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A Review of Voice Therapy Techniques Employed in Treatment of Dysphonia with and Without Vocal Fold Lesions

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Abstract
Purpose of Review The purpose of the review is to provide otolaryngologists a framework for understanding voice evaluation by speech-language pathologists and the voice therapy techniques they employ.
Recent Findings Recent reports have demonstrated the efficacy of behavioral voice therapy in the management of a variety of types of dysphonia, including those associated with vocal fold lesions and those without.
Summary Otolaryngologists can be experts in managing specific laryngeal lesions to improve voice. However, not all voice problems have lesions amenable to surgical or medical therapies. Many are associated with maladaptive voicing behaviors. Speech-language pathologists can be experts in both the evaluation of vocal function and technique. They may employ a variety of techniques to improve vocal quality and function in patients with and without structural or neurologic laryngeal pathology. Otolaryngologists can partner to manage a constellation of voice problems with directed voice evaluation and therapy. A basic review of these techniques and this partnership with voice therapists is presented.

Keywords Voice therapy · Phonosurgery · Muscle tension dysphonia · Laryngeal pathology · Laryngeal hyperfunction · Dysphonia

Introduction

Evaluation and treatment of dysphonia is more complex than it seems. From the time that Manuel Garcia first observed the delicate movement of the human vocal folds in situ during phonation, physicians have focused on lesions of the vocal folds as the sole source of all dysphonia. Masses, inflammation, and neurologic deficiencies clearly create problems with voice and can be treated with expected improvement in hoarseness. But what about the patients who are concerned about fluctuating dysphonia? They note occasional hoarseness that seems to improve with reduced vocal demands, a vacation, a glass of wine, a day without a cell phone, or a day without the stress of a boss, a bill collector, or a troubled home. From the physician's perspective, the vocal folds show no masses, no specific inflammation, and no discernible abnormalities of motion. These patients have hoarseness, but the patient and physician feel frustrated that there is nothing that can be easily seen to treat. Extreme cases are easy to identify in patients who are completely aphonic, yet have normal swallowing, cough and—often—laugh. There are no lesions along the vocal folds and they demonstrate completely normal range of motion. To the discerning clinician, such patients demonstrate marked laryngeal hyperfunction and can be easily treated by someone who understands the function of the larynx and how voice is produced. Milder examples are encountered by otolaryngologists every week—if not every day—and may present as fluctuating hoarseness, vocal fatigue, loss of vocal projection, and

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throat discomfort that they may *or may not* associate with voicing. These patients do not need a surgery and will not improve with a pill. They need careful assessment of laryngeal function that requires a team approach to both diagnosis and treatment.

Speech-language pathologists can be trained experts in vocal function. While not all specialize in this more esoteric discipline within the broad field of communication specialists, those that do can be tremendously helpful in treating problems with vocal function. These disorders may be *primary* and without any specific vocal fold pathology or *secondary* to lesions noted along the vocal folds that interfere with creation of a stable mucosal waveform. It is not uncommon for these patterns of altered laryngeal function to persist following treatment of a specific vocal pathology with restoration of normal or near-normal vibration. As one might imagine employing a physical therapist in the management of musculoskeletal injury, otolaryngologists may benefit significantly from working with voice therapists in everything from functional voice disorders without structural pathology to optimizing voice in patients with any number of vocal lesions before and after directed surgical or medical treatment. Often, poor vocal technique and compensatory laryngeal hyperfunction contribute to the development of traumatic vocal pathologies such as nodules, polyps, and cysts. In the majority of cases, addressing this hyperfunction is critical to obtaining optimal voice and preventing repeated traumatic vocal pathology. As such, we believe that the otolaryngologist would benefit from a basic understanding of how speech-language pathologists employ voice therapy to aid in evaluation, recovery, optimization, and protection of phonation.

Voice Evaluation

Voice therapy really begins during the voice evaluation. We have found it invaluable to assess patients with dysphonia as a team. The otolaryngologist is responsible for identifying organic pathology of the vocal folds, while the speech pathologist is essential to evaluate the function of the larynx. During auditory perceptual evaluation, the speech pathologist observes the efficiency of breathing, coordination of breath and voice, and tension in the base of tongue, neck, jaw, etc. During laryngoscopy and/or laryngeal stroboscopy, the speech pathologist evaluates palatal function, tongue tension, lateral or anterior-to-posterior laryngeal compression, as well as any excess vertical laryngeal motion and/or breath holding or tension during the breathing cycle. Voice treatment probes can be done during the examination to see if the patient is stimulable for improved voicing with improved breath support, tone placement, and projection to name a few. Once the exam is completed, patient education begins with a review of the examination, with the otolaryngologist and any inefficiencies or hyperfunction observed. These observations can be used to educate the patient regarding how their current vocal technique may be contributing to their vocal concerns.

Voice Treatment

The guiding principle for voice treatment is to restore the best possible voice with the least amount of effort. In therapy, we use a physiologic model. That is, our goal is to restore the voice to a patient's optimal voice through training efficient vocal physiology, much like an athlete is trained to use optimal form in their sport. The rationale is that by using the voice efficiently, not only will the voice be clear and resonant, but it will also be more resilient to future voice problems. By targeting optimal vocal physiology, the end result is a balance of the respiratory, phonatory, and resonance systems. Patients should learn to breathe efficiently, coordinate their breath and sound efficiently, and resonate effectively with the focus of the tone out the front of their mouth. The techniques used to train some of these concepts vary from patient to patient depending on what works best for each individual. There are, however, some widely recognized techniques used in voice therapy that can be applied to patients with functional and some organic voice disorders. Our treatment becomes very "patient centered" and our interventions are tailored to each patient's needs. If a technique is not working for a patient, we simply switch techniques in order to find one that will work for that individual to achieve balanced physiology. We also rely on our patients to set the pace in therapy. Some patients understand a concept and apply a technique rapidly. Others need to spend more time on the basics such as learning to breathe efficiently, without tension. Some patients need more psychological support and more time helping them understand how things such as stress level can affect their breathing and voicing. Our discussion here of vocal techniques is not meant to be exhaustive, but rather is meant to explain some of the most commonly used voice therapy techniques and to introduce the otolaryngologist to what is really going on in a voice therapy session.

Breath Support

Breath support affords the power to voicing. We have found it very beneficial to begin voice treatment with training more *efficient breathing*. While it is not essential to

breathe diaphragmatically in order to produce a clear voice, it requires much less effort and tension to do so. It is much easier to control the exhalation of air for speaking or singing with the abdominal muscles rather than with the chest muscles. Many voice patients carry a lot of tension in their upper abdominal muscles and hold the breath making it difficult to voice efficiently. Other patients tend to hold a lot of tension in their upper bodies, tensing their shoulders and lifting their chests with each breath. Isolating the breath work helps them become conscious of these unconscious patterns. Breathing efficiently also helps to put the body into the relaxation response mode, which is incredibly beneficial for many of our patients who have anxiety as a component of their voice disorder. Breathing diaphragmatically is also good for patients in general with claimed benefits ranging from decreased blood pressure and heart rate to increased memory and decreased fatigue. Of course, we do not stop with just the breath, we move on to helping the patient coordinate breath and sound without tension using a lip trill or a tongue trill (like a Spanish "r") for example. It is very difficult to make these sounds with tension in the system or without enough air. Efficient coordination of breath and sound can also be felt making a sound like blowing in a kazoo or humming. Some patients then are able to get the feel of releasing tension and are able to apply optimal technique in conversation after some drill and practice on sentences and paragraphs.

Voice Therapy Techniques

Initially designed to improve vocal technique in singers and actors, *resonant voice therapy* [1] was adapted to voice disorders by Verdolini-Marston, Burke, Lessac, Glaze, and Caldwell [2•]. The Lessac Madsen Resonant Voice Therapy (LMRVT) technique is designed for patients with laryngeal hyperadduction or laryngeal hypoadduction. The goal of this therapy technique is to shift the tone focus to the front of the mouth (palate, tongue, and lips) and nose. "Nasal consonants" (i.e., *m*, *n*, *ng*) or a "basic training gesture" (e.g., a specific type of humming) is often used to facilitate forward resonance. The focus on forward phonation allows for maximum voice output intensity and resonance with minimal vocal fold impact pressure [3]. In this program as with most voice therapy techniques, the patient is moved through a hierarchy when applying the technique: sounds, words, sentences, paragraphs, and conversation. Some astute patients get the feel of the front-focused resonance and are able to jump through the hierarchy from sounds and words to phrases and conversation very rapidly. Others take longer to get to a point where they can really apply the technique in conversation in their daily life.

Another set of voice exercises often used to help balance and strengthen the respiratory and phonatory systems are *vocal function exercises* (VFE) [4•]. This program is made up of a set of 4 exercises to be practiced 2–3 times daily. These include (1) sustaining the vowel "*ee*" on a note slightly higher than the speaking pitch (approximately an F above middle C for women and an F below middle C for men) as long as possible without strain, (2) stretching the vocal folds by gliding from a low tone to a high tone on the word "knoll" (lip trills, tongue trills on front vowels-/*u*/,/*e*/ or/*o*/can be substituted when necessary), (3) contracting the vocal folds by gliding from a high tone to a low tone on the chosen sound, (4) sustaining the vowel/*o*/or/*e*/on each of the following notes: C, D, E, F, and G for women and an octave lower for men. These exercises provide a structured activity in which patients can apply optimal vocal technique successfully in addition to strengthening the musculature. They work well as a fairly quick daily warm-up for patients to do.

Range expansion and stabilization techniques (REST) are exercises that also help improve vocal technique and expand vocal range [5]. This program involves 3 exercises. For the first exercise, the patient is taught to glide from a comfortable pitch to a pitch approximately 1/3 of an octave higher than that, hold the tone briefly, and then relax down to the starting tone, rest and repeat 2–3 times. The second exercise requires phonating at a comfortable pitch and going from soft to loud ("swell tone") holding the tone 3–4 s and repeating 2–3 times. This allows the patient to feel breath control for loudness variation (rather than straining or pushing from the larynx to increase loudness). The last exercise requires the patient to sustain phonation as long as possible on a vowel produced at 3–4 comfortable pitches. This helps the patient to build respiratory endurance.

Stretch and flow involves another set of exercises also aimed at rebalancing the respiratory, phonatory, and resonatory subsystems. These exercises were first described by Stone and Casteel in the early 1980s [6]. They can be very effective in helping patients with persistent hyperadduction of the vocal folds as well as those who struggle to balance the systems with more simple exercises such as the vocal function exercises. The goal of these exercises is to gain volitional control over the vocal subsystems using voiced and unvoiced vocal stimuli. The first exercise is to simply feel airflow (with a sigh) followed by stretch and flow (with a slow whisper). Next, the patient is asked to stretch and flow with voice. Once they get the feel of using airflow without tension, they then reduce the stretch and then reduce the flow while maintaining the balanced subsystems. Again, this technique is then applied in a hierarchy of tasks progressing from sounds to conversation.

There are many other treatment techniques that can be used to improve vocal technique by balancing respiration, phonation, and resonation. These can be implemented as necessary depending on a patient's need, level of understanding, and ability to hear and feel efficient versus inefficient vocal production. There are a number of techniques that take advantage of a *semioccluded vocal tract*. As with resonant voice therapy, the idea is to produce an "easy, economical, effortless, resonant voice." Dr. Ingo Titze refers to optimizing vocal function using a semioccluded vocal tract as "impedance matching" (matching the ratio between pressure and flow) between the vocal tract and the vocal folds [7]. To help a patient understand this concept, a clinician can use front-focused nasal sounds (*m* and *n*) and words, trills, front-focused vowels, anterior fricatives (/*v*/or/*ff*), or bilateral plosive sounds (/*p*/or/*b*/). If necessary, some patients benefit from phonating into a straw. This helps them automatically coordinate the breath with phonation resonating at the front of the mouth where the straw is. Blowing bubbles into a cup of water while phonating can provide this resistance while facilitating continuous airflow and forward resonance. The straw and the water are gradually weaned from the activity and the technique is applied to words, sentences, and conversation.

Other techniques may need to be implemented in order to achieve greater relaxation of the extrinsic laryngeal muscles. Arnold Aronson [8] first described *direct manipulation and massage* of the laryngeal area in order to rapidly regain voicing in dysphonic or aphonic patients. Dr. Nelson Roy expanded on this technique and researched its efficacy [9]. Pressure is applied in a small circular motion to the areas with tension (often the thyrohyoid muscles though not limited to these) and the larynx is gently lowered. These techniques can be used to facilitate awareness of tension impacting voice production. Massage with digital manipulation of the larynx or a combination of this with other reviewed techniques decreases the hyperactivation.

Many patients experience dysphonia or aphonia due to excessive muscle tension with speaking. Tension in specific sets of extralaryngeal muscles results in distinct changes in vocal quality. For example, base of tongue tension and anterior-to-posterior supraglottic compression create a low, throat-focused, "muffled" sounding voice. Excessive elevation of the larynx with tension in the vocal folds may create complete aphonia or a breathy high-pitched voice with a wider than expected posterior glottic gap (sometimes referred to as *hyperfunctional underclosure* of the vocal folds). Speaking at the bottom of one's speaking range with slackened vocal folds and low airflow produces glottal fry. For any case of muscle tension dysphonia/laryngeal hyperfunction, the speech pathologist will select a technique or combination of techniques which matches best with that particular patient, that is, the technique(s) that helps them achieve optimal vocal technique with minimal effort. Functionally aphonic patients often need additional work with laryngeal massage as well as creative use of any technique that may help increase airflow and reduce muscle tension. For example, having patients run stairs to the point of heavy breathing can increase airflow, forcing the patient to use continuous airflow while speaking. The physical need for oxygen with exercise tends to override the tension used with voicing. This also serves as a distraction as the patient is focused on the exercise rather than their voicing. This activity can often facilitate normal or near-normal voicing for a functionally aphonic patient. Counseling and education are always integrated into the sessions as necessary, particularly with this population where dysphonia may be a manifestation of anxiety or emotional stress.

Paradoxical vocal fold motion (sometimes poorly described as 'vocal cord dysfunction') is a functional breathing disorder that likely falls along the continuum of laryngeal hyperfunction. Many of the patients who have laryngeal hyperfunction during breathing also evidence laryngeal hyperfunction with speaking. Therefore, in addition to specific breathing exercises aimed at preventative and rescue strategies for controlling and eliminating breathing symptoms, many of these patients also require some degree of voice therapy to reduce tension in the system throughout the day.

Voice Therapy in Patients with Specific Laryngeal Pathology

Patients with benign mucosal lesions such as vocal nodules—which do not typically require surgery—are likely good candidates for voice therapy if patients are interested in improving their voice. The otolaryngologist plays an important role in recommending voice therapy when appropriate and setting the stage for patient "buy-in" and follow-through with voice therapy. In the case of a small cyst or polyp, voice therapy may be appropriate to determine if the patient is able to "voice around the lesion" and achieve adequate voicing for his or her vocal demands. In some cases, the lesion may even resolve completely [10]. Any of the techniques previously mentioned may be implemented with these patients. The patient also may benefit from vocal hygiene suggestions aimed at improving vocal health and reducing vocal fold trauma. These include doing more of what is good for the voice (e.g., drinking more water to keep the vocal folds hydrated or using appropriate voice amplification) and doing less of what is not good for the voice (e.g., smoking, drinking alcohol to excess, drinking too much caffeine, yelling, speaking over noise, etc.).

Speech pathologists can play a role in optimally treating patients with benign mucosal lesions who are surgical candidates (e.g., those with cysts or polyps). Ideally, the surgeon as well as the speech pathologist evaluates the patient. This will allow the speech pathologist to initiate preoperative counseling including education regarding lifestyle changes and vocal exercises that can facilitate healing. We find that preoperative counseling in addition to 1–2 preoperative voice therapy sessions to introduce optimal vocal technique sets the stage for postoperative success. Most surgeons prescribe a period of vocal rest following phonosurgery (typically 2–14 days). Educating the patient regarding the rationale, the necessary preparation for voice rest, and alternative communication options available can ensure understanding and maximize compliance with recommendations. If the patient shows appropriate healing during postoperative laryngeal exam, the surgeon will generally allow the patient to begin vocal exercises with an emphasis on stretching and contracting the vocal folds to facilitate organized healing and prevention of scar. Starting therapy with VFE is often the easiest to train at this point, but stretch and flow or REST exercises can also be used. Further voice therapy will be completed as necessary to balance the subsystems/train optimal vocal technique. In order to ensure that vocal trauma is eliminated or minimized, vocal hygiene education is continued with an emphasis on preventing further vocal fold injury.

Diagnostic voice therapy can be a useful tool in determining if a patient has muscle tension dysphonia or an underlying neurologic voice disorder such as spasmodic dysphonia (SD) or vocal tremor in cases where chronic constriction or compensatory muscle tension is masking the symptoms. The above-noted therapy techniques can be used to reduce or eliminate muscle tension, which then can unveil underlying spasms or other neurologic voice condition. Diagnostic voice treatment can also be used to help determine the exact nature of the neurologic voice disorder including adductor, abductor, or mixed SD with or without tremor when the compensatory hyperfunction is masking the underlying spasms. Voice therapy aimed at training efficient vocal technique has been shown to be effective to help patients with SD optimize results post directed botulinum toxin injections. According to Murry and Woodson [11], patients who received a combined modality approach with directed botulinum toxin injections and voice therapy experience an extension of improvements compared with those patients who received injections alone.

As noted above, patients with vocal tremor often develop compensatory laryngeal hyperfunction that can result in increased dysphonia, vocal fatigue, or effort. If the vocal tremor is mild, patients can often benefit from voice therapy focusing on training optimal technique. Patients with a more significant tremor who have either not improved with medical treatment or their improvement has plateaued might also benefit from voice treatment. These patients may benefit from using a specific set of strategies to reduce the perception of the tremor such as improving coordination of breath and voice, using shorter vowel segments, and using a slightly higher pitch [12].

Patients with progressive neurological disorders such as Parkinson's disease also may benefit from voice treatment. The *Lee Silverman voice treatment* (LSVT) program has been proven to be highly effective in treating hypophonia related to Parkinson's disease with results demonstrating improvements in vocal intensity [13•], glottic closure [14], facial expression [15], articulatory accuracy [16, 17], and intelligibility. LSVT is based on the principles of targeting loud phonation at high intensity with an emphasis on calibration or carryover of loud phonation into daily conversation. There are 4 daily exercises including a sustained "ah," gliding from a low tone to a high tone, gliding from a high tone to a low, and then repeating a set of 10 functional phrases, with all tasks completed at loud volumes. Over the course of 4 weeks, the patient progresses through a hierarchy of tasks from phrases to conversation. The patient participates in treatment 4 times a week for 4 weeks to increase respiratory and phonatory strength as well as facilitating calibration and carryover into daily conversation.

The otolaryngologist and speech pathologist can also work together to optimally treat patients with vocal fold paralysis. If the paralyzed vocal fold is close to midline, it is possible that the patient may be able to compensate with optimal vocal technique including increased breath support. They often need training for this as the body tends to naturally try to compensate with pushing or increased laryngeal tension. This leads to poor vocal quality, inadequate vocal projection, and subsequent vocal fatigue. If the vocal fold is paralyzed lateral of midline, the patient is unlikely to benefit enough from voice therapy alone and the otolaryngologist will determine if they would benefit from vocal fold augmentation or medialization. The patient may benefit from voice therapy after these procedures if the patient's goal voice has not been attained. Often, particularly if the patient has been compensating for the vocal fold paralysis for several months or years, the compensatory muscle effort will persist. Using voice techniques aimed at training optimal vocal physiology can facilitate optimal vocal clarity, loudness, and ease of production.

Voice disorders are common in the elderly population with forty-seven percent of elderly experiencing a voice disorder in their lifetime [18]. Presbyphonia or vocal fold bowing is a disorder that results in glottic insufficiency and affects at least 30 % of the elderly with voice disorders [19]. These patients can benefit from voice therapy focusing on increasing vocal strength and flexibility with a

specific set of vocal exercises as well as balancing vocal physiology to reduce excessive muscle tension which may be compensatory for the glottic insufficiency. Gorman et al. [20] demonstrated improved glottic closure in this population with use of VFE [21] demonstrated improved scores on the Voice-Related Quality of Life (VRQOL) after treating patients with resonant voice therapy and VFE.

Voice therapy is very useful in treating voice disorders in pediatric patients. As in the adult population, pediatric patients can benefit from treatment for both organic and functional voice disorders with the use of direct voice treatment and age-appropriate education regarding vocal hygiene. The goal of therapy is similar to the goal of treatment when working with adults, helping the child achieve the best voice with the least amount of effort. Children can be trained to use efficient vocal technique for speaking, vocal play, and vocal projection using voice and breathing exercises that can be integrated into age-appropriate play and activities.

There are other, less obvious patient populations and circumstances where voice therapy can be useful. For example, patients undergoing airway surgeries such as cordotomy or cricotracheal resection may benefit from learning voicing methods which can help them adapt to altered physiology and better compensate for the alterations in their laryngeal function associated with these procedures. In addition, patients with puberphonia or mutational falsetto, patients who are transgender, and patients who have special issues related to their singing voice can benefit from voice therapy. Many speech pathologists also treat patients with chronic cough where a medical cause has been ruled out. These patients can benefit from techniques to suppress the cough as well as standard voice therapy to reduce or eliminate laryngeal hyperfunction that can contribute to laryngeal irritation or trigger the cough.

Conclusion

Patients benefit from the combined efforts of both an otolaryngologist and speech-language pathologist in the management of dysphonia. This holistic approach allows for improved vocal outcomes in patients with and without structural or neurologic pathology. With a good understanding of the techniques employed by voice therapists and an appreciation of how they can help vocal function, otolaryngologists can treat their patients with voice concerns more effectively and more economically as more costly and invasive interventions may not be required to achieve satisfactory results.

Compliance with Ethics Guidelines

Conflict of Interest Dr. Karen Drake, Dr. Linda Bryans, and Dr. Joshua S. Schindler declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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