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Singer's Dysphonia: Etiology, Treatment, and Team Management

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Abstract

Singers will often suffer from dysphonia. This may range from a mild breathiness or vocal fatigue to severe hoarseness. It is a problem that nearly all professional singers have experienced or will experience over their careers. As practitioners, it is our goal to recognize the disparate etiologies of dysphonia, diagnose them correctly, and treat them efficiently and effectively as would be demanded by the needs of a professional voice user. For a singer, the responsibility is to learn how to care for one's vocal instrument and recognize dysphonia early, so that it can be easily treated before there is a severe problem. These issues are addressed with the goal of creating a collective understanding about dysphonia in singers so that the singer, physician, laryngologist, voice therapist, vocal teacher, and other caregivers can coordinate as a team to administer the best care and achieve excellent results.

Keywords

professional voice, dysphonia, laryngeal anatomy, laryngeal physiology, dysphonia treatment, dysphonia etiology

Caring for a professional singer is a demanding and challenging task. Singers are vocal athletes at the top of their game. Caring for a singer's voice is equivalent to caring for a professional basketball player's knee. Their needs are much greater and more acute than those of the patient who is not a singer. To create a sustainable career, they need to be vocally fit at all times, expeditiously returning from injuries to their top form and avoiding career ending injuries. It takes a team for this to occur. Just as a basketball player may have a head coach, orthopedist, internist, masseuse, chiropractor, strength coach, and sports psychologist, the singer may have a vocal coach, laryngologist, internist, medical subspecialist, voice therapist, and performance psychologist. The singer, who is the most important part of the team, must also be attuned to his or her own health and alert caregivers to early vocal changes so that he or she can be investigated and treated before a significant injury occurs. To be effective, each team member must excel in his or her specialty as well as understand the roles of others so they can work in concert. Familiarity with laryngeal anatomy, basic vocal physiology, and the common medical problems that a singer may encounter and how they are treated will also enhance each team member's ability to care for the singer, resulting in excellent care overall.

The larynx consists of both intrinsic and extrinsic muscles (see Table 1). The intrinsic muscles consist of nine muscles that act to change the position and tension of the vocal folds and stabilize them for phonation. They do not play a role in generating the vibration of the vocal fold that leads to phonation. The extrinsic muscles of the larynx are those that are attached to the outside of the larynx. These muscles are involved in swallowing. When swallowing, the larynx must move anteriorly and superiorly to protect against aspiration into the trachea. Although these muscles should not be involved in phonation, they often are in a pathologic way. When singers strain, they may recruit the extrinsic laryngeal musculature to increase acoustic power over the short term (Berke et al., 1990). It is clear though, that this is not an ideal technique to achieve long-term production of acoustic power. It increases the stress on vocal fold tissues resulting in damage that leads to pathologic changes, vocal fatigue, increasing strain, anterior neck pain, muscle soreness, vocal inefficiency, and dysphonia (Jiang & Titze, 1994). A clue that recruitment of swallow muscles is occurring is vertical movement of the larynx with pitch or volume change. The larynx should be stable, moving minimally with phonation despite pitch and volume changes.

As was reported by Hirano in 1974, the vocal folds are not cords but folds of tissue consisting of five layers (see Figure 1). Histologically, it is clear that the vocal folds are built for passive vibration. The deepest layer of the vocal fold consists of the thyroarytenoid muscle and is referred to as the body. The

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Table 1. Intrinsic and Extrinsic Muscles of the Larynx

I. Intrinsic muscles
A. Adductor
1. Cricothyroid
2. Thyroarytenoid
3. Interarytenoid
4. Lateral cricoarytenoid
B. Abductor
1. Posterior cricoarytenoid
II. Extrinsic muscles
A. Larynx elevator
1. Thyrohyoid
2. Digastric
3. Stylohyoid
4. Mylohyoid
5. Geniohyoid
6. Hyoglossus
7. Genioglossus
B. Larynx depressor
1. Sternothyroid
2. Sternohyoid
3. Omohyoid

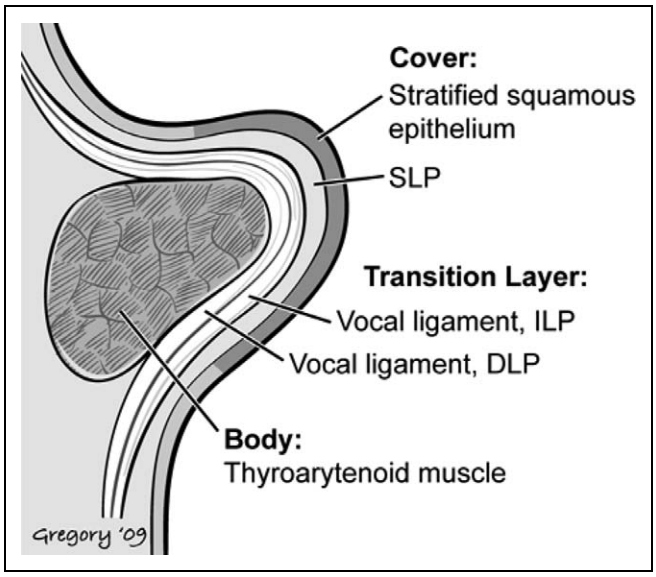

Figure 1. The layers of the vocal fold.

deep and intermediate layers of the lamina propria are known as the vocal ligament and transition layer. The superficial layer of the lamina propria (SLP) and epithelium together form the vocal fold cover. Each layer has distinct mechanical properties and can be differentiated by the concentration of elastin and collagen fibers. The arrangement of these proteins within the lamina propria allows passive vibration of the vocal fold cover over the body, resulting in the formation of the mucosal wave. The transition layer provides support as well as adhesion between the cover and the body. The cover floats over the body much like river water and a raft tethered to the river bottom float freely over the earth. Because the cover is attached to the body, changes in the body's mass and tension will affect the vibratory characteristics of the cover. For example, as the thyroarytenoid muscle lengthens and thins, the cover will stretch and tense, resulting in a higher frequency of vibration and thus a higher pitch.

Efficient singing can be defined as producing the desired sound with the least effort and minimal trauma to the vocal folds. This takes talent and years of training. As our knowledge of vocal fold physiology has increased, it has become clear that singing does not require great strain. In fact, singing should require minimal effort and strain is a sign of dysfunction. Singers who understand vocal fold physiology can visualize what should be occurring in the larynx, and this helps them execute. Physiologically, the vocal folds are energy transducers that convert aerodynamic power, generated by the chest, diaphragm, and abdominal musculature, into acoustic power radiated at the lips and heard as voice (Titze, 1988). Efficient phonation occurs when there is minimal loss of aerodynamic power as it is converted into acoustic power. Just prior to the initiation of phonation, the intrinsic muscles move the vocal folds toward the midline, into approximation or near approximation. The muscles then set the tension and mass of the vocal folds and hold the vocal folds in position against the air pressure created by the chest, diaphragm, and abdomen (subglottic pressure). It is the subglottic pressure that drives the vocal folds and forces them to passively vibrate. This air pressure provides the energy of the phonation, not the activity of the intrinsic or extrinsic laryngeal musculature. When the vocal folds are nearly or lightly closed, the subglottic pressure forces the vocal fold cover laterally. Due to the elasticity of the vocal folds, when the cover reaches its most lateral excursion, the energy rebounds and is transferred into a closing force that returns the cover back to its original position and shape. In addition, when the glottis opens and air rushes through, a negative pressure is generated secondary to the Bernoulli effect, pulling the vocal folds together. The continued subglottic air pressure then again forces the vocal fold covers laterally and a phonatory glottic cycle beings again (see Figure 2). This physiologic explanation of vocal fold vibration and the glottic cycle is known as the myoelastic-aerodynamic theory of voice production (Titze, 1995; Van Den Berg, 1958).

As the vocal folds close during each cycle, the glottal airflow is interrupted and an acoustic signal is produced. This signal is then amplified or dampened at specific frequencies based on the characteristics of the resonance chamber. This chamber extends from the vocal folds to the lips and nasal vestibule. Manipulation of the resonance chamber will alter the frequencies that are dampened or amplified. It is this resonance that turns the buzzing sound of the vocal folds into recognizable vocal sounds, much as a saxophone changes the buzz of a vibrating reed into recognizable musical notes.

The energy for vocal fold vibration and voice is derived from subglottic air pressure. A supple vocal fold cover is necessary for an efficient transfer of aerodynamic power into acoustic power. The cover must vibrate easily and smoothly in response to the subglottic pressure. The intrinsic laryngeal

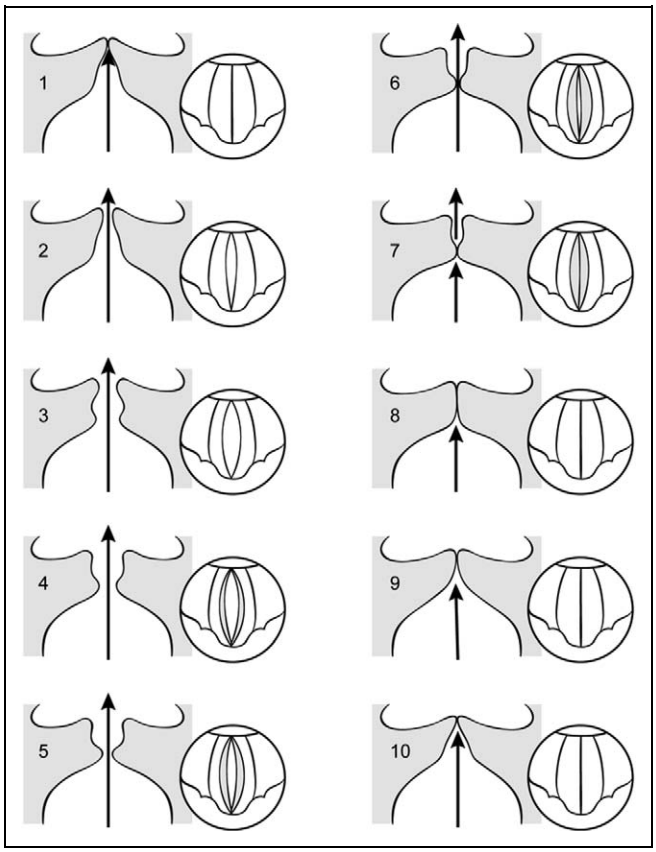

Figure 2. The phonatory glottic cycle.

musculature simply shapes the vocal folds based on the desired pitch and holds them in position. The resonance chamber alters the acoustic signal to create recognizable and beautiful sound. Although this requires immense skill and precision to perform on a professional level, it does not require significant strain.

When this system becomes unbalanced by pathologic changes in the vocal fold tissue or by poor vocal technique, a vicious cycle of vocal decompensation will result. Pathologic changes in the vocal fold cover alter the vibratory characteristics of the fold and increase the power needed to initiate phonatory vibration. This increases the stress on vocal fold tissues and results in damage that leads to further pathologic changes requiring yet another increase in energy to initiate phonation and so on (Jiang & Titze, 1994). A cycle of repetitive trauma and wound healing ensues that causes histologic changes in the SLP and epithelium, altering the mechanics of the cover and hence the cover's vibratory characteristics (Courey, Shohet, Scott, & Ossoff, 1996; Thibeault et al., 2002). When the vibration of the cover is adversely altered, the acoustic signal emitted is degraded with the resultant negative change in phonation and voice production. This negative change is perceived as dysphonia. Anything that negatively alters the vibratory characteristics of the vocal fold cover will result in dysphonia.

Dysphonia in a singer is not only hoarseness or raspiness, but it is any change in the voice at all. This may be breathiness; loss of range; decreased color, fullness, or brightness; strain; vocal fatigue; increased warm up or cool down time; vocal breaks; or loss of pitch control. These are but a few of the common symptoms that singers develop. It is at this early point, before there is frank hoarseness, that a professional singer should consult with his or her team and undergo a laryngeal examination. Although the symptoms may be minor or intermittent, they are a signal that something, hopefully minor, is wrong. To remain vigilant, it is helpful to perform a vocal fold swelling test each day. One such test, which should be performed at the same time each day for consistency, is singing as softly as possible in the upper register, "5 5 5 5 4 3 2 1." Repeat it, raising the pitch half a step and stopping when it requires an increase in energy. One should reach approximately the same pitch each day. When the pitch reached is lower than usual, it is an indication of vocal fold swelling.

Mechanical stress is not the only contributor to vocal fold pathology and alteration of the vocal fold vibration. Any change in the balance of the phonatory system can lead to changes in vocal fold vibration as well as predispose the vocal folds to wounding trauma. Hydration is extremely important as dehydrated vocal folds become stiffer (Chan & Tayama, 2002). Stiffer vocal folds require more subglottic pressure to initiate phonation (Verdolini, Titze, & Fennell, 1994). Increased subglottic pressure and stiffer vocal folds result in increased vocal fold stress and trauma.

One of the most highly publicized causes of vocal fold inflammation and dysphonia is laryngopharyngeal reflux (LPR). Vocal fold inflammation not only changes vocal fold vibratory characteristics but also makes vocal folds more susceptible to trauma. Although for many years it was thought that LPR could be a cause of laryngitis, it was not until 1991 that this was clearly demonstrated (Chodosh, 1977; Koufman, 1991). Nearly 20 years later, LPR is still a very controversial topic, especially as LPR now seems to be overdiagnosed as a cause of dysphonia.

Another frequent cause of laryngeal inflammation is allergic rhinitis and its various treatments (Cohn, Spiegel, & Sataloff, 1995). Singers with respiratory allergies need to be treated very differently from nonprofessional voice users. Their allergies need to be tightly controlled as they can lead to vocal fold inflammation, increase glottal mucous, decreased facial resonance, chronic cough, and decreased pulmonary function. Many available treatments can exacerbate a patient's dysphonia. Antihistamines are extremely drying and should be avoided. Steroid pulmonary inhalers can be devastating to singers. They can cause vocal fold inflammation and fungal laryngitis, which are reversible but can also lead to vocal fold atrophy, which may be permanent (Gallivan, Gallivan, & Gallivan, 2007). Alternatively, nasal steroids, montelukast sodium, and immunotherapy are effective treatments that do not significantly affect the larynx.

Although LPR and respiratory allergies are two of the most common medical causes of laryngeal inflammation and dysphonia, the list of possible medical etiologies is extensive (see Table 2). All voice team members must be aware of the array of causes of dysphonia and that not all dysphonia is due to reflux.

Table 2. Systemic Causes of Dysphonia

Laryngitis—viral, bacterial, or fungal	
Sinusitis	
Respiratory allergies	
Pulmonary dysfunction	
Lower respiratory tract infection	
Tonsillitis	
Autoimmune disease	
	Sarcoidosis
	Wegener's granulomatosis
	Lupus
	Rheumatoid arthritis
	Amyloidosis
Aging	
Hearing loss	
Laryngopharyngeal reflux	
Endocrine dysfunction	
	Hypothyroidism
	Sexual hormone imbalance
	Normal menstrual cycle
Neurologic disorders	
	Myasthenia gravis
	Stroke
	Dystonia
	Tremor
	Multiple sclerosis
Anxiety	
Substance abuse	

There are many patients who are unsuccessfully treated for reflux related dysphonia, only to find that the true etiology of their symptoms is laryngeal carcinoma. We must be ever vigilant in investigating etiologies alternative to LPR. In addition, considering that the use of tobacco and alcohol is higher in a performing population, malignancy must be ruled out as the cause of any dysphonia that lasts longer than 2 weeks.

In a singer, if a vocal fold lesion is discovered, it is most likely not carcinoma but a benign vocal fold lesion. Vocal trauma, misuse, and abuse result in damage to the tissues of the vocal fold that results in these lesions (Gray & Titze, 1988). The most common benign lesions noted in singers are nodules, polyps, and cysts. These generally occur on the vocal fold vibratory edge at the junction of the anterior and mid-third of the fold because this is the area of the greatest impact stress (Jiang & Titze, 1994). These lesions are often grouped together under the lay term *vocal fold nodules* or *nodes*. In reality, these lesions are very different from each other, require different treatments, and may have different outcomes. It is important to distinguish between the various lesions and understand the basic differences in their treatment and prognosis.

Vocal fold nodules are the most common benign lesions in singers and in the general population. They are small, fusiform, symmetric, bilateral lesions (Dikkers & Schutte, 1991). Nodules have a significant thickening of the epithelium and basement membrane as well as a mature and dense fibrous stroma in the SLP (Courey et al., 1996; Kotby, Nassar, Seif, Helal, & Saleh, 1988; see Figure 3).

While nodules have a consistent appearance, polyps can be quite varied. Their hue may range from translucent to red. They are generally unilateral and can be sessile or pedunculated. Clinically and histologically, they are classified into three categories: gelatinous, angiomatous, and transitional (Kleinsasser, 1982). Gelatinous polyps have a loose edematous stroma with an almost watery appearance. The angiomatous polyps have increased vasculature and vascular spaces. The transitional polyps are a combination of the two. Unlike nodules, the basement membrane is unaltered (Courey et al., 1996). They are not related to other polyps found throughout the body and do not have the potential of malignant degeneration.

Vocal fold cysts are the least frequent benign lesion of the vocal fold. They are completely submucosal ovoid lesions that occur within the SLP. At times, the lesion is not visualized but fullness and a decreased vocal fold mucosal wave is identified at the junction of the anterior and mid-third of the vocal fold. These lesions are generally unilateral but can be bilateral in rare cases. Vocal fold cysts are categorized as either mucinous or epidermoid, and each has a true lining. Epidermoid cysts are lined by squamous epithelium and filled with keratin while mucinous cysts are lined by cuboidal or columnar epithelium and filled with mucous (Bouchayer et al., 1985; Monday, Cornut, Bouchayer, & Roch, 1983). Both lesions occupy space in the SLP and displace the tissue of the SLP. They are usually adherent to the vocal ligament and create a more significant inflammatory response than either a nodule or a polyp.

Correct identification of the lesion is important because the treatments and prognoses of a nodule, polyp, and cyst are different. The use of videostroboscopy is essential to the accurate diagnosis of these lesions. It is useful or essential in 68% of cases and will alter the diagnosis and treatment plan 13% to 14% of the time (Casiano, Zaveri, & Lundy, 1992; Remacle, 1996). For a singer, a treatment plan should never be made without a videostroboscopy. The videostroboscopy works by using pulsed light to illuminate the vocal folds via a laryngoscope. The pulses are slightly asynchronous with the vocal fold frequency. As a result, a pseudo-slow motion video is created. The effect is similar to a person dancing under a strobe light at a disco. The videostroboscopy allows evaluation of the vibratory characteristics of the vocal fold cover. These characteristics are affected in disparate ways by the various lesions. As such, the videostroboscopy aids in diagnosis of the lesion. Videostroboscopy also allows visualization of the glottal closure, amplitude of vibration, and symmetry or asymmetry of the mucosal waves. These findings, which reflect vocal fold function, are not discernable under constant light. It is recommended that all singers undergo a baseline videostroboscopy when they are in good vocal health. Many singers have slight vocal fold irregularities at baseline. If these irregularities are first seen during a dysphonic episode, they may be mistaken as the offending pathology with a resulting misdiagnosis and ineffective treatment.

Once a correct diagnosis is obtained, an effective treatment regimen can be recommended. Laryngitis and nodules almost always clear with conservative treatment while polyps may

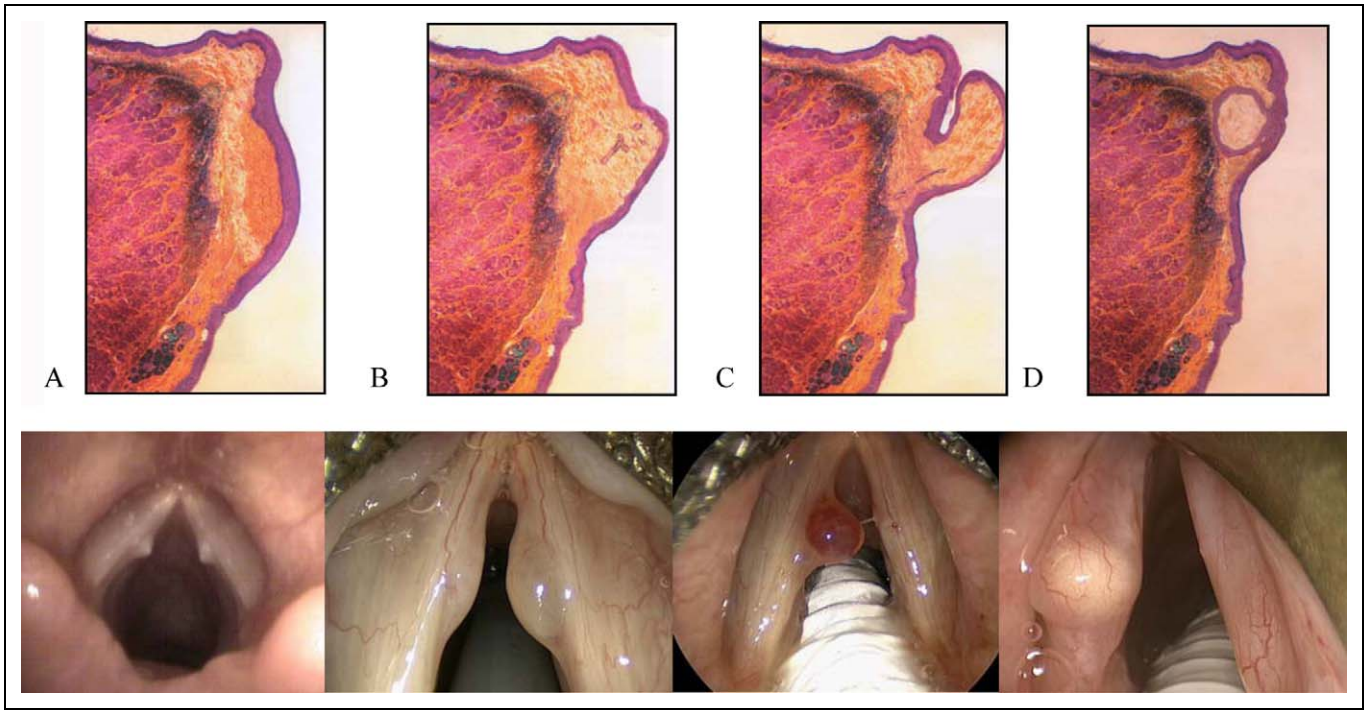

Figure 3. Histologic schematic of a vocal fold nodule (A), sessile polyp (B), pedunculated polyp (C), and keratin cyst (D) produced by Adobe Photoshop manipulation of a normal vocal fold treated with a Movat stain.
The corresponding in vivo appearance is directly below each slide. Images 3A–3D reprinted with permission from Ossoff, Shaphay, Woodson, and Netterville (2003, color fig. 16 1–3).

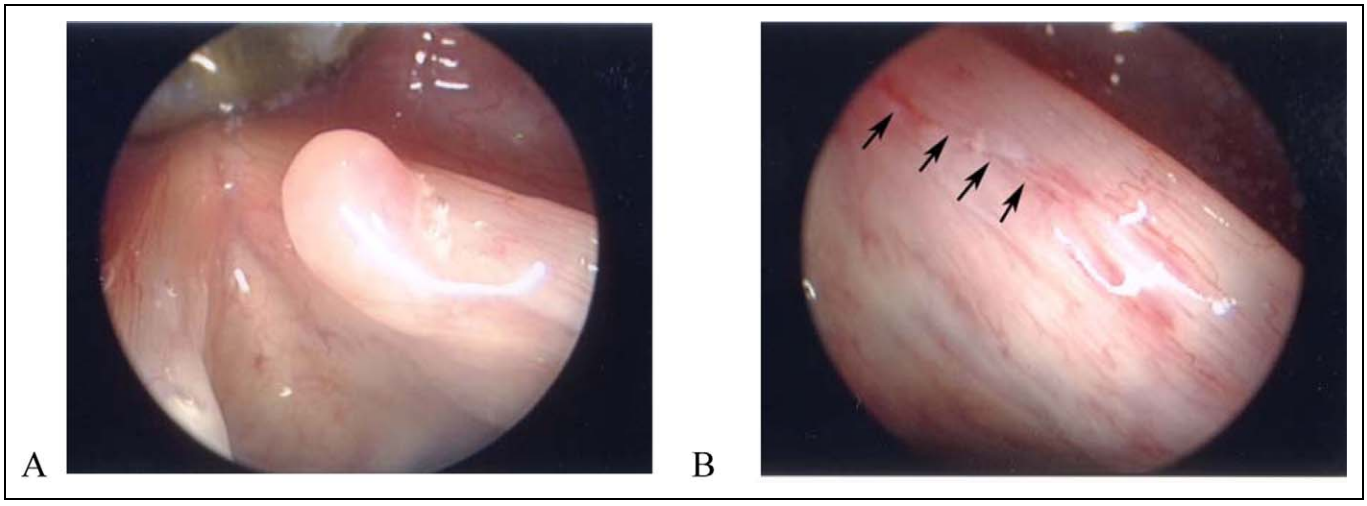

Figure 4. Preoperative polyp (A) and postoperative image (B).
Arrows indicate cooptation of mucosal edges of the microflap allowing primary healing.

occasionally resolve and cysts rarely do. In all cases, the underlying etiology must be addressed to treat the current episode and prevent recurrence. Contributing medical issues must be identified and controlled. Lifestyle issues need to be addressed. The diet is modified to reduce reflux, and dairy is restricted for singers who find that it increases their phlegm. Smoking of any kind should cease. Throat clearing should be avoided as it is extremely traumatic. Hydration is to be optimized with eight glasses of water per day, and dehydrating caffeinated fluids are minimized. To further improve hydration, the environment should be humidified, especially in the winter when the natural dryness of the air is exacerbated by radiant heat. Many of the jobs that allow singers to pursue their careers affect the voice. Waitering, hostessing, or bartending are three vocations prevalent in the

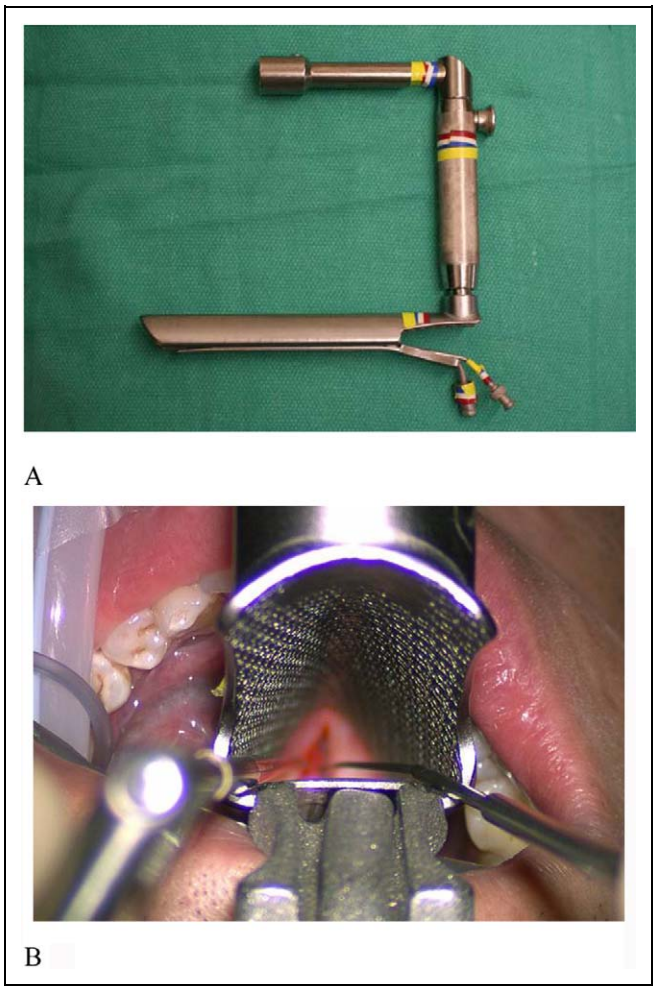

Figure 5. Laryngoscope (A) and transoral exposure and micro-instrumentation (B).

performing community and are hazardous to singers. Alternate employment with a low voice demand should be sought.

One of the activities that is most damaging to singers and often overlooked is speaking. When performers are singing, they will use the vocal techniques they have learned. When they speak, often no attention is paid to technique. Yet, speaking accounts for 99% of a singer's phonation time. In addition to normal voice use, singers may act as their own producer and manager, booking all of their performances and handling their daily business. They often stay late after performances to speak with fans and business associates, generally in a loud environment.

When performers are on tour, all of the above issues become magnified. Not only are they singing more than usual, but they are eating poorly, have a high speaking voice demand with interviews and radio shows, are exposed to dry air in a tour bus or airplane, and are physically fatigued from the rigors of traveling and performing nightly. This is a perfect storm for vocal decompensation.

When addressing behavioral management, the singing voice specialist (SVS) is extremely helpful. The SVS is a speech language pathologist/voice therapist and singer who combines the knowledge of music, pedagogy, and performance with therapy. They are uniquely qualified to aid in the rehabilitation of an injured singer and are an integral part of the voice team. In the author's voice institute, all singers are seen at each medical visit by both the laryngologist and the SVS. With different backgrounds, they work synergistically to provide optimal care. If necessary, the SVS will then see the singer once or twice a week for therapy. In these sessions, time allows further evaluation of the singer's behaviors, vocal technique, vocal abuses, and vocal demands both inside and outside of performance. The SVS will perform laryngeal function testing, which objectively evaluates the efficiency and quality of the voice. Information gleaned from the medical visit, therapy session, and laryngeal testing allows the SVS to create a personalized voice program for the singer that will optimize vocal therapy. The SVS employs a wide array of therapy techniques and will work closely with the singing teacher as each one's expertise complements the other. Regardless of how experienced or accomplished a singer may be, self-reference is difficult and an external expert is always helpful.

Behavioral changes and voice therapy take devotion and time. Singers will often seek a rapid resolution of their symptoms because of scheduling demands. They will frequently turn to voice rest or steroids secondary to tradition and associates' testimonials. These may be helpful but dysphonia will return if a diagnosis is not made and a broader treatment plan initiated. Voice rest can aid in a quicker resolution of vocal fold inflammation. There is minimal benefit of voice rest beyond 1 week and it may even be detrimental. Similarly, steroids can be helpful in the treatment of acute inflammation, allowing a performer to complete a show in the near future. They must be used with caution. Not only do they have physical side effects, but singing through inflammation can lead to a permanent injury. It is safer to cancel a performance or audition than risk permanent injury or a poor show. As caregivers, we must make and enforce this difficult recommendation when it is medically necessary. Performers may see their engagement as an opportunity that cannot be missed. As their caregivers, it is our duty to be their advocate and protect their health and their careers. The canceling of one show rarely ends a career but a vocal injury can.

Conservative treatment of vocal fold nodules, polyps, and cysts results in the resolution of symptoms in nearly half of the patients with submucosal vocal fold lesions, ultimately saving these patients from an operation (Cohen & Garrett, 2007). When conservative treatment fails, surgery becomes an option. The indication for surgery is not the presence of a vocal fold lesion but a lesion causing dysphonia severe enough that the singer can no longer perform.

Surgical treatment of benign vocal fold lesions is more reliable and successful than it has been in the past. Historically, these lesions were grasped and either bluntly or sharply removed. This leaves a bare area that heals by secondary intention with an abundant amount of scar resulting in a variable vocal outcome. Improved surgical technique resulting in

Figure 6. Intraoperative setup.

consistently good vocal outcomes was developed after discovering that these lesions were submucosal within the SLP. It became logical to open the vocal fold and remove the lesion from inside while preserving the SLP and causing minimal trauma to the epithelium. When the surgery is complete, there is coaptation of the edges of the incision and primary healing can occur (see Figure 4). This technique has been termed microflap surgery. (See accompanying Web video of cyst excision, available as supplementary material at http://mmd.sagepub.com/ supplemental.) It minimizes the formation of scar tissue and results in a preservation of the vibratory characteristics of the cover (Courey, Gardner, Stone, & Ossoff, 1995; Sataloff et al., 1995). Nearly all professional singers who undergo this type of surgery will return to active careers (Zeitels, Hillman, Desloge, Mauri, & Doyle, 2002). The surgical outcomes are operator dependent. When considering surgery, a singer should seek an otolaryngologist who specializes in this type of surgery, has significant experience, and is part of a voice team.

Microflap surgery is microsurgery. Everything is done through the mouth via a laryngoscope that exposes the vocal folds (see Figure 5). A powerful microscope is used to magnify the lesion that generally ranges from 2 mm to 5 mm (see Figure 6). The surgical instruments are specially constructed for this surgery and consist of 3 mm scissors and dissectors at the end of a 27 cm shaft (see Figure 7). Due to the fulcrum effect created by this length of shaft in relation to a small working tip, every slight movement or tremor is magnified at the end of the instrument. Because the lesion is so small and the tissues are so delicate, all movements must be well controlled to avoid vocally devastating consequences. Although the lesion is small, it will take 45 to 60 min to remove it.

After surgery, the patient is on complete voice rest so the flap can heal. The optimal length of voice rest is not known. The author prescribes 4 to 5 days, but some surgeons may prescribe 2 full weeks. Once voicing begins, there is a slow progression of voice use beginning with 5 min on the first day and doubling every day thereafter. Weekly voice therapy begins immediately after voice rest. Therapy minimizes scar formation, strengthens the voice, and teaches efficient vocal technique. Patients will begin singing at approximately 4 weeks and will be ready for a full performance at 8 to 12 weeks.

Care of the professional voice is a highly demanding and specialized task. These vocal athletes require a team of professionals to meet their health needs. All the members of the team must excel in their arena but they must also understand the roles of others so they can work in concert. A collective awareness of basic laryngeal anatomy and physiology and the causes

Figure 7. Microsurgical scissor.

of dysphonia, as well as the skills and treatment modalities provided by other team members, fosters educated and timely referrals, knowledgeable and responsible patients, and collaborative treatment, which, most importantly, results in excellent care. As we rise to the challenge of caring for professional singers, our level of care is elevated and enhances the standard of care for all of our patients.

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Bio

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