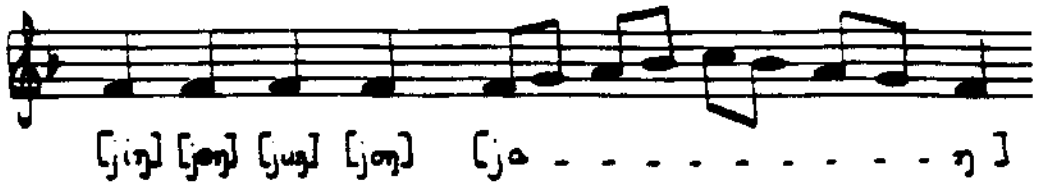


Fig. 3. Lindquest Exercises: Nng-ah,
Nierri tu mi chiania bella

Ying, yang, yoong



Eh-oo-eh

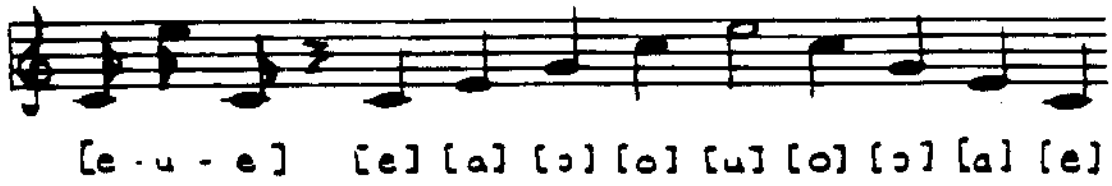
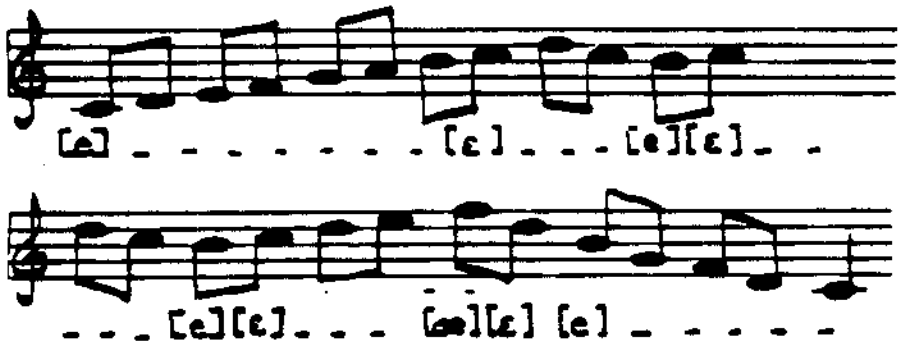
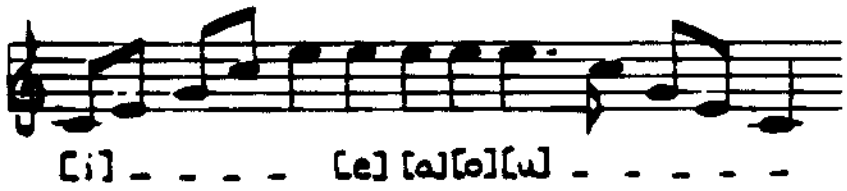


Fig. 4. Lindquest Exercises: Ying, yang, yoong; Eh-oo-eh

Eh



Ee + 4



Steam engine

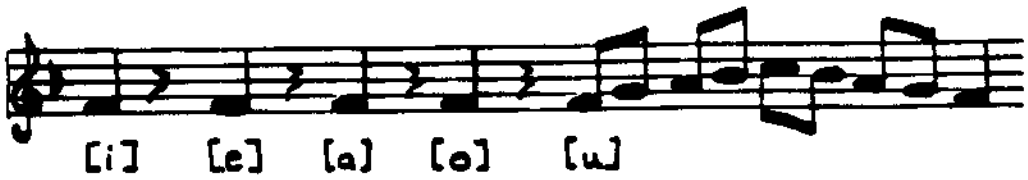


Fig. 5. Lindquest Exercises: Eh, Ee + 4, Steam engine

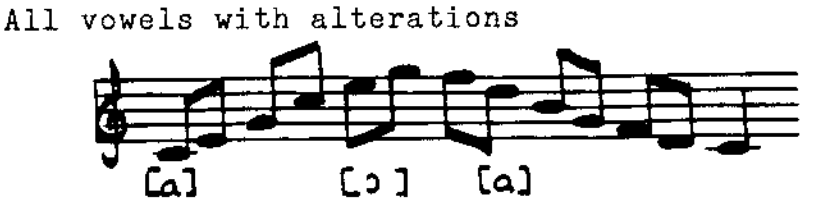


Fig. 6. Lindquest Exercises: All vowels with alterations

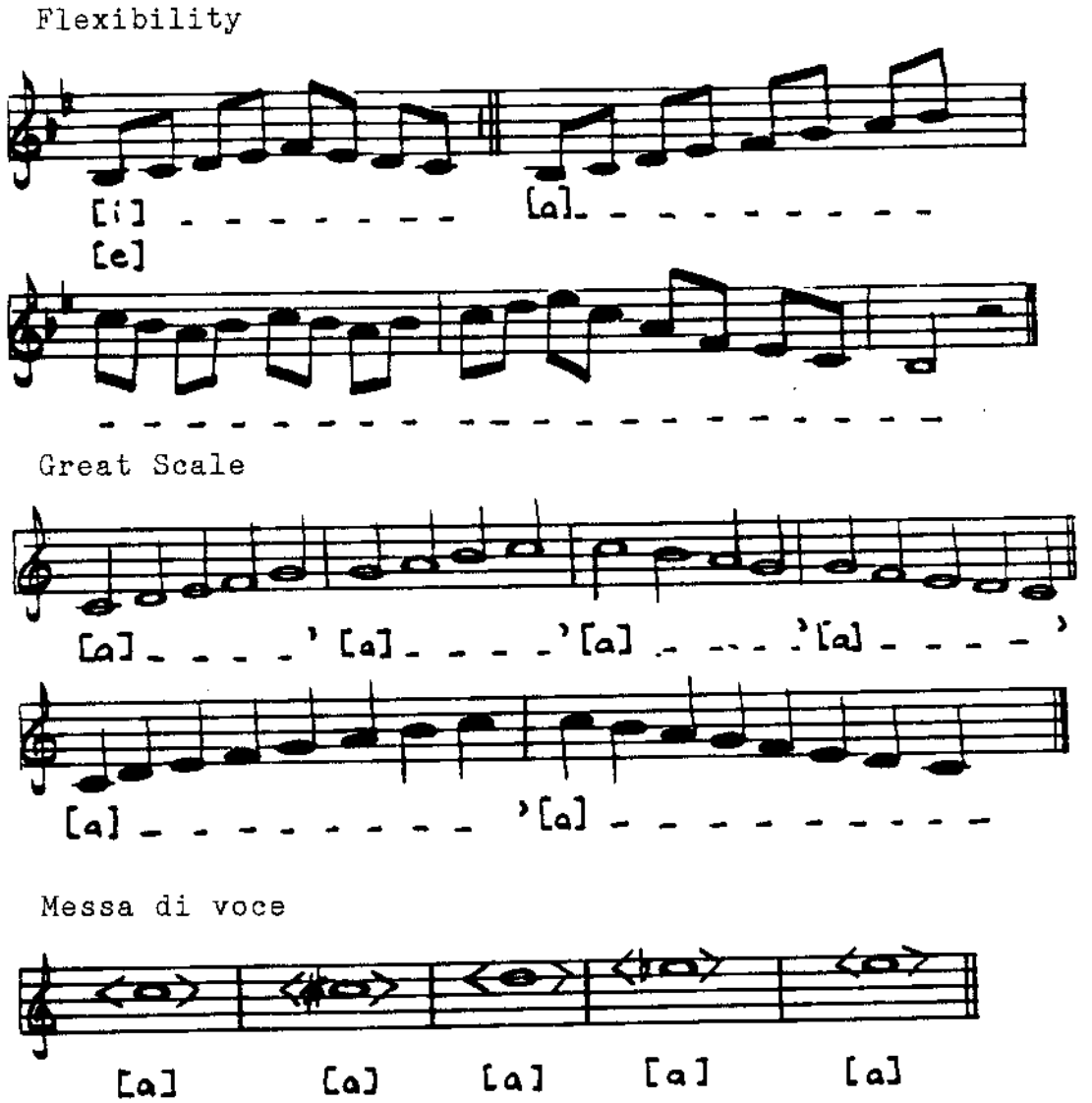


Fig. 7. Lindquest Exercises: Flexibility, Great Scale, Messa di voce

The gentle warm-up exercises prepare the voice much as warm-up procedures aid athletes: the muscles get a gentle stretching. The "coperto" exercise, through use of the two-octave skip and vowels which encourage register changes, enables the singer almost immediately (with proper instruction) to use pure heavy register ("chest") and light register ("falsetto" or "whistle"). This exercise evidently was devised by Wilcox[138] for use with male voices and adapted by Lindquest to use with all voices.[139] The "alleluia" vocalise encourages a blending of the registers, especially for the top note.

Some of the exercises accomplish more than one goal at a time and act as co-ordinating units. The "Nng" vocalise sets ground work for a good vocal attack and encourages "tone focus." Exercise C-4 separates the registers, then blends the registers, and automatically aids the singer in finding the proper vowel alternations (vowels are altered to aid resonance and control timbre in the upper range), a technique recommended by Garcia,[140] Coffin,[141] and other

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[138]John C. Wilcox, The Living Voice, (New York, 1945).

[139]Allan R. Lindquest, Taped lessons and interviews (1971, 1972, 1977, 1983).

[140]Manuel Garcia, Hints On Singing, (New York, 1894, 1982), p. 12.

[141]Berton Coffin, Coffin's Sound of Singing, 2nd ed., (Metuchen, New Jersey, 1987), Chapters 16 and 17.

singing teachers. Flexibility, proper vowel resonance, and vocal attack may be practiced by using the final vocalises listed under letter D. Exercise D-1 is done quickly, eventually aiding flexibility and the feeling of vowel alterations. Exercise D-2 encourages vowel clarity and strength. Exercise D-3 allows practice for a gentle but non-breathy vocal attack. Various singers and teaching studios have used Exercise D-4 for its value in teaching flexibility and vowel formation. Lindquest also taught more advanced exercises (Exercises E-1, E-2, E-3), such as the "messa di voce" and the "Great Scale" from the Italian school. In general, Lindquest seems to have combined a physiological basis (perhaps in part gained from the Swedish throat surgeon), successful methods from the Italian school (Garcia, Lamperti, Marchesi, Witherspoon), and concepts of colleagues such as Wilcox with his own innovative ideas, explanations, and exercises. No doubt sixty years teaching experience provided ample time for trial and adjustments.[142]

Other vocal experts have used the same or similar exercises to develop, train, or rehabilitate the voice. The yawn-sigh exercise appears often in many of the reviewed sources. It seems to enhance relaxation while gently massaging the mechanism and producing a better voice

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[142]Allan R. Lindquest, Taped lessons and interviews (1971, 1972, 1977, 1983).

quality. Speech therapists, such as Boone[143] and Case,[144] use the yawn-sigh with their patients, and singing teachers advocate its use as well. Vennard[145] recommended the exercise as one of his two key vocalises, both of which he discussed with and may have borrowed from Lindquest,[146] one of Vennard's teacher/colleagues. Currently singing teachers, such as Tavener,[147] are advocating the use of the yawn-sigh, although its execution may differ from teacher to teacher.

Coffin, also a student and colleague of Lindquest, describes for female voices a singing exercise similar to Lindquest's yawn-sigh and coperto exercises:

> . . .sing "little oo" in Whistle Register on a downward glide to an /AH/ on the lowest note, which may be either two octaves or a twelfth below. The "little oo" is first gained by a pencil sharpener sized opening of the lips and with a thought of nasality. Later the sound can be gained by a certain opening in the back of the throat as heard by children on the playground.[148]

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[143]Daniel R. Boone, The Voice and Voice Therapy, (Englewood Cliffs, New Jersey, 1983), pp. 180-182.

[144]James L. Case, Ph.D., Clinical Management of Voice Disorders, (Rockville, Maryland, 1984), p. 188.

[145]William Vennard, Singing the Mechanism and the Technic, (New York, 1967), p. 219.

[146]Lindquest, interview, 1977.

[147]"Point Counterpoint," The NATS Bulletin, Vol 41, No. 2 (November/December 1984), p. 28.

[148]Berton Coffin, Coffin's Sounds of Singing, 2nd ed., (Metuchen, New Jersey, 1987), p. 121.

The exercise proceeds to include singing half steps up the scale on the [u] vowel and thus, according to Coffin, establishes vocal cord action for female head voice. Coffin gives for male voices a similar exercise which begins on the "little oo" in falsetto register and establishes male mixed voice or "covered voice," a term used by Lindquest to describe his "coperto" exercise.[149] Coffin recommends exercises similar to other Lindquest exercises, such as the "siren," the "Nng-ah," and vowel and flexibility vocalises from the Italian school.[150]

Proctor also advocates use of exercises similar to those from the Italian school. Examples he gives are an exercise to aid singers in breath control (a prolonged crescendo and diminuendo on a tone sustained as long as possible), a flexibility scale, and scales which work over the "break" or register change in the voice.[151] Proctor recommends that singers practice vowel exercises to achieve optimal vocal resonance, a process which consists of the appropriate shaping of the supraglottic airway. He states that during these exercises some emphasis may be placed on lowering the entire mandible and keeping the larynx low in

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[149]Ibid, p. 131.

[150]Ibid, Chapters 12-14.

[151]Donald F. Proctor, Breathing, Speech, and Song, (New York, 1980), pp. 109-110.

the neck.[152] Proctor does not seem to advocate some of the previously mentioned exercises which give practice in extending the range and singing notes in the upper range. As he explains:

> I stress here that these scales which we have been discussing need not, and indeed should not, extend to the highest notes of the voice. . . .One of the first questions I ask a patient who is in trouble with the voice is whether or not he practices his high tones. If he does so excessively this is very likely the source of trouble.[153]

McKinney also advocates more conservative exercises which begin in mid-range and work downward by half steps, or arpeggiated exercises which start fairly low in the range and extend upward, but first limited to an interval of a fifth and eventually extending to a twelfth. He recommends that each warm-up routine include general bending and stretching body exercises and exercises designed to release tension in the shoulders, neck, and throat. McKinney states that although singing does not require great muscle strength, it does require muscle coordination, and that the muscles needed for singing may be trained effectively through a planned exercise program.[154] Further, Sataloff believes that vocal practice is essential to the singer,

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[152]Ibid, p. 114.

[153]Ibid, pp. 111, 114.

[154]James C. McKinney, The Diagnosis and Correction of Vocal Faults, (Nashville, Tennessee, 1982), pp. 182-183.

just as physical exercise is to the athlete, and that "proper vocal practice incorporates scales and specific exercises designed to maintain and develop the vocal apparatus."[155]

All professional voice users, whether singers, actors, or speakers, should choose techniques and an exercise program which best suit their own voices and changing vocal conditions. They may limit their choice of techniques to those they have found successful in their own fields, or they may wish to try exercises and vocalises from different voice professions and different schools of thought. In his study of singing techniques from English, French, German, and Italian schools, Miller concludes that some systems for producing vocal sound are more efficient from the standpoint of physical function than are others. Singers, as well as those from other vocal professions, might wish to heed his advice to young singers:

> The young singer, European, North or South American, or Asiatic, should look for a technique which will equip him or her to sing expressively without violating physical function; such a technique should avoid the over-specialized vocal production which often results from the aesthetic demands of regional schools of singing. A wise singer will look for that internationalization of technique which closely

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[155]Robert T. Sataloff, M.D., "Professional Singers: The Science and Art of Clinical Care," American Journal of Otolaryngology, Vol. 2, No. 3 (August, 1981), p. 255.

> corresponds to the best elements of the historical tradition of the Italian School.[156]

If the essentials of the Italian system are the preferred technique, a singer will choose, according to Klein, specific ideas and exercises to master breathing, resonance, vowel formation and attack, the sostenuto, the legato, the portamento, the "messa di voce," and agility.[157]

Perhaps these same techniques and exercises are beneficial not only to singers but to other voices as well, including those with disorders. Luchsinger and Arnold claim that singing produces increased ventilation of the blood in the lungs, helps build resistance to respiratory disease, and benefits the larynx by helping its muscles, ligaments, and joints retain their elasticity and strength for a longer time.[158] Sataloff reports that singing lessons greatly help nonsingers with voice problems, often expedite therapy, and appear to improve the result in some patients.[159] In writing about voice therapy for benign lesions of the vocal cords, Brodnitz says that vocal exercises have to be

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[156]Richard Miller, English, French, German and Italian Techniques of Singing, (Metuchen, New Jersey, 1987), p. 206.

[157]Herman Klein, The Bel Canto: With particular reference to the singing of Mozart, (London, 1923), pp. 20-34.

[158]Richard Luchsinger, M.D. and Godfrey E. Arnold, M.D., Voice-Speech-Language, (Belmont, California, 1965), p. 156.

[159]Robert T. Sataloff, M.D., "The Professional Voice: Part III. Common Diagnoses and Treatments," Journal of Voice, Vol. 1, No. 3 (September 1987), pp. 288-289.

planned with an understanding of the basic facts of voice production, and that any improvement of resonator and activator control will improve vocal cord function.[160] Speech therapists report success with singing exercises for their patients and provide samples of various types of vocalises.[161] Generally, therapists recommend singing exercises to improve laryngeal strength rather than to relieve hyperfunction or muscle tension dysphonia and any resultant pathology such as polyps or nodules. Sometimes the recommendation for these voice disorders (as discussed earlier in the chapter) is partial voice rest or reduction of vocal use in conjunction with other therapy techniques; therefore, an important issue presents itself: would singing exercises or vocalises designed to train, strengthen, and condition the voice put undue strain on an already hyperfunctional and/or physiologically abnormal

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[160]Freidrich S. Brodnitz, "Vocal Rehabilitation in Benign Lesions Of The Vocal Cords," Journal of Speech and Hearing Disorders, Vol. 23, No. 1 (February, 1958), p. 115.

[161]David Blair McClosky, "General Techniques And Specific Procedures For Certain Voice Problems," Approaches to Vocal Rehabilitation, ed. Morton Cooper, and Marcia Harting Cooper, (Springfield, 1977), p. 144; John P. Moncur, Modifying Vocal Behavior, (New York, 1974), pp. 200-208; Joseph C. Stemple, Clinical Voice Pathology, (Columbus, Ohio, 1984), p. 131, citing J. Barnes, "Voice Therapy," a paper presented at the Southwestern Ohio Speech and Hearing Association, Cincinnati, Ohio, Fall, 1977.

voice, or would the benefits of exercise for a healthy larynx hold true for the abnormal voice?

Singers and other professional voice users often use exercises to train and condition the voice, and therapists may recommend specific exercises to help restore an abnormal voice. Selecting appropriate exercise is not always easy for the voice user, the teacher, the therapist, or the physician; and sometimes the selection of exercises as well as technique becomes a trial-and-error procedure. It would seem wise to select techniques and exercises which have been successful in some areas, apply them to various vocal conditions, and test the results with modern technology.

CHAPTER IV

METHODOLOGY

Design

This study uses an individual subject research design to provide data concerning the effects of certain conditions on the behavior of individual subjects. Silverman states that the simplest design of this type would be one that permits relevant "before and after" measures or pre-therapy and post-therapy measures to be made.[1] The effects of specific vocal exercises on these individual vocal conditions are assessed and reported: muscle tension dysphonia, nodules, recurrent laryngeal nerve paralysis, and iatrogenic dysphonia.

Subjects

Subjects for this research project come from the private practice of physicians in Houston and Denton, Texas. They are chosen according to the following criteria: the attending physician's belief that the vocal instruction and exercise program might be helpful to the patient; the patient's willingness to participate in the program; and the patient's ability to match and reproduce musical pitch.

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[1]Franklin H. Silverman, Research Design & Evaluation in Speech-Language Pathology and Audiology, 2nd ed., (Englewood Cliffs, New Jersey, 1985), p. 61.

Subjects are selected solely on the basis of health conditions and with no regard to age, gender, or ethnic background. Each patient is given a verbal description of the research program and asked if he or she would like to participate and be included anonymously in the research results.

Diagnostic Equipment and Technique

Flexible fiberoptic video nasolaryngoscopy and a diagnostic document are used to assess vocal conditions before, during (when applicable), and after vocal instruction and the exercise program. Equipment includes fiberscope (flexible fiberoptic laryngoscope or nasolaryngoscope), light source, television camera and monitor, and video cassette recorder. A list of the exact equipment in each physician's office appears in Appendix A. Video tapes (See Appendix B) are made over a period of time and distributed to observers for assessment.

The researcher has developed a diagnostic procedure (Variables for the Diagnostic Procedure and Illustrations for Functional Variable No. 5, pp. 143-147) which are used to assess organic, functional, and perceptual variables. Rating scales similar to those used by many speech pathologists (as discussed in Chapter Two) have been chosen to represent normal and abnormal conditions. Observers rate the general condition of the laryngeal area and the

condition of the right and left vocal folds as organic variables. They are asked to note any abnormalities in the epiglottis or the arytenoid cartilages and any evidence of dehydration, inflammation, mucous strands, edema, or leukoplakia anywhere in the laryngeal area. The rating scale for this first variable includes 0 for normal and +1, +2, and +3 to indicate the severity of any abnormality. Organic variables two and three assess the conditions of the right and left vocal folds by a rating scale which uses 0 to indicate a normal condition, +1 for general edema, mucous strands or build-up, and/or inflammation, +2 for acute nodule (soft, red), and +3 for chronic nodule (hard, white); -1, -2, -3 to indicate the severity of a condition involving removal of cord tissue (surgery for nodules, stripping, etc.); and -1 to indicate median paralysis, -2 for paramedian paralysis, and -3 for intermediate paralysis. Functional variables are vocal cord adduction and six variables which some experts believe indicate hyperfunctional activity (excess tension) in the larynx. Observers rate vocal cord adduction (cord closure) both visually and perceptually by using 0 to indicate a normal closure; +1, +2, +3 for different levels of hypertension; and -1, -2, -3 for grades of hypotension.

Six functional variables, identified by Van L. Lawrence, represent normal or hyperfunctional conditions

within the larynx. He explains his thesis for determining excess tension during phonation:

> When one looks at the laryngeal posture in quiet, tidal breathing, that represents the image which requires the least possible expenditure of laryngeal muscular energy. Changing the laryngeal posture from that rest position implies muscle use. The more muscle use, the more effort. Effort conservation in phonation is much of what classical voice training is all about. . . . Phonation posture for the larynx should thus resemble that for quiet breathing as closely as is reasonable if one is to be effective, efficient, and not profligate in terms of muscle exertional expenditure.[2]

Speech experts, such as Danioff[3] and Zemlin[4], imply their concurrence with the above thesis. When giving advice to singers, other voice experts also imply their agreement, as does Proctor, who says that "optimum performance in speech and song results from delicate control of the breathing and vocal mechanisms, not from the expenditure of great force."[5] If rest position (quiet tidal breathing) for the larynx represents the least effort, then a posture similar to rest position would seem to indicate least

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[2]Van L. Lawrence, M.D., "Habitual Pitch of Speaking Voice and the Singer," The NATS Journal, Vol. 44, No. 1 (September/October 1987), p. 26.

[3]Raymond Daniloff, Gordon Schuckers and Lawrence Reth, The Physiology of Speech and Hearing, (Englewood Cliffs, New Jersey, 1980), pp. 175, 188, 204.

[4]Willard R. Zemlin, Speech and Hearing Science: Anatomy and Physiology, (Englewood Cliffs, New Jersey, 1968), pp. 181-188.

[5]Donald F. Proctor, Breathing, Speech, and Song, (New York, 1980), p. 158.

possible effort during phonation. Allowances for extreme pitch change in singing also seem logical, as vocal cords must become longer for high pitch and shorter for low pitch;[6] however, Lawrence believes that, even with pitch variations and artistic changes in color and tone, basic laryngeal posture should remain the same if optimum performance occurs. As a laryngologist observing the phonating larynx through fiberoptic laryngoscope, he wants to see the following laryngeal posture: the aryepiglottic complex in a pointed Gothic arch; most of the length and width of the vocal folds visible; the vestibular folds (false folds) inactive; the hypopharynx (the area surrounding the larynx) standing away from the endolaryngeal structure and not constricted from the side or front-to-back in order to provide resonance space; and a minimal amount of vertical laryngeal movement during sound production.[7] Using similar criteria for assessing laryngeal posture, Cleveland reports success in a case study involving a singer with nodules. The laryngeal posture in this particular case was thought to be "normal" during singing but showed

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[6]Raymond Daniloff, Gordon Schuckers and Lawrence Reth, The Physiology of Speech and Hearing, (Englewood Cliffs, New Jersey, 1980), p. 204.

[7]Lawrence, p. 26.

"constriction" during speech, and with correction of speech habits the nodular condition was resolved.[8]

With Lawrence's criteria as its thesis, this study evaluates similar functional variables: arytenoid cartilage closure angle, length of vocal folds visible during phonation, action of the ventricular (false) folds, position of epiglottis, laryngeal introitus, and pharyngeal circumference diameters. Proper function of these areas of the larynx are evidently important in preventing laryngeal disease, for David Brewer, lists these among others as early symptoms and signs: posterior position of epiglottis on phonation, arytenoids to base of epiglottis on phonation, and approximation of false cords (first degree--anterior thirds, second degree--anterior two thirds, third degree--full length).[9] Luchsinger and Arnold also attest to the action of the ventricular folds, the descent of the epiglottis, and constriction of the laryngeal vestibule during hyperkinetic dysphonia.[10] Acoustically speaking, Ingo Titze says, "Bright sounds and muffled sounds can be

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[8]Thomas F. Cleveland, "Viewing the Voice: 'A Picture is Worth a Thousand Words'," The NATS Journal, Vol. 45, No. 2 (November/December 1988), pp. 31-32.

[9]David Brewer, M.D., "Early Symptoms and Signs of Laryngeal Disease," Upstate Medical Center, Department of Otolaryngology and Communication Sciences, S.U.N.Y., 1983.

[10]Richard Luchsinger, M.D. and Godfrey E. Arnold, Voice-Speech-Language, (Belmont, California, 1965), p. 304.

obtained on a continuum by adjusting the ventricular folds, the epiglottis, and other structures with in the larynx."[11] Accepting that the functional action of these areas may be important to sound and health, observers rate them using a scale from 0 to indicate normal function to +1, +2, +3 to represent excessive muscular tension. Illustrations (pp. 146-147) provide aid for the assessment of arytenoid cartilage closure angle, and additional descriptions of the different levels of hyperfunction suggest judgments in length and width of the vocal folds which should be visible during phonation.

Perceptual variables include pitch range, intensity range, breath volume, and flexibility. Since these areas are usually affected by laryngeal disease and dysfunction (as discussed in Chapter Two), the observers are asked to give a subjective judgment concerning "normal expectation." The rating scale for each of the four perceptual variables includes 0 for normal; -1, -2, or -3 to indicate a below normal expectation; and +1, +2, or +3 for an above normal expectation.

Variables for the diagnostic procedure are listed below (pp. 143-145):

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[11]Ingo Titze, "Voice Qualities Governed by the Velum and the Epiglottis," The NATS Journal, Vol. 42, No. 3 (January/February 1986), p. 25.

Variables for the Diagnostic Procedure

ORGANIC VARIABLES

1. General condition of laryngeal area

epiglottis
arytenoid cartilages
evidence of:
dehydration
inflammation
mucous stranding
edema
leukoplakia

Rating scale 0 normal
severity of condition
+1
+2
+3

2. Condition of right vocal fold

Rating scale 0 normal
+1 general edema, mucous strands or build-up, or inflammation
+2 acute nodule (soft, red)
+3 chronic nodule (hard, white)

removal of cord tissue, stripping, etc.:
severity of condition
-1
-2
-3

-1 median paralysis
-2 paramedian paralysis
-3 intermediate paralysis

3. Condition of left vocal fold

Use same rating scale as for right fold.

FUNCTIONAL VARIABLES

4. Cord closure (visual and perceptual)

Rating scale
- 0 normal
- hypertension: severity of condition
  - +1
  - +2
  - +3 (occasional spasticity)
- hypotension: severity of condition
  - -1 (breathy)
  - -2 (whisper)
  - -3 (occasional aphonia)

5. Arytenoid cartilage closure angle

Rating scale
- 0 normal
- hyperfunction (Refer to illustrations for each rating, pp. 146-147)
- +1
- +2
- +3

6. Length of vocal folds visible during phonation

Rating scale
- 0 normal
- hyperfunction:
- +1 2/3 in view
- +2 1/2 in view
- +3 1/3 or less in view

7. Width of vocal folds visible during phonation: directly related to action of the ventricular (false) folds

Rating scale
- 0 normal (full width of folds in view; little or no action of false folds)
- +1 anterior third covered by false folds
- +2 anterior 2/3 covered
- +3 full length covered

8. Position of epiglottis

Rating scale 0 normal (against tongue base)
hyperfunction (overhang indicating tension):
severity of condition
+1
+2
+3

9. Laryngeal introitus

Rating scale 0 normal space
hyperfunction (constriction indicating tension):
severity of condition
+1
+2
+3

10. Pharyngeal circumference diameters

Use same rating scale as for laryngeal introitus.

PERCEPTUAL VARIABLES

11. Pitch range

Rating scale 0 normal expectation
below normal expectation
-1
-2
-3
above normal expection
+1
+2
+3

12. Intensity range

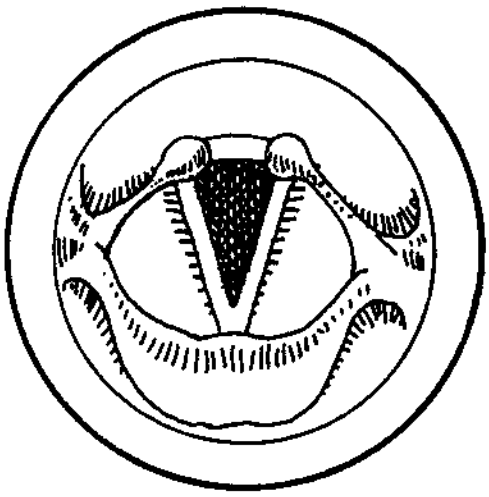
Use same rating scale as for pitch range.

13. Breath volume

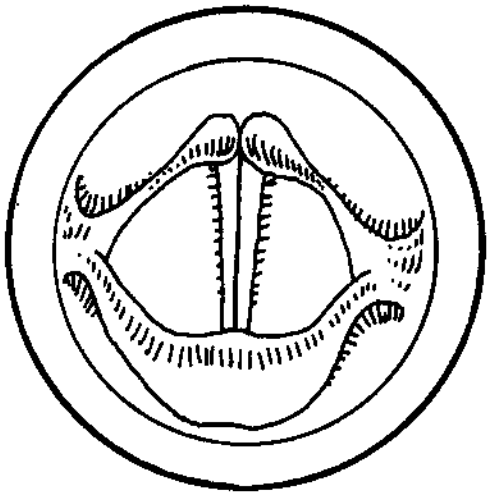
Use same rating scale as for pitch range.

14. Flexibility

Use same rating scale as for pitch range.



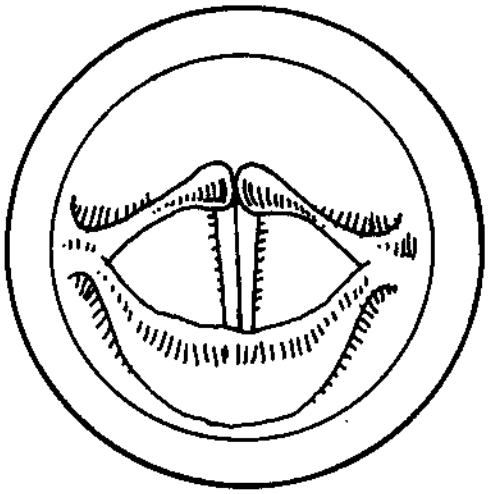
"Rest" Position
(quiet tidal breathing)



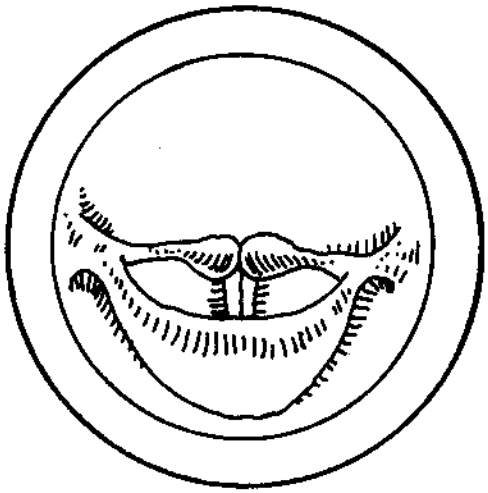
Ideal Phonatory Posture
(for mid-range voice)

Rating: Normal 0

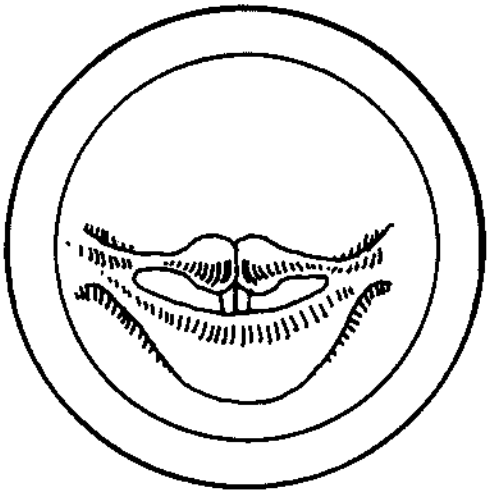
Fig. 8. Functional Variable No. 5: "Rest" Position and Ideal Phonatory Posture



Rating: +1



Rating: +2



Rating: +3

Fig. 9. Functional Variable No. 5: Hyperfunction

Exercise Program

For this study, the researcher has selected seven vocal exercises from the routine designed by Allan Lindquest. The reasons for this choice include Lindquest's connections with the Bratt studio and the Italian school of technique, his use of specific exercises to en ance or develop the basic areas of vocal technique; the use of some of the exercises by other vocal experts as discussed in Chapter Three; and the researcher's familiarity and experience with the exercises. Since Lindquest insists that explanation and instruction are necessary before attempting any of the exercises,[12] each student/patient receives individual instruction concerning the actual execution of the exercises. Pitch and vowel adjustments are made to suit individual voices and conditions. For example, one might be advised to begin Exercise B.1. (p. 149) on G-flat or A-natural instead of A-flat as indicated on the exercise sheet (p. 150), or the patient might not be able to execute a two-octave leap at first, and would be instructed to sing an octave and a fifth or less to perform Exercise B.1. In another situation, a patient might be able to sing an extension of Exercise C.2. to include more vowels and a wider pitch range. Comfortable range, voice classification,

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[12]Allan R. Lindquest, Taped lessons and interviews (1971, 1972, 1977, 1983).

physiological condition, and type of voice disorder are all factors in adjustments for the exercise routine; however, the basic format is the same for all participants and includes the following routine:

A. The warm-up "massage" (gentle stretching)
    1. Yawn-sigh
    2. Siren
B. Separation and blending of the registers
    1. Coperto
    2. Alleluia
C. Tone focus, attack, vowel clarity & modification, flexibility
    1. Nng-ah
    2. Flexibility exercise
    3. Nierri tu mi chiania bella

Musical notation for one segment of each of the above exercises appears on p. 150. As patients progress and vocal conditions improve, they may use more complicated exercises from those listed and discussed on pp. 123-128.

Vocal instruction for the student/patients also includes recommendations for body and facial posture and breathing techniques. The researcher/instructor may discuss body alignment,[13] and give suggestions concerning positions

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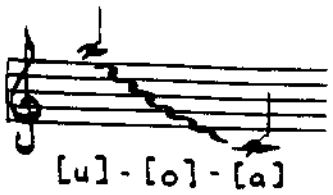
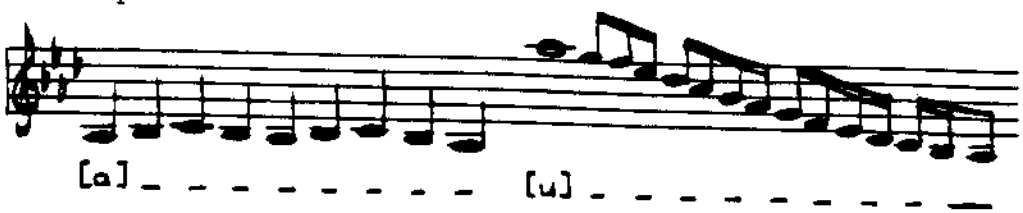
[13]Meribeth Bunch, Dynamics of the Singing Voice, (New York, 1982), p. 19.

1. Yawn-Sigh

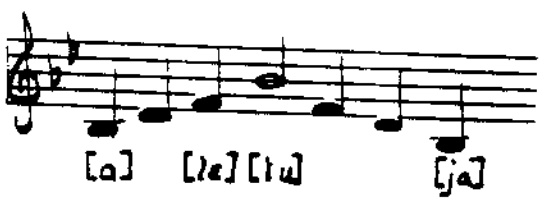


2. Siren

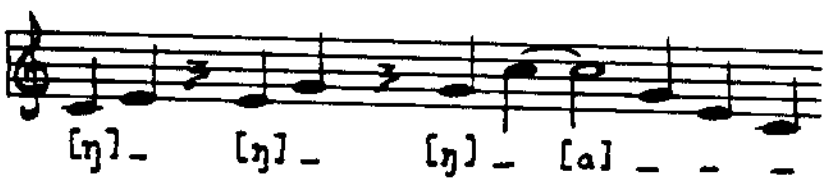
3. Coperto



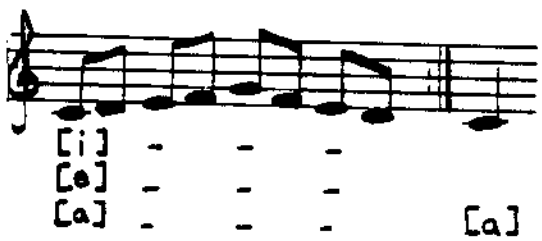
4. Alleluia



5. Nng-ah



6. Flexibility exercise



7. Nierri tu mi chiania bella

Fig. 10. Selected Exercise Routine

of tongue, jaw, lips, and teeth.[14] Instruction for breathing technique includes simple explanations of diaphragmatic, abdominal, and intercostal muscle interactions and hints for taking deeper breaths and prolonging exhalation. Before beginning each segment of each exercise, student/patients are encouraged to take a long, slow breath through the nose while maintaining an open throat, a breathing technique taught by Lindquest.[15]

The researcher recommends that each student/patient do his or her exercise routine at least once each day before voice use. If time allows and the individual feels that the vocalises are especially helpful in any given situation, the routine may be done twice a day, or any individual vocalise may be sung more than once or twice a day. The researcher encourages the participants to practice and perform the exercise routine in front of a mirror to check body and facial posture and to help concentrate on breathing habits. Although the researcher is aware of the benefits of limited voice use, absence of aggravating factors, reduction of stressful situations, and other factors discussed in Chapter

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[14]Meribeth Bunch, Dynamics of the Singing Voice, (New York, 1982), pp. 103-109; Robert T. Sataloff, M.D., "The Professional Voice: Part II. Physical Examination," Journal of Voice, Vol. 1, No. 2 (June 1987), p. 198; Allan R. Lindquest, Taped lessons and interviews (1971, 1972, 1977, 1983).

[15]Allan R. Lindquest, Taped lessons and interviews (1971, 1972, 1977, 1983).

Three, for this study no attempt is made to alter the patient's normal life patterns, except in the following manner: the patient is asked to perform the exercise routine at least once each day; the patient is asked to use the instruction received for the exercise routine as much as possible in daily voice use; and the patient is encouraged to recall and use the physical sensations and habits established by the exercises in other voice usage.

Case Study Format and Results

The format for reporting each individual case includes a brief history, description of the voice disorder, therapy procedure and instruction, and "before" and "after" conditions. The case history asks for basic information such as age, gender, occupation, and voice usage. The description of the voice disorder includes past vocal health and treatment as well as the present problem. The patients are encouraged to keep a record of therapy procedure, including which exercises they use, how often and how long they practice, and if and when they notice any changes in their voice. Conditions before, during, and after the exercise program are assessed and reported in the following manner:

1. The patient's assessment of perceptual or sensoral conditions before beginning therapy and any positive or negative changes during and/or after the exercise program.

These assessments include technical aspects of speech and/or singing such as breath control, pitch range, volume, flexibility, and tone quality.

2. A description of the vocal conditions given in the attending physician's medical charts. This description includes information about the patient's voice before, during, and after the exercise program.

3. Results from the diagnostic document designed for this study. The observers' evaluations of organic, functional, and perceptual variables for each video segment are placed on separate diagnostic rating sheets. (See Appendix B for sample rating sheet.)

Three physicians act as observers of the video tapings. One is an attending physician (of patients included in the study), and the other two are independent physicians who practice in Abilene, Texas, and San Diego, California. Credentials for all three physician/observers indicate the value and dependability their expertise brings to this study. All have M.D. degrees from Baylor College of Medicine, specialization in otolaryngology, and certification from the American Board of Otolaryngology. These physicians belong to professional societies, have published numerous articles, and have provided lectures and presentations for their fellow colleagues in medicine and professionals in other fields. Two hold, or have held, academic appointments in prestigious medical schools. All

are familiar with fiberoptic techniques and have experience in this area of diagnosis. Total experience in medical practice ranges from thirteen years to thirty-six years. The physician/observers received instructions for using the diagostic rating sheets (Appendix B), rating sheets for each video segment, pages 137-147 of this study, and a video tape entitled, "Suggested Criteria for Fiberoptic Diagnosis of Laryngeal Hyperfunction" by Van L. Lawrence. The researcher has prepared, edited, and sent video segments (Appendix B) of patient behavior to the physician/observers. The researcher included in the video segments the full examination as taped by the attending physician with the following exceptions: remarks by patient or physician which could identify the patient; explanations of the procedure or instructions to the patient; multiple trials of the same maneuver where all are similar; and technical problems such as fogging of the lense, or gagging or swallowing by the patient. The physician/observers are not told which video segments represent conditions "before" or "after" exercise, what conditions have been diagnosed, or what treatment techniques have been used. They make judgments solely on the conditions and behavior visible on each video tape segment.

This study reports interobserver reliability which, according to a study by Robinson and Weir,[16] should show a high degree of interobserver agreement. In Robinson and Weir's examination of sixty-three patients following microlaryngeal surgery for benign lesions, two examiners agreed in rating the voice on a scale of 1 to 4 in eighty percent of cases, and in rating indirect laryngoscopy findings on a scale of 1 to 5 in seventy-six percent of cases. In this study, estimates of interobserver reliability were calculated by using a Generalizability Coefficient as discussed by Crocker and Algina.[17] An estimation of ρ_{i*}^2, the coefficient, is accomplished by using the results of the two-factor ANOVA. This estimation is carried out through formula $\rho_{i*}^2 = \frac{\sigma_p^2}{\sigma_p^2 + \sigma_{e/n}^2}$. The figure σ_p^2 represents the variance of the subjects' universe or total scores, and the figure σ_e^2/n represents the averaged residual or error variance among the three observers. In cases where residual error was inflated due to interaction effects, as determined by the Tukey Test, the quantity σ_e^2 was adjusted by partitioning out the interaction effects. The initial and final ratings for each

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[16]P. M. Robinson and A. M. Weir, "Interobserver variability in assessment of the larynx," Clinical Otolaryngology, (December, 1987), pp. 413-415.

[17]Linda Crocker and James Algina, Introduction To Classical and Modern Test Theory, (New York, 1986), p. 167.

variable for all subjects were included in calculations of reliability, which appear below:

Variable	First Video Segment	Final Video Segment
Organic Variable 1 (general laryngeal condition)	.9915	.9999
Organic Variable 2 (right vocal fold)	.9936	.9818
Organic Variable 3 (left vocal fold)	.9779	.9635
Functional Variable 4 (cord closure)	.8746	.9082
Functional Variable 5 (arytenoid cartilage closure angle)	.9712	.9460
Functional Variable 6 (length vocal folds visible)	.9547	.9544
Functional Variable 7 (width vocal folds visible)	.9588	.8150
Functional Variable 8 (position of epiglottis)	.9708	.9999
Functional Variable 9 (laryngeal introitus)	.9267	.9417
Functional Variable 10 (pharyngeal circumference diameters)	.8977	.8920
Perceptual Variable 11 (pitch range)	.9425	.9020
Perceptual Variable 12 (intensity range)	.9821	.9811
Perceptual Variable 13 (breath volume)	.9602	.9999
Perceptual Variable 14 (flexibility)	.9852	.9812

The researcher concludes from these findings that the diagnostic ratings given by the physician/observers are reliable and may be used to assess specific conditions as described and discussed in the study.

CHAPTER V

CASE STUDIES

Case Study No. 1 (Patient A)

Patient A, a male 67-year-old retired university professor, began the exercise program with a long history of voice problems. He reported having vocal difficulties such as fatigue and hoarseness often during his speaking/lecturing career, and his medical chart revealed two different attempts at voice therapy during a ten-year period. Patient A stated that he did well for a while after the first sessions in speech therapy, but then began to experience difficulties again. He saw an ear, nose, and throat doctor who recommended that he take a refresher course with a speech therapist. At this time, the ENT doctor diagnosed edema and thickening of the vocal cords. The speech pathologist diagnosed a restricted pitch range, diplophonia and less control at the upper and lower ends of that range, coarseness and lack of control with increased loudness, reduced duration on lower pitches, tension in the neck, habitual throat clearing, and a habitual speaking pitch which seemed lower than optimum. The speech pathologist recommended two to three visits a week to the speech clinic, with monitoring of throat clearing and coughing, and an attempt to use a more mid-pitch range

rather than the lower pitch ranges. The researcher assumes that this therapy was again helpful; however, within three years, his medical charts once again began to reveal vocal problems such as "scratchy throat," "contact ulcer," and "laryngeal dysfunction."

Patient A began the exercise program by attending instructional sessions about once a month and then more frequently, about once a week, toward the end of his five-month participation. He reported doing the exercise routine about three times a week for about ten minutes, sometimes omitting some of the exercises. Patient A's evaluation of the exercise program is as follows:

> After doing the routine, my throat feels more relaxed. It seems to help raise the pitch of the speaking voice. I used to clear my throat more often. The voice seems less raspy and easier to control. I know they would really help if they were done more regularly, but being busy and forgetting to do them are problems.

Four months after the completion of Patient A's participation, he voluntarily called to offer his appreciation of the program and to state his belief that the exercises "really help when I remember to do them."

Patient A's clinical charts describe his condition before and after the exercise therapy. Before Patient A began the therapy. the chart reads: vibratory margins of vocal folds irregular in outline, laryngeal posture squeezed, false cords meeting, some hyperkeratosis on both folds. After Patient A's participation, his medical chart

reads: sixty percent better, swelling less pronounced on left fold, laryngeal posture good while doing the exercise routine, less hyperkeratosis.

Results from the diagnostic sheets completed by the three physician/observers indicate improvement in Patient A after participating in the exercise program. All three observers diagnosed the organic variables (laryngeal condition and right and left vocal folds) as being improved by one scale step. Functional Variable 4 (cord closure) is rated as still 0 (normal) by two observers and improving from +1 (hypertensive) to normal by the other physician. Functional Variables 5, 6, and 7 (arytenoid cartilage closure angle and length and width of vocal folds visible) are rated as improved by one scale step by all observers. The three observers rate functional Variable 8 (position of epiglottis) the same (normal) before and after exercise. Two of the observers assess functional Variables 9 and 10 (laryngeal introitus and pharyngeal diameters) as improving by one scale step; the third observer rates them as normal. According to two observers, perceptual Variable 11 (pitch range) improves by one scale step; while the other observer rates the improvement as two scale steps. Perceptual Variable 12 (intensity range) receives a one-step improvement rating by two observers and the same (normal) rating by the third. All three physicians assess Variable 13 (breath volume) as still normal, while Variable 14

(flexibility) receives these three ratings: the same (normal), a one scale step improvement, and a two scale step improvement. In summary, the three physician/observers generally agree that Patient A improved in organic, functional, and perceptual aspects.

Case Study No. 2 (Patient B)

Patient B, a male 56-year-old music teacher, began participation in the exercise program after experiencing chronic vocal problems for most of his professional career. His career of thirty-four years has involved teaching choral music at high school and university levels, directing music as a part-time or full-time minister of church music, and teaching elementary music education at the university level, which is his present position. Patient B states that he found it imperative to hold more than one position at a time throughout most of his career. Teaching choirs with limited music reading skills called for the use of rote methods and extensive use of the voice. Through the years, the vocal apparatus took much abuse, which resulted in chronic hoarseness and the development of extremely poor vocal habits. Patient B feels that the culmination of these circumstances came about six years ago when an ear, nose, and throat specialist diagnosed ulcers on his vocal cords and advised as little speaking and singing as possible in order to avoid more serious consequences.

Patient B reports that he used the exercise program on a regular basis. Rarely missing, except perhaps on weekends, he vocalized faithfully each day by going through the entire routine of exercises. He states that he often used some of the exercises several times during a particularly stressful or demanding day. Patient B states his personal evaluation of the instruction and exercise program:

> The results of using the vocalises and medical analysis by use of laryngoscope and video tape have been extremely beneficial. Within a period of four or five months, the health of the vocal cords, and the ease of tonal production improved dramatically. The ulcers have not recurred, and a freedom from tension in both the singing and speaking voice is now evident to me.

Clinical charts describe Patient B's conditions before, during, and after the exercise program. Before the patient's exercise therapy, the attending physician reports evidence of dehydration, redness on the laryngeal surface of the epiglottis, but no inflammation or edema on the arytenoid cartilages. The patient shows marked evidence of muscle hyperfunction during phonation. This is characterized by constriction of both pharyngeal diameters even when the patient is not phonating. In speech phonation, the larynx becomes almost invisible, and only approximately one quarter of the length of the vocal folds can be visualized. The epiglottis and tongue base almost approximate the posterior pharyngeal wall, but this does

improve when he elevates the pitch of his speaking voice. As to the phonation of spoken vowels and sung vowels, the laryngeal posture during singing is considerably more physiologic than is the posture during simple speech maneuvers. After about ten months of the patient's exercise therapy, the physician reports that the patient continues to demonstrate vocal hyperfunction in speech and to a lesser degree with singing voice. The vocal hyperfunction consists of hyperactivity in the tongue base with persistance of an almost total closing off of the oral pharynx and hypopharynx by the tongue base when the patient speaks the vowels "a" and "i." His posture during singing is somewhat better than this but is still not ideal. On stroboscopy he demonstrates persisting thick heavy mucoid secretion on the left vocal fold near the posterior commissure, and, as a consequence, the majority of his vocal fold vibratory cycle is not synchronous. When he ascends into falsetto or "head" register, the vibration becomes symmetrical and the thick secretion moves off the vibratory portion of the vocal folds themselves. The physician reports no visible difference in his status from the previous recording. Fifteen months later the physician reports that the edges of Patient B's vocal folds, particularly of the left fold, look cleaner. During phonation, the folds appear to be meeting a lot more cleanly, and stroboscoby reveals good symmetrical closure of the vibrating folds. Posture of the larynx has

improved during singing and, to a lesser degree, while speaking, and is particularly good while doing the exercises.

Ratings from the three physician/observers indicate eventual improvement in Patient B's condition. After ten months on the exercise program, the organic condition is essentially the same, although one physician indicates a two-step improvement in general laryngeal condition (the other observers' ratings remaining "normal"). A different physician/observer indicates a one-step improvement (to normal) in the condition of both vocal folds, but the other two rate both folds as remaining +1 on the abnormal scale. Some ratings indicate slight improvement in functional variables; however, as some ratings indicate a worse condition, the researcher assumes that the functional conditions remain essentially the same after ten months of exercise. Perceptual variables, on the other hand, appear improved. Two observers assess pitch range (Variable 11) as one step better, and one observer indicates a three-step improvement. Intensity range (Variable 12) receives the same rating (-2) from one observer but one- and three-step improvement from the other two. Two observers rate the breath volume (Variable 13) as the same (or normal), and the other shows a one-step improvement rating. One observer rates flexibility (Variable 14) the same (normal), but one physician indicates a three-step improvement (from -2 to

+1) and the other a one-step improvement (from -2 to -1). Assessments of the final tape segment 3, after fifteen months of exercise, indicate improvement in organic, functional, and perceptual aspects. When compared to the "before exercise and training" tape segment 1, ratings for tape segment 3 show improvement in all variables. All physician/observers give the organic variables a normal rating. Two observers give functional Variables 4-8 a normal rating; while one indicates a +1 hyperfunctional rating for Variables 5-6. Variable 9 (laryngeal introitus) receives these ratings: 0 (remaining normal); +2 (remaining +2 hyperfunctional); and +1 (improving from +3 hyperfunctional). Variable 10 receives a normal rating from one observer (improving from +1); and +1 from the other two (improving from +2). All three physician/observers rate all perceptual variables as normal or better than normal (improving in seven ratings from -2). Assessments from the three tape segments indicate that Patient B's condition improved to normal in organic and perceptual aspects. Although improvement occurred in functional variables, some aspects of hyperfunction remain.

Case Study No. 3 (Patient C)

Patient C, a female 30-year-old professional "rock" singer, began the exercise program while continuing her heavy voice usage and with a condition described as nodular

swellings on the vocal folds. Her medical records, which span a period of ten years, indicate a history of vocal difficulties such as laryngitis, hyperkeratosis, allergy, and pharyngitis, as well as nodules and problems with her singing voice. During this time, Patient C complained of being unable to sing from F (above middle C) to C (above middle C), a pitch range where much of her repertoire lay. The attending physician recommended vocal instruction and therapy, after which he noted some improvement in the patient's condition. During the next four years, the patient returned with similar problems culminating with soft nodular swellings. Voice usage at this time included three to four hours a day of rehearsal and several hours of performance at night. At one time during this period, the medical chart reveals that the patient admitted using the voice in rehearsal and performance as much as thirteen hours a day.

Patient C began the exercise therapy by using the first three exercises (yawn-sign, siren, and coperto) within a limited pitch range and then gradually working toward the complete routine. The first four weeks she did the first exercise for five minutes in the morning and then did exercises one, two, and three for ten minutes before work five days a week. During the second month, she again used the first exercise for five minutes in the morning and used exercises one, two, three, four (alleluia) and six

(flexibility exercises) fifteen minutes before work. During the last month of therapy, Patient C used exercises one and two for five to ten minutes each morning. Then, fifteen minutes before work, she went through the entire routine. The patient describes her opinion about the benefits of the exercise:

> Notes which "cracked" or would not come out (G, A, and B above middle C) are returning. Control is returning to do such things as hold notes longer and to do vocal "hot licks." I am more aware of my speaking voice, and the pitch of my speaking voice is higher now.

Patient C's medical charts, over a period of ten years, reveal her tendency to develop nodular swellings. The swelling sometimes would appear more pronounced on the left fold and at other times on the right. Examinations two years and one year before beginning the exercise therapy revealed pre-nodular swelling. At the time of this study, the patient's examination indicated a situation closer to a true nodular fibrosis. With mirror exam, there was a very strong impression of nodularity which diminished somewhat under the nasolaryngoscope as recorded on video. Her medical chart for this examination reads: nodular swelling, larger on right vocal fold; incomplete glottal closure with air gaps anterior and posterior to nodular swellings producing breathy singing tone and raspy speech; inefficient phonation. After three months of the patient's exercise therapy, the attending physician reports:

> She is examined again today with the nasolaryngoscope, and it can be seen that comparing today's view with that in (three months previously) that she has cleared her vocal fold on the left side, and on the right her nodule or polyp is about one/third less in size. Her air gap, and resulting breathiness, is about half of what it had been earlier. I think she is clearly on the right track, will ask her to continue with what she has been doing. I would like to see her again in about two months, and I think that should take care of the problem.

The physician/observers rate Patient C before and after the exercise program. Two assess Organic Variable 1 (laryngeal condition) as still normal after exercise, but the other observer rates the condition as improved from +1 to normal. The condition of the right vocal fold (Variable 2) receives a +3 rating from all three physicians before exercise, indicating a chronic nodule. After exercise two observers rate the right vocal fold with a +1, a two step improvement, but the third observer still gives a +3 rating. The left vocal fold (Variable 3), which receives +1, +3, and +2 assessments before exercise, gains 0, +1, and +3 ratings after exercise. Two observers rate functional Variable 4 (cord closure) as the same after exercise with -2 and 0 assessments both times; however, the third observer rates the condition as normal and then -1. Functional Variables 5 (arytenoid cartilage closure), 6 (length of vocal folds visible), and 9 (laryngeal introitus) remain essentially the same after exercise, although one-step improvement is perhaps indicated. The three observers disagree on Variable 7 (width of vocal folds visible): +1 to 0 indicating

improvement, 0 to 0, remaining normal, and 0 to +1 suggesting slightly more hyperfunction. Variable 8 (position of epiglottis) remains normal after exercise. Two observers rate Variable 10 (pharyngeal diameters) as normal after exercise, one suggesting one-step improvement and the other indicating no change; however, the other observer rates Variable 10 as three steps worse, from 0 to +3. One observer was unable to assess perceptual variables on the first segment, but the other two physicians indicate that improvement occurred in these areas. They rated pitch range (Variable 11) as normal after exercise, one indicating one-step improvement; intensity range (Variable 12) as -1, one indicating improvement; breath volume (Variable 13) as normal, one suggesting a two-step improvement, the other a one-step improvement; and flexibility (Variable 14) as 0, a two-step improvement, and -1, the same rating as before exercise. In summary, two of the physician/observers suggest that improvement occurred in organic and perceptual variables. Slight improvement may have occurred in some of the functional variables.

Case Study No. 4 (Patient D)

Patient D, a female 24-year-old university student and library employee, volunteered for the exercise program with a paralyzed vocal fold and resulting problems with her speaking and singing voice. Patient D visited her physician

after four months earlier having experienced a case of the flu, during which she completely lost her voice for a week. She still had not regained full use of her voice, as her speaking voice lacked volume, and she lacked control of breath and tone while attempting to sing.

Patient D participated in the exercise program for eight weeks, during which she reported high motivation to practice after fearing she could do nothing but accept the loss. For the first four weeks, she began the day with the first two exercises (yawn-sigh and siren). At lunch break she quickly went through the exercise routine and then again with more concentration during the evening. The first practice times were short, as she tired quickly and found better results with shorter sessions done more often. After the fourth week, as more exercises were added to her routine, as well as songs, she gradually shifted to longer practice sessions of about twenty minutes each. She continued to do the first two exercises several times during each day. Patient D comments about her progress:

> During the last few weeks I found that I didn't have to work as much to get results. I cut back the practice time to roughly four times a week, with some of the exercises thrown in at odd times. My voice was stronger so I could work longer and more consistently. I started really enjoying making noise again and would find myself experimenting making sounds just to hear them. Other people commented that they could hear a difference in my speaking voice, which of course was very encouraging. I've begun singing in my church choir again. I've also had a couple of opportunities to sing a solo.

A phone call to Patient D, three months after completing her study, indicated that she was continuing to use the exercise routine. She stated that if she missed as many as three consecutive days, she noticed a difference in her voice. She reported that her upper range had developed so that she now had a higher range than before the paralysis. The low range still seemed less clear and strong, but she had noticed improvement in this area during the last three weeks. Patient D indicated that she was still trying to apply the sensations acquired while singing to her speaking voice.

Medical reports for Patient D indicate changes in her condition after she began the exercise program, although no changes were apparent during three office visits before that time. Upon first examining the patient, the physician reported her condition and recommended treatment. The chart reads: has had problems with a hoarsenes ever since she had the flu; lost her singing voice; very difficult exam, unable to see the vocal cords very well because she squeezed so hard with the false cords; on video, able to see that left vocal cord is moving beautifully but the right is not; has a paresis or paralysis of the right vocal cord; will try Medrol for a week; may need intensive speech therapy. Two subsequent visits within the same month revealed no change in the condition; and all testing, such as thyroid studies, chest x-ray, and CAT Scan of head and neck, proved normal.

Just before beginning the patient's exercise program, the attending physician stated Patient D's condition as follows: paralysis of the right vocal cord; weak, breathy quality; hypertension. On the office chart, the patient listed her complaint as "hoarseness; can't talk loudly and can't sing." After four weeks of exercise thearpy, Patient D began to show improvement in sound, with a less breathy phonation, wider pitch range, and more volume. The physician described her condition as improved, although she still demonstrated symptoms of hyperfunction in the laryngeal posture. Patient D stated that she noticed improvement in volume and endurance. After four more weeks of the patient's exercise, the attending physician commented about her "tremendous improvement in voice quality and vocal cord movement" and pronounced her condition as normal, with two functioning vocal folds, clear quality, and normal laryngeal posture when singing.

Results from the diagnostic sheets completed by the three physician/observers indicate concurrence with the attending physician's diagnoses. Before exercise, Patient D received +1, 0, and 0 for Variable 1 (laryngeal condition); 0 ratings for the left vocal fold (Variable 3); and -1, -2, -3 ratings for the right vocal fold (Variable 2). After four weeks of exercise, videotape segment 2 reveals no change in the condition of either vocal fold, but all observers rate the laryngeal condition as normal. After

four more weeks of exercise, the final rating sheets all list Variables 1 and 3 as still normal. One observer rates the right vocal fold (Variable 2) as now normal; one is unable to assess the condition; and the other still rates the fold as -2, but writes in the margin; "returning function on right side? neural recovery?" Functional Variable 4 (cord closure) receives a -1 rating from all observers in segment 1, gains a one-step improvement to normal from two observers in segment 2, and moves to 0 (normal) from all observers in segment 3. In general, functional Variables 5-10 receive an average +1 or +2 hyperfunctional rating in segment 1, improve in segment 2, and receive normal ratings in the final segment. One observer does rate Variables 6 and 7 (length and width of folds visible) as +1 in the final segment, signifying one- and two-step improvement from the first tape segment. Average ratings for the perceptual variables moved from -2 to -1 in the first tape segment to 0 (normal) from all observers in the final segment. This improvement seems particularly significant, as the first ratings were in three instances as poor as -3. Results from the diagnostic rating sheets for Patient D suggest significant improvement in organic, functional, and perceptual variables.

Case Study No. 5 (Patient E)

Patient E, a fifty-eight-year-old housewife and singer, began the exercise program with a paralyzed vocal fold and resulting problems with her singing voice. Two years and five months previously, she apparently had suffered severe tracheitis and bronchitis which resulted in total loss of voice and difficulty in swallowing. After about ten days, the voice began to recover, eventually allowing her to speak but without any efficiency. Four months later, Patient E reported to the present attending physician for a second opinion regarding a diagnosis of the paralyzed vocal fold. The physician confirmed the diagnosis of a totally immobile left vocal fold and observed a flicker of movement involving the left arytenoid cartilage. The patient agreed to a short-term course of Cortico steroid but, upon returning later in the month, revealed no flicker of movement of the arytenoid. The physician determined that the appearance of movement had, in fact, been the impact response of the right side closing against the left. The speaking voice did sound stronger, more audible, and clearer as a result of increasing hyperfunction of the normal right side. Two months later the patient returned with complaints about the degree of voice she had: weak speaking voice and inability to sing. At this time, she began seeing a speech therapist who successfully treated tension and poor posture in the neck area and hyperfunction in the speaking voice. At

various times during the next two years, the physician would occasionally see indications that normal function might be returning; however, at the time Patient E began the exercise program, she retained her paralyzed left fold and complained of having no endurance in her speaking voice. Although she had been a soprano soloist before the paralysis, she had begun to sing in her church choir as an alto with limited range, breathiness, and uncontrollable vibrato.

Upon beginning the exercise routine, Patient E reported that the first two exercises (yawn-sigh and siren) would often come out only as a "squeak." Some days nothing would come out upon first try in the morning but would be better upon the second or third attempt later in the day. Eventually, when actual singing tone could be produced, she concentrated on correcting some facial tension, a tendency for the tone to "short out," and undesirable vibrato in the tone. Within six weeks, the patient could actually do the full exercise routine, which she performed each day and sometimes twice a day. She began to apply the vocal progress gained in exercise to solo repertoire. Patient E, who kept a diary, comments about her progress:

> Aug. 3---Back to the Dr. Met (researcher) who gave me some exercises.
> Aug. 10---(Researcher) is so pleased with tones I'm producing and is quite sure I'll be singing soprano again.
> Oct. 12---(Researcher) so encouraging; says I will sing solos again.

Nov. 9---Voice lesson was great, voice so clear. Speech therapist was quite impressed and had no idea who was singing so well. Dr. also excited and would like to work up my case for a seminar.
Dec. 11---Sang two solos at party. Was scared to death. First time in almost three years.
Jan. 4---Did a lot of scope work: vocal cord still paralyzed but everything around it works great. (Physician) cannot understand how in the world the voice is developing so well.
Feb. 1---Good voice lesson. The vibrato (excessive) is gone. Don't know why, also getting a brighter tone.
Mar. 18---Sang a solo in church. Went quite well.
Apr. 19---Sang "Pie Jesu" from Faure's "Requiem." Went well. Have been so pleased at the stamina through the long, extra rehearsals. The next goal is to sing in July for a national convention in front of 20,000 people. All this, in just one year. Another plus is the speaking voice is much stronger. At the beginning, I could not speak to my husband in another room. Still have to be very careful to keep voice pitched low and not talk too loudly in general conversation.

Clinical charts for Patient E describe her vocal conditions immediately before and after the exercise program. Her condition before is described as paralysis of left vocal fold with breathy vocal quality and uneven vibrato. After ten months of the patient's exercise, the physician describes her condition as follows: paralysis of vocal fold remains unchanged; singing voice is excellent even not considering patient's age and unilateral cord paralysis.

The physician/observers rate the changes in Patient E's vocal condition during ten months of exercise. Before the program began, Variables 1 and 2 look normal to two

observers, but one physician notes a +1 condition in the general laryngeal area and on the right vocal fold. Two observers assess the left vocal fold as -2 or having paramedian paralysis, while the other rates it a -1 but writes in the margin: "can't see well." Ratings for Variable 4 (cord closure) are -1, -1, and 0. All three observers give a +2 to Variable 5 (arytenoid closure angle), and two observers also rate Variable 6 (length of folds visible) as +2, while the other gives Variable 6 a +1. One observer cannot assess Variable 7 (width of folds visible), and the other two give ratings of 0 and +1. One physician rates Variables 8 (position of epiglottis), 9 (laryngeal introitus), and 10 (pharyngeal diameters) as +3 indicating hyperfunction in these areas; one other physician concurs by giving +2 ratings in Variables 8 and 9 but a 0 (normal) rating for Variable 10, which receives a +1 from the third physician, who rates Variables 8 and 9 with 0 and +1 respectively. Tape segments 2, 3, and 4 show improvememt taking place in all areas except Variables 2 and 3. The left vocal fold (Variable 3) remains paralyzed and receives consistent ratings from all three observers. The right vocal fold, which compensates for the left, receives a normal rating from two observers and a +1 from the third. The final tape segment taken after ten months of exercise suggests improvement to normal in all areas, with the exception of the paralyzed vocal fold. Two observers rate

this variable as -1, while the other marks "cannot assess" and writes in the margin: "motion?" Two physicians give a 0 or normal rating to the other organic variables and all functional and perceptual variables. The third observer indicates with a +1 remaining hyperfunction in Variables 5-10 but gives a normal rating to perceptual variables.

Several follow-up contacts within a period of four years reveal that Patient E continues to use the exercise routine and is still performing as a soloist. Her attending physician, through use of stroboscopy, pronounces the left vocal cord paralyzed; laryngeal posture normal when singing; speaking voice efficient; and singing voice excellent.

Case Study No. 6 (Patient F)

Patient F, a female 25-year-old professional "country-western" singer, volunteered for the exercise therapy with iatrogenic complications, allergy complaints, and a demanding work schedule. Four years previously, during her first visit to the attending physician, she spoke of a vocal cord nodule or polyp which had been stripped surgically and resulted in a voice which was worse than before the surgery. She also stated at this time that she had been on allergy testing and inhalant treatment since age seven. During this first visit, the physician described her speaking voice as coarse, harsh, and characterized by multiple leaks in the frequency spectrum. Upon learning

that Patient F planned to begin singing in a cocktail lounge six nights a week for four hours a night, the physician remarked, "To me it is a minor miracle that with a speaking voice as hoarse as hers she could even audition." Her indirect laryngoscopy revealed a virtual absence of vibratory or apparently vibratory tissue on the vocal folds; and although the cords were symmetrical, they scarcely met at all even on extreme efforts. Her phonation was not improved by twisting her head to the right or to the left nor by the physician's artificially "squeezing" the folds together. After trying an injectable steroid and moisturizer, the physician diagnosed her laryngeal status as essentially unchanged. He believed that, as a consequence of the removal of excess tissue from the vibratory margin of the vocal fold, the patient would have a more or less permanent air escape and that she probably would not have an excellent quality of voice. A conferring physician agreed with the diagnosis, stating that he did not think her problem was allergic, but that she had some moderate stiffness to both vocal folds, as well as a poor approximation of the posterior part of the vocal apparatus. He asked her to see a speech therapist and voice instructor but did not "hold out a lot of hope for her." Evidently, after instruction and therapy, Patient F was able to sing professionally even with her condition, but she returned four years later after experiencing extreme

problems of hoarseness. When examined before beginning the exercise program, she was singing five nights a week for five hours with about four solid hours of singing. She was unable or unwilling to stop her job temporarily for vocal rest. She stated that she used her mid-range voice a lot, and that since most of her songs had a wide range, she was having great difficulty in singing them.

Patient F participated in the exercise program for six months, during which she kept a daily record of her exercise and work schedule. She reported doing her exercise routine (Exercises 1-6) six days a week for about twenty minutes a day. On the days she had rehearsal (usually for two to three hours), she used some or all of the exercises before rehearsal, as well as before work, which involved four hours a night, six days a week. Four weeks after beginning the exercise program, Patient F reported that she noticed improvement in the feeling of her voice, that the exercises were becoming easier to do, and that her pitch range seemed to be increasing. After five months of exercise the patient comments:

> I can now do songs I was never able to sing before. I have a wider range and clearer tone. I can hold notes longer.

Clinical charts reveal Patient F's vocal condition before and six months after beginning the exercise therapy. Before the patient's exercise, the chart reads: history of vocal polypbectomy and resulting hoarser voice due to scar

tissue; vocal fold edema. After six months of exercise, the attending physician describes her progress as a "dramatic improvement" and further observes "good laryngeal posture in singing; would like to see further improvement in speaking voice."

The physician/observers evaluate Patient F's vocal conditions as recorded on videotape before and after using the exercise program. They rate Variable 1 (laryngeal condition) as normal before and after exercise. Variable 2 (right vocal fold) receives -2, -1, and +1 ratings, and Variable 3 (left vocal fold) receives -1, -1, and +1 ratings. After exercise, the +1 ratings for Variables 2 and 3 become 0 or normal and the other ratings remain the same. The ratings of +2, -2, and -1 for Variable 4 (cord closure) indicate a situation of inefficient closure coupled with hyperfunctional effort. In the second tape segment (after exercise), the ratings for Variable 4 are +1, a one-step improvement in hyperfunction, -1, a one-step improvement in closure, and +1, moving from inefficient closure to hyperfunction. In the first tape segment, one physician rates functional Variables 5-9 with a +1, another rates them 0 or normal, while the third rates Variable 5 as +1, Variable 6 as +2, Variable 7 as 0, Variable 9 as +2, and is unable to assess Variable 8. After exercise, Variable 5 (arytenoid closure angle), Variable 8 (position of epiglottis), and Variable 9 (laryngeal introitus) receive

normal ratings from all observers. Variable 6 (length of folds visible), Variable 7 (width of folds visible), and Variable 10 (pharyngeal diameters) get a normal rating from two observers and a +1 from one observer. Perceptual ratings before exercise average two steps below normal expectation. According to the physician/observers, exercise brings about a one-step improvement in perceptual variables. In general, ratings for Patient F indicate no change in organic conditions and a one-step improvement in functional and perceptual variables.

Case Study No. 7 (Patient G)

Patient G, a female 39-year-old vocal student, began the exercise program with a past history of laryngitis, vocal problems, and iatrogenic complications. During her first visit to the attending physician, she reported past problems with her voice for some years and related that another doctor had recommended "stripping" the vocal folds (due to their excessive thickness) to improve her singing voice. Following this surgery, Patient G stated that her voice had been much worse and that it would not return even after trying to force the sound, as recommended by the surgeon. Upon examination, the present attending physician diagnosed her as a virtually aphonic patient with an extremely breathy quality and hyperfunctional activity within the larynx. He referred Patient G to a speech

therapist, who evaluated her condition as hypertensive aphonic vocal quality; extreme clavicular and laryngeal tension; and tense, clavicular breath support. The speech therapist recommended therapy which would promote true cord rather than false cord phonation, facilitate general and specific relaxation, and stabilize optimum pitch and focus. After nine months of speech therapy, Patient G's voice quality and functional activity had improved. At this time hyperfunctional activity was still evident in the singing voice and, as the patient was still disturbed about the quality and range of her voice, she volunteered for the exercise program.

Patient G's condition required that she begin the exercises on a very limited basis concerning vocal endurance, pitch range, and flexibility; however, toward the end of her five-month participation, she had progressed to attempting the full exercise routine. At first she vocalized only four or five notes but gradually extended her range to include the exercises as written. She limited her practice time to short workouts of ten minutes or less two to three times a day, and then extended her practice to longer sessions. Patient G comments on her progress:

> When Dr. (attending physician) recommended that I work with (researcher), I was somewhat dubious because I still had very little voice. At the beginning of my therapy my voice was very raspy and hoarse and had a range of approximately four notes, A below middle C to D or E above.

> I learned very rapidly that if I ran through the exercises the first thing in the morning, there was a noticeable improvement in my speaking voice, and my family frequently commented on it. My speaking voice continued to grow stronger.
>
> Although my range did not seem to increase rapidly, the tones of the notes I could sing became considerably stronger and prettier. I learned that if I performed the first two exercises when I was hoarse, my voice would clear up. This was partially from teaching me to raise the pitch of my speaking voice.

Clinical charts for Patient G describe her vocal conditions before and after the exercise program. Two months before she began the exercise program, her chart provides this information: laryngeal dysfunction; left vocal fold appears more loose and the more vibratory, and the right is the more densely scarred; still hyperfunctional with her speaking voice, employs a glottal attack at times using her vestibular folds to excess. After five months of exercise, the physician reports: no real visible change; sound is surprisingly good; progression from air-turbulence noise only to phonatory adequacy and beginning of singing voice.

The physician-observers report Patient G's conditions before beginning speech therapy, after eight weeks of speech therapy, after seven months of speech therapy, and after five months on the exercise program. On the first tape segment, the three organic variables receive a normal rating from one observer. One physician gives a normal rating to Variable 1 (laryngeal condition) but is unable to rate the condition of both vocal cords. The other observer rates

Variable 1 as +1 and gives a -1 to Variables 2 (right vocal cord) and 3 (left vocal cord). After eight weeks (tape segment 2), the organic ratings remain the same, except that the second observer is able to rate both folds as -2. After seven months of speech therapy (tape segment 3), all three observers rate the patient's laryngeal condition (Variable 1) as normal. One still rates the vocal folds as normal, but the other two rate both Variables 2 and 3 as -1, a one-step improvement in rating by one physician. After five months on the exercise program (tape segment 4), all three physician/observers rate all three organic variables as normal.

Ratings on tape segment 1 indicate hyperfunction in all functional variables before beginning speech therapy. One physician is unable to assess Variable 4 (cord closure), but the other two indicate a condition of inefficient closure coupled with hyperfunctional effort with ratings of -2 and +1. Variable 5 (arytenoid closure angle) receives +2 from two observers and +3 from the third. Two physicians rate Variable 6 (length of folds visible) with +3, while the other rates it as +2. Variable 7 (width of folds visible) gets +1, +2, and +3 ratings. Two observers give a +1 rating to Variable 8 (position of epiglottis), and the third rates it as +2. All three physicians rate Variable 9 (laryngeal introitus) with a +2. Two also give a +2 to Variable 10

(pharyngeal diameters), while the third is unable to assess this variable.

After eight weeks of speech therapy, although cord closure (Variable 4) remains inefficient, hyperfunctional aspects evident in Variables 5-10 have improved significantly. Two observers indicate a one-step improvement in Variable 5 (arytenoid closure angle), while the third gives a two-step improvement. One-, two-, and three-step improvements are the ratings given to Variable 6 (length of folds visible). One physician assesses Variable 7 (width of folds visible) as the same, but the other two give two and three steps improvement in their assessments. Variable 8 (position of epiglottis) receives the same rating as before from two observers but gains a one-step improvement from the third. Two physicians grant Variable 9 (laryngeal introitus) a one-step improvement, and the third gives a two-step improvement. One observer gives one-step improvement, another awards a two-step improvement, while the third is unable to assess Variable 10 (pharyngeal diameters).

The ratings for tape segment 3, taken seven months later, suggest that Patient G was able to retain most of the functional improvement gained in the first eight weeks of speech therapy. One physician rates functional Variables 4-10 as remaining the same or, in three instances, improving by one step. Another physician rates most of the functional

variables as one step worse than on tape segment 2 but still better than tape segment 1. The third physician rates Variables 4 and 5 with one-step improvement, Variables 6 and 9 as the same, and Variable 7 as two steps worse; and is unable to assess Variables 8 and 10.

The ratings for tape segment 4, taken after five months on the exercise program, suggest improvement to normal in functional variables. Variable 4 (cord closure) still receives a -1 from one observer, but is rated 0 (or normal) by the other two observers. Variable 7 (width of folds visible) receives +1 from one physician, which indicates a one-step improvement. Another circles 0 and +1, while the third physician circles 0 and writes "singing" by it, and also circles +2 and writes "speaking" by the +2. All other functional variables receive normal ratings from all three physician/observers.

Ratings from the diagnostic sheets for Patient G indicate a below normal condition in perceptual aspects before speech therapy and exercise, and, though improvement occurs after speech therapy and again after the exercise program, perceptual variables remain "below normal expectation." Patient G begins with -2, -3, and -2 ratings in Variable 11 (pitch range); improves to -2, -2, and -2 in tape segment 2; then moves to -1, -2, and -1 in tape segment 3; and finally reaches -1, -1, and -1 in tape segment 4. Variable 12 (intensity range) looks similar with ratings of

-3, -3, and -2 in tape segment 1, ratings of -2, -1, and -2 in tape segment 2, ratings of -2, -2, and -1 in tape segment 3, and final ratings of -1, -1, and -1. One observer is unable to assess Variable 13 (breath volume), but the other two rate this variable as -3 and -2 in tape segment 1, as -2 and -2 in tape segments 2 and 3, and give final ratings of -1 and -1. The three observers rate Variable 14 (flexibility) with -2, -3, and -2 in the first tape segment, with -2, -2, and -1 in tape segment 2, with -2, -2, and -2 in the third tape segment, and with -1, -1, and -1 in the fourth and final tape segment. In summary, Patient G improved the appearance of her larynx in organic aspects, improved functional behavior to normal in six of seven aspects, but was able to improve to only -1 (one step below normal) in perceptual qualities.

Follow-up contacts within a period of several years reveal that Patient G continues to improve the quality of her speaking voice. Although she does not use the exercise routine on a regular basis, she states that when she sings or uses her voice for public speaking, she does the routine for a "warm-up." The attending physician reports that, although stroboscopy reveals the absence of vibrating tissue on the right vocal fold, her voice is much improved and unrecognizable as the same person. At the final writing of this report, the researcher finds Patient G's singing voice essentially the same as at the end of her exercise therapy

in relation to pitch range, volume, and flexibility. Some improvement seems present in regard to tone quality, with less evidence of breathiness.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Related Literature

Good vocal health is a vital concern for those people who use the voice in a professional capacity, such as teachers, singers, actors, clergymen, and lawyers. People in occupations which put extreme demands on the voice need to know what vocal disorders can occur, what causes them, and how to diagnose, treat, and possibly prevent them.

No absolute criteria exist for determining what is normal or abnormal in the human voice, but most speech pathologists agree that a disorder is present when pitch, loudness, quality, or flexibility differs from other voices of the same age, gender, and cultural group. Other voice specialists, such as singing teachers, also address these same parameters when assessing or training the voice or when correcting vocal faults.

Voice disorders, or abnormal vocal conditions, are usually classified in the general categories of organic disorders (which include physical conditions such as inflammation, tumors, those from trauma or accident, and neurologic disease), disorders of function (such as muscle tension dysphonia or hyperfunction either with or without organic pathology such as nodules or contact ulcers, and

resonance abnormalities), and psychogenic disorders (which involve loss of normal voice due to stress or emotional conflict). Because any of these disorders can occur in a previously healthy larynx, professional voice users should seek regular, complete, and professional voice evaluations. A complete voice evaluation usually involves three areas of diagnosis: a case history (which gathers basic information, such as age, occupation, previous disorders, and onset and duration of the present problem); a laryngologic exam (during which the physician views the interior of the larynx); and a voice profile, which is a psycho-acoustic evaluation of the voice in regard to respiration, pitch, loudness, and quality.

Various clinical techniques and equipment are available for making vocal assessments. These include the wet spirometer (to measure respiratory function), the visi-pitch voice analyzer, electromyography for measuring muscular activity, aerodynamic tests (which measure air flow, phonation efficiency, and subglottic pressure), and procedures which measure vocal fold vibration such as stroboscopy and high speed photography. A rather recent diagnostic tool is the fiberoptic nasolaryngoscope which, when attached to video camera and cassette recorder, allows observation and recording of the interior of the larynx while the patient is speaking or singing. Disadvantages of

this technique include lack of image definition, low color fidelity, and wide-angle distortion. Objective measurement is impeded by lack of an absolute distance marker, variability in movement, and lack of consistency of the structures in view. However, all reviewed sources attest to its superiority in evaluating changes in organic or functional problems.

After the physician or voice specialist has diagnosed the voice problem, treatment is prescribed. This can include surgery, drugs, and/or therapy. Although the qualified physician prescribes surgery and/or drug treatment, professional voice users should be aware of all the options in treatment and, certainly, the possible side-effects from or detrimental results which may occur with surgery, drugs, or other treatment techniques. Voice therapy is often the selected treatment either alone or in addition to surgery and/or drugs. Therapy includes a wide scope of technical approaches but generally addresses pitch, tone focus, voice quality, volume, breath support, vibrato, resonance imbalance, and hypofunctional or hyperfunctional aspects. Usually, the therapeutic approaches involve auditory training, respiratory control, relaxation, instruction in proper vocal attack and optimum pitch, mandible and tongue adjustments, and perhaps specific exercises such as warm-ups or yawn sighs.

Exercise as training or treatment for the voice has been around since ancient times, and extensive training for the singing voice through exercise may be traced from the seventeenth and eighteenth centuries to the present. The benefits of therapeutic and conditioning exercise have been well established in fields such as medicine and sports and, to a certain extent, in the voice professions. However, sources in vocal fields disagree about the benefits of various techniques and the extent to which exercise is beneficial to the voice. Even so, singers and other professional voice users often employ exercises to train and condition the voice, and therapists may recommend specific exercises to help or restore an abnormal voice. Selecting appropriate exercise is not an easy task for the voice user, the teacher, the therapist, or the physician, and sometimes becomes a trial-and-error procedure. It would seem wise to select techniques and exercises which have been successful in some areas, apply them to various vocal conditions, and test the results with the most modern technology available or practical.

Purpose

Research in the area of vocal health reveals the need to determine which specific exercises might be beneficial to alleviate pathological and/or dysfunctional voice conditions. Therefore, the purpose of this study was to

describe the response of a variety of pathological voices to a selected set of vocal exercises that are used to train the singing voice. Specific research problems were to describe (before, during, and after exercise) the laryngeal conditions of patients diagnosed to have muscle tension dysphonia (laryngeal hyperfunction), nodules, recurrent laryngeal nerve paralysis, or iatrogenic dysphonia.

Methods

Subjects for this research project were selected from the private practice of cooperating physicians who felt that the vocal instruction and exercise program might be helpful. Among the patients selected were two males and five females whose ages ranged from twenty-four years to sixty-seven years. Occupations of those involved included teachers, students, housewife-singers, and professional "pop" singers.

This study used an individual subject research design (case studies) to report the effects of specific vocal exercises on pathological voice conditions. Instrumentation for assessing conditions before, during (where applicable), and after exercise included a brief case history, subject interviews, attending physicians' medical charts, flexible fiberoptic video nasolaryngoscopy, video cassette recorder and video tape segments, three physician/observers, and a specific diagnostic procedure, which provided a method of assessing organic, functional, and perceptual variables.

Three physician/observers rated three organic variables (general condition of the laryngeal area and the condition of the right and left vocal folds), seven functional variables suggested by Van L. Lawrence, M.D. (cord closure, arytenoid cartilage closure angle, length of vocal folds visible during phonation, width of folds visible, position of epiglottis, laryngeal introitus, and pharyngeal circumference diameters), and four subjective perceptual variables (pitch range, intensity range, breath volume, and flexibility).

For the exercise program, the researcher chose seven vocalises from the routine designed by Allan R. Lindquest, whose techniques combined those of the Italian school with those of Swedish studios which produced such singers as Flagstad and Bjoerling. The seven vocalises included a warm-up "massage" and exercises for separation and blending of the registers, vowel clarity and modification, tone focus, vocal attack, and flexibility. In addition to the exercise routine, subjects received basic instruction in breathing techniques, proper body and facial posture, and relaxation. No attempt was made to alter subjects' normal life patterns or amount of voice usage, except in the following manner: subjects were asked to perform the exercise routine at least once each day; to use the instruction received from the exercise routine as much as

possible in daily voice use; and to recall and use the physical sensations and habits established by the exercises in other voice usage.

Results

In general, the seven subjects chosen for this study showed improvement in the variables selected for assessment during and after the time period when the subjects allegedly were using the exercise program and techiques. Improvement varied in quantity and quality according to each individual situation.

Two case studies of muscle tension dysphonia (laryngeal hyperfunction) reflected improvement after exercise in organic, functional, and perceptual variables. The two male subjects, ages fifty-eight and sixty-seven, had experienced vocal difficulties for most of their teaching careers. One is now retired, so any lasting results cannot be assessed; however, the other continues to use the exercise program and to claim improvement in his overall vocal condition. The attending physician rated the first case as making sixty percent improvement in vocal fold swelling, hyperkeratosis, and functional laryngeal posture after five months exercise. The attending physician for the second case diagnosed his condition of marked vocal hyperfunction as much improved during singing and, to a lesser degree, during speech after two years of exercise; and, with aid of stroboscoby, rated

vocal fold closure during phonation as clean and symmetrical after exercise. The three physician/observers rated conditions in video segments of the first case as remaining normal or improving by one or two scale steps in organic, functional, and perceptual variables after exercise. According to the physician/observers, the second case improved perceptual aspects but remained hyperfunctional after ten months of exercise. After fifteen months, the observers rated this case as having improved to normal in organic and perceptual variables and improving in functional variables but retaining some signs of hyperfunction.

One case study of nodules revealed improvement after three months on the exercise program. This would not seem particularly significant in cases of nodules, except that in this situation a young female "rock" singer was unwilling or unable to reduce her extensive vocal usage (four to eight or more hours of rehearsal and performance five to six days a week). The subject claimed that notes which had previously "cracked" or that would not sound were returning, that control to sustain longer note values and to execute "vocal hot licks" had returned, and that her speaking voice had raised in pitch. The attending physician diagnosed the condition before exercise as nodular swellings, larger on the right vocal fold, and incomplete glottal closure producing inefficient phonation, breathy singing tone, and

raspy speech. After three months of exercise, the diagnosis was as follows: clear fold on the left side; nodule on right side about one/third less in size; air gap and resulting breathiness about one/half what it was; "clearly on the right track." Two physician/observers rated this case of nodules as improved in organic and perceptual variables. The other observer did not indicate improvement in the vocal folds and was unable to assess the perceptual variables in the first tape segment. Ratings from the three observers may have indicated slight improvement in some of the functional variables.

Two of the case studies involved a paralyzed vocal fold as the result of viral infection, and in both cases improvement occurred in all areas of assessment during and after the exercise program. Both female singers, ages twenty-four and fifty-eight, claimed an increase in the pitch range of their voices, even gaining notes higher than before the paralysis. Both noticed a difference in the speaking voice after exercise, indicating more strength in volume and longevity. Both women were able to return to singing in church choirs and doing solo work.

The attending physician for the younger singer diagnosed the paralyzed fold when the patient sought his help for hoarseness, lack of volume in the speaking voice, and inability to sing, symptoms evidently brought about by a

viral infection four months earlier. After five subsequent office visits and no improvement, the patient began the exercise program. After four weeks, the physician described her condition as improved but still demonstrating symptoms of hyperfunction in the laryngeal posture. Four more weeks of exercise gained her this diagnosis: tremendous improvement in voice quality and vocal cord movement; condition appears normal with both folds functioning; clear quality; and normal laryngeal posture when singing.

The attending physician for the older singer diagnosed her paralytic left fold four months after her apparent loss from severe tracheitis and bronchitis. During the next two years, the patient saw a speech therapist, who successfully treated tension and poor posture in the neck area and hyperfunction in the speaking voice, but as the patient was unhappy with her singing voice of limited range, breathiness, and uncontrollable vibrato, she began the exercise program. After ten months of exercise the attending physician described her condition as follows: paralysis of vocal fold remains unchanged; singing voice is excellent even not considering patient's age and unilateral cord paralysis.

Results from the diagnostic ratings awarded by the physician/observers suggested improvement in organic, functional, and perceptual variables for the younger singer.

Two observers gave normal ratings in all variables, and the other observer granted normal ratings except in two functional areas which indicated slight hyperfunction. For the older singer with the remaining paralyzed vocal fold, ratings after exercise were normal in all other variables from two observers. The third observer granted a normal rating in perceptual variables and a rating of slight hyperfunction in all functional variables.

The last two case studies involved iatrogenic dysphonia after vocal fold surgery. The two female patients, ages twenty-five and thirty-nine, had suffered severe hoarseness and breathiness as a consequence of the removal of excess tissue from the vibratory margin of the vocal fold. Both subjects experienced improvement in vocal conditions after speech therapy and again after the exercise program.

The first subject, a young "country-western" singer, was able to continue her career after speech therapy and vocal instruction; however, four years later she was again experiencing extreme problems of hoarseness and loss of pitch range when she began the exercise program. After five months of exercise, while continuing her heavy work schedule of four hours of solid singing five nights a week, she claimed to have a wider range and clearer tone, to be able to hold notes longer, and to be singing songs she was never able to sing before. The attending physician diagnosed her

condition before exercise as follows: history of vocal polypbectomy and resulting hoarser voice due to scar tissue; vocal fold edema. After six months of exercise, the physician pronounced the condition as showing a dramatic improvement with good laryngeal posture in singing, and expressed his desire for further improvement in the speaking voice. In summary, ratings from the physician/observers indicated no change in organic variables and a one scale step improvement in functional and perceptual variables.

The second subject, after surgery and forceful, unsuccessful attempts to phonate, was diagnosed by the attending physician as a virtually aphonic patient with extremely breathy quality and hyperfunctional activity within the larynx. Nine months of speech therapy improved the subject's voice quality and functional activity, but as hyperfunction was still evident in the singing voice and the subject was disturbed about the quality and range of her voice, she began the exercise program. During her five months of exercise, the subject stated that the pitch range of her singing voice increased from four or five notes to over an octave, that the tone improved, and that each day she performed the exercise routine her speaking voice was clearer and stronger. Her attending physician reported no visible change in the organic condition, but pronounced laryngeal posture in singing as good and the sound as

surprisingly good. According to the physician, after nine months of speech therapy and five months of singing exercises, this aphonic patient progressed from air-tubulence noise only, to phonatory adequacy and beginning of a singing voice.

Ratings from the physician/observers for four successive tape segments indicated improvement in all variables. Before speech therapy, the subject received ratings which represented extreme hyperfunction and severe inadequacy in perceptual variables. After nine months of speech therapy, organic variables remained one scale step below normal, functional variables had improved to moderate or slight hyperfunction, and perceptual variables had improved an average of one scale step but remained two scale steps below a normal expectation. After five months on the exercise program, ratings from the observers indicated that this subject improved the appearance of her larynx to normal in organic variables, improved functional behavior to normal in six of seven aspects, but was able to improve only to one scale step below normal in perceptual qualities.

Discussion

Therapeutic results are often difficult to assess accurately due to the nature of the healing process, differences in individuals and their specific pathology, and the presence of uncontrollable outside factors; therefore,

it is with caution and conservatism that the researcher presents these conclusions. Specific research problems were to describe the laryngeal conditions of various pathological and/or dysfunctional voices before, during (where applicable), and after the exercise program. Descriptions of the vocal conditions, acquired by interviewing the subjects, reading the attending physicians' medical charts, and obtaining diagnostic results from three physician/observers, supplied objective and subjective assessments of changes which occurred during the time the subjects claimed to be using the exercise routine. In all seven case studies the patient, the attending physician, and the three physician/observers noted a change or changes in laryngeal conditions and/or behavior after using the exercise routine designed by Allan R. Lindquest. Although the positive changes could have been due to unknown factors, it is the opinion of the researcher that the exercise routine was beneficial in alleviating pathological and dysfunctional conditions found in the subjects of this study. Just as gentle stretching exercises benefit muscles in other parts of the body, as demonstrated in sports, medicine, and other fields, vocalises for the voice may have the same effect on laryngeal health. Designed to train the healthy singing voice, Lindquest's routine employed vocalises to "warm up" and gently stretch the muscles of the

larynx, to separate and blend the registers, to practice vowel clarity and modification, to encourage tone focus and a good vocal attack, and to develop flexibility and strength. For the seven subjects of this study the routine seemed effective in alleviating pathological conditions and/or dysfunctional behavior; however, since this research used a single case study design, more research is needed to determine the effects of the exercise program on additional subjects.

No behavior or condition became worse, but the improvement varied from subject to subject in quality and quantity due to differences in the individual, the type of disorder, or outside factors. The exercises seemed particularly helpful to dysphonias caused by a paralytic vocal fold. In the case of the younger singer, recovery may have occurred without any exercise or therapy, but in the case of the older singer, exercise (or other factors present during the exercise program) enabled her to return to solo singing even with a paralyzed (paramedian position) vocal fold. In the two cases of muscle tension dysphonia, improvement occurred in organic, functional, and perceptual variables selected for observation in this study. Since improvement was slow but apparently significant and long-lasting in one of these cases, further research seems indicated in this area. The one case of nodules responded

favorably during the exercise program while continuing extensive voice usage. Further research should indicate whether the exercise program might be an alternate method of rehabilitation for singers who are unwilling or unable to reduce work loads or change life styles. Two case studies of iatrogenic dysphonia revealed that although speech and exercise therapy may be helpful to alleviate some of the functional and perceptual complications, the prognosis is guarded for recovery from surgery when some or all of the vibratory margin of one vocal fold is removed. While experiencing vocal difficulties, one subject was able to continue professional singing; however, the other subject, while improving her speaking and singing voice, was unable to continue formal study toward a professional career. Further research might indicate which therapy techniques and exercises are most helpful for cases of this nature.

Since the subjects of this study seemed to benefit from the use of this particular exercise routine, the researcher believes that these exercises may be helpful to alleviate pathological conditions and/or dysfunctional behavior in other subjects. One might also logically expect benefits from these exercises in aiding singers and other professional voice users to avoid vocal difficulties brought about by misuse.

Additional conclusions and implications for future research seem evident. The diagnostic technique used for this study was capable of showing change in laryngeal conditions and, in general, was consistent with patients' and attending physicians' assessments of improvement. The variables suggested by Van L. Lawrence for determining hyperfunction in the larynx were useful for this study and effective for diagnosing conditions before and after the exercise therapy. Investigations which replicate this diagnostic procedure would further test its accuracy and dependability. Since the selected exercises and vocal technique seemed to affect pathological voice conditions observed in these case studies, the voice profession should investigate the efficiency of other techniques, exercises, and musical vocalises which might bring about positive changes in vocal conditions and behavior.

APPENDIX A

EQUIPMENT

EQUIPMENT

Office 1

1. Olympus E N F Type P Fiberscope
2. Sanyo Color Video Sound Camera VCC540, S L I K Japan
3. Sennheiser microphone, Germany
4. Items (2) and (3) mounted on curved steel bar with pedestal base
5. Xenon Cold Light Fountain Model 487C
   Karl Storz attachment to camera
6. Sony U-Matic Video Cassette Recorder 3/4 inch, VO2610
7. Trinitron Television set KV 1914
8. Sony Remote Control to VCR and TV

Office 2

1. Olympus E N F Type P Fiberscope
2. Panasonic Color Video Camera WV-3230 Newvicon
3. Olympus ILK-3 Cold Light Supply
4. NEC Auto Color TV Monitor
5. Panasonic Video Cassette Recorder VHS 1/2 inch
6. F. L. Fischer Microscope Stand

APPENDIX B

INSTRUCTIONS, SAMPLE RATING SHEET, AND VIDEO TAPE

INSTRUCTIONS FOR USING THE DIAGNOSTIC RATING SHEETS

1. Refer to Chapter IV, pp. 137-147, for information on how to use the diagnostic tool.

2. For each variable, please circle one number or X in each applicable category. Usually, one number should represent the condition of each variable. Occasionally, two numbers might best represent the condition. For example, for organic variable no. 2, a patient might be (-2) because of paralysis and also (+1) as a result of hyperfunctional complications. If this should occur, please so indicate on the rating sheet.

3. (0) will always represent a normal condition. Circle (X) if you cannot assess the variable in any particular segment.

DIAGNOSTIC RATING SHEET

Patient_____ Segment_____ Observer____

ORGANIC VARIABLES (p. 143)

1.	0	+1	+2	+3	X			
2.	0	+1	+2	+3	-1	-2	-3	X
3.	0	+1	+2	+3	-1	-2	-3	X

FUNCTIONAL VARIABLES (pp. 144-145)

4.	0	+1	+2	+3	-1	-2	-3	X
5.	0	+1	+2	+3	X	(pp. 146-147)		
6.	0	+1	+2	+3	X			
7.	0	+1	+2	+3	X			
8.	0	+1	+2	+3	X			
9.	0	+1	+2	+3	X			
10.	0	+1	+2	+3	X			

PERCEPTUAL VARIABLES (p. 145)

11.	0	-1	-2	-3	+1	+2	+3	X
12.	0	-1	-2	-3	+1	+2	+3	X
13.	0	-1	-2	-3	+1	+2	+3	X
14.	0	-1	-2	-3	+1	+2	+3	X

VIDEO TAPE

A copy of the video tape, which was sent to the three physician/observers, is on file in the College of Music at the University of North Texas. Copies of the tape are available from the author, Music Department, Lamar University, Beaumont, Texas.

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