The Use of Inhalation Phonation in the Voice Studio: A New Approach to Addressing MTD in Singers

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[Editor's Note: A tutorial video illustrating procedures outlined in this article may be accessed on the official NATS YouTube channel, https://youtu.be/uMgaW4ckuws.]

INTRODUCTION

Singing is both an art and an athletic endeavor. It requires a perfect coordination of the respiratory, phonatory, and resonance systems for an optimized vocal production. However, just as athletes can experience decreased performance because of a physical imbalance (e.g., muscular injury or weakness), a singer can be challenged with a loss of range, power, vocal quality, and decreased ease of phonation with an imbalanced speaking or singing voice. Muscle tension dysphonia (MTD) is a voice disorder related to muscular imbalance in and around the vocal mechanism.[1] The muscle tension patterns in MTD can be significant in nature and even prevent normal phonation from taking place, which is why aphonia (the inability to produce sound) is often grouped with MTD as the letter A (MTD/A).[2] Most singers experience a mild to moderate form of MTD, but it is possible for singers to become aphonic because of extreme muscle tension patterns. Singers with MTD present with symptoms that include a high laryngeal carriage, hyperactive contraction of the ventricular folds, and an anterior-posterior squeeze from the arytenoid cartilages forward to the epiglottis.[3] Symptoms of MTD include difficulty singing in a particular range of the singing voice, effortful voice production, fatigue and/or hoarseness after singing for a short period of time, and discomfort with voice use. MTD is typically exacerbated by emotional stress and overuse/misuse of the voice, and can also be present secondary to primary vocal disorders such as a vocal fold paresis (i.e., partial paralysis), a benign vocal fold lesion such as a cyst or nodule, or other irritations of the larynx (e.g., laryngophargyneal reflux disease [LPRD]), allergies, or inflammation from a bacterial or viral infection. Abnormal muscle patterns can also arise from a habitual vocal technique, personality, misaligned physical posture, and/or insufficient breath management; it is not uncommon for there to be palpable tension in the extrinsic laryngeal musculature and associated soreness to the touch. MTD patterns can present in both the speaking and singing voice, and it is not uncommon to have tension patterns from speaking negatively impact the singing technique (Figure 1).

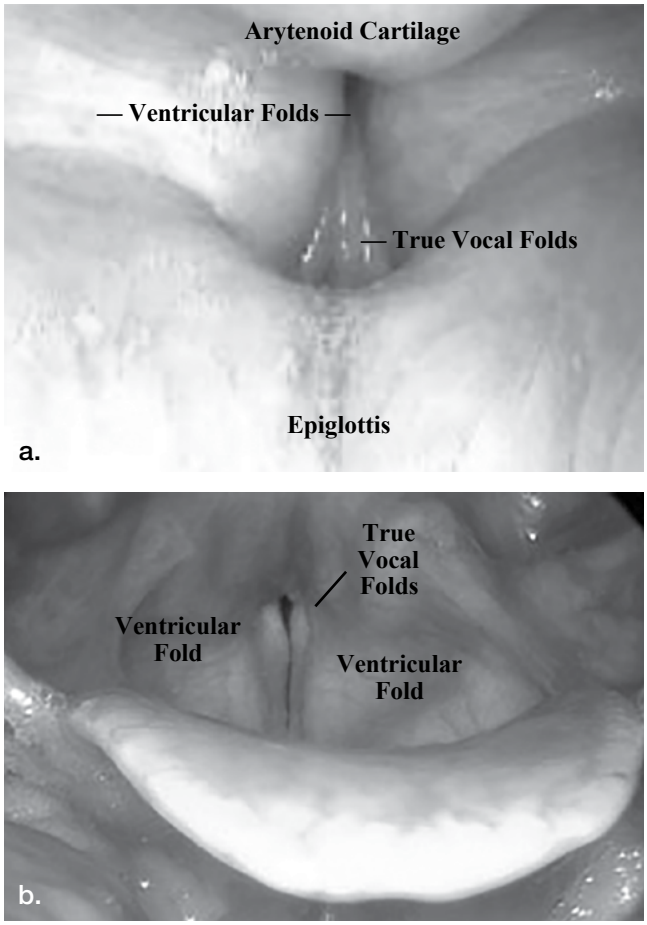

Figure 1. a) Extreme MTD, anterio-posterior and lateral squeezing of surrounding musculature (photo used with permission from Blue Tree Publishing); b) moderate MTD with lateral compression (photo used with permission from Tom Harris, British Voice Association).

MTD was initially classified in 1982 by Koufman and Blalock who later coined the "Bogart-Bacall Syndrome," after the low-pitched and gravelly voices of Humphrey Bogart and Lauren Bacall.[4] The definition of MTD was modified to "muscle misuse voice disorder" by Morrison in 1983[5] and later redefined as MTD in 1986[6]—including four specific classifications based on the glottal configurations, tension patterns, presence of supraglottic tension, and/or mucosal lesions. Most of the literature describing MTD relates to the tension patterns observed in the speaking voice.[7]

In singers, MTD presents differently and more subtly. Singers are extremely sensitive to minute changes in the laryngeal mechanism and quite masterful at manipulating extrinsic laryngeal musculature, often compensating for an underlying irritation, weakness, or change in vibratory patterns of the vocal folds. Because singing in general is more flow-based than speaking voice production, the classic changes that are telltale signs of MTD in the speaking voice are not present with singing (e.g., glottal fry, low fundamental frequency, rough or gravelly vocal quality).[8] Thus, MTD often goes undetected in singers until the muscle tension patterns impact vocal range, vocal flexibility, cause fatigue or pain, or result in changes in the vocal quality. By this time, muscle tension patterns have been well established and often mucosal changes (i.e., vocal fold swelling) in the mid-membranous portion of the vibratory edges of the vocal folds occur as a result. The glottal configurations present in singers with MTD do not fall into perfect categories, nor are they the only form of muscle tension observed. Tension is often also co-occurring in the tongue base, jaw, and the hyoid complex of muscles, which can result in decreased mouth opening and a high posturing of the laryngeal carriage. There can also be a restriction of the laryngeal cartilages reducing vocal range. Muscle tension in and around the laryngeal mechanism also causes a disturbance in the pharyngeal space and a decrease in overall resonance as a result; MTD actually causes a dampening of the source of vibration into the filter or vocal tract, which directly impacts secondary vibration/resonance.[9] Tension in the extrinsic laryngeal musculature (i.e., sternocleidomastoids, scalenes, trapezius) can cause an imbalance in

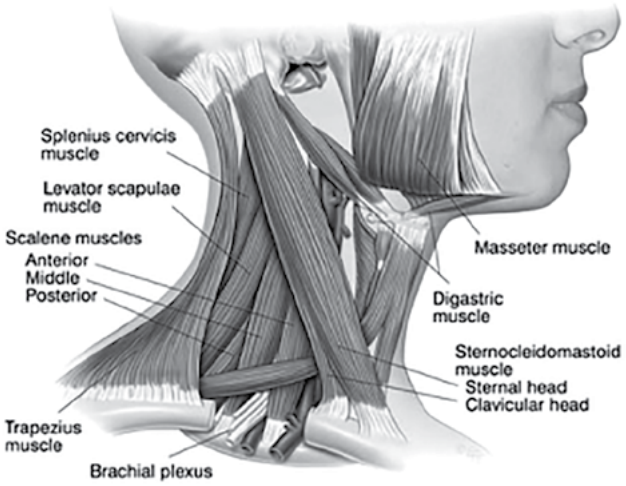

Figure 2. Musculature surrounding and potentially impacting the larynx and phonation either from muscle tension patterns and/or misalignment of the head in relationship to the spine.

intrinsic laryngeal musculature, especially as increased tension in the thyroarytenoid muscle and/or increased compression of the true vocal folds during phonation (Figure 2).[10]

Tension in the head, neck, and shoulders also can impact postural alignment, and often is seen as rounded shoulders, a forward head position, and depressed sternum.[11] Singers who sing with any kind of muscle misuse or overuse often will complain of vocal fatigue, may experience hoarseness or a voice change at the end of a voice lesson or performance, and can experience increased effort. They also may present with a speaking voice that doesn't match their singing *Fach* (particularly sopranos and tenors). However, the singing voice quality may not change significantly, and consequently their tension can go unnoticed by others, especially if they do not openly discuss the difficulties they are experiencing.[12] Depending on the characteristics of the muscle tension patterns, the upper range may be particularly difficult because of the increased compression on the vocal mechanism or the singer may experience difficulty accessing the chest/modal voice. It is also not uncommon for singers with MTD (especially sopranos and tenors) to have difficulty accessing their lower register after practicing or following a voice lesson. These are common signs of hyperfunctional muscle use.

MTD is traditionally addressed in the voice studio by reducing and/or eliminating muscle tension directly with massage, by optimizing the laryngeal carriage position with a downward massage, or, if moderate to extreme, circumlaryngeal manipulation to help lower the laryngeal environment,[13] by increasing the effectiveness of breath management/balance during phonation, through the optimizing of postural alignment, physically releasing tension in the head, jaw and tongue during phonation, by promoting flow-based phonation, and decreasing overall effort required for phonation.[14]

Inhalation phonation (IP), a phonatory technique traditionally used as a voice therapy method, may be utilized for a more direct and effective manner of restoring optimal flow phonation and the sensations of efficient voice production. Inhalation phonation is the production of voice during inspiration paradox to normal voice production and has appeared in voice research as "inspiratory phonation," "ingressive voice production," or reverse phonation.[15] IP has been used as a form of voice therapy for patients with MTD, granuloma, benign vocal fold lesions, vocal fold scar, unilateral vocal fold paralysis, superior laryngeal nerve paresis, spasmodic dysphonia, and functional dysphonia.[16] IP is now considered part of the standard protocol during strobovideolaryngology to aid in identifying laryngeal vestibule lesions and in differential diagnosis between cysts and lamina propria lesions.[17]

The literature on inhalation phonation is primarily focused on the speaking voice, but the concepts and benefits apply to phonation, in general. When we inhale, the vocal folds and the muscular architecture in the supraglottic tract expand and open. When we inhale phonate, the following changes occur:

- the diaphragm contracts;
- the larynx descends (tracheal pull);
- tongue and jaw relax;
- the velum lifts;
- there is ventricular distention/ventricular fold separation;
- the mucosal wave moves in an inverse direction (reverse Bernoulli effect);
- cricothryoid muscle activation occurs with commensurate vocal folds lengthening;
- there is decreased arytenoid compression;
- a lengthening and widening of the hypopharynx is created;
- pharyngeal space for resonance is optimized;
- there is an instant elimination of anteroposterior constriction;
- vocal fold adduction occurs, but not through the full membranous cord;
- there is an overall contact instability resulting in increased airflow;
- fundamental frequency increases;
- the mucosal wave tends to increase and normalize amplitude of waveform;
- there is report of a steeper slope of harmonic peaks in the acoustic signal (Figure 3).[18]

RATIONALE FOR USING INHALATION PHONATION WITH THE SINGER

Singers who have developed hyperfunctional muscular patterns often have difficulty modifying those behaviors because they have been learned. One of the clear benefits

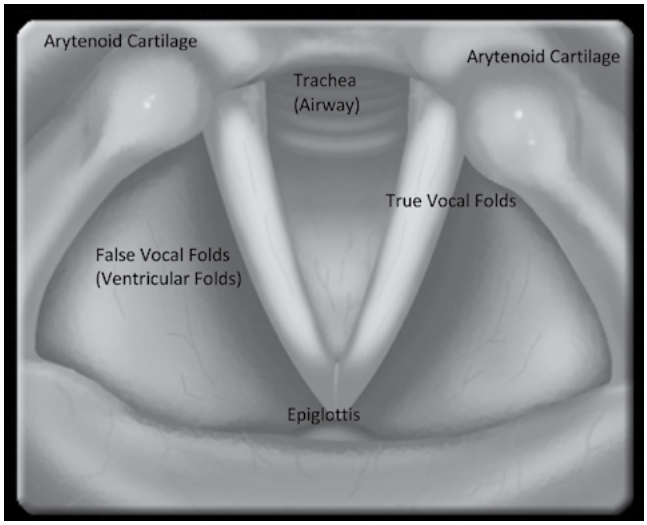

Figure 3. When we inhale phonate, the vocal folds adduct, but with a slight opening at the mid-membraneous part of the vocal folds, and the muscular architecture in the supraglottic tract expands and opens. This action also results in ventricular distention/widening, an inverse mucosal wave (reverse Bernoulli effect), cricothyroid muscle activation with commensurate vocal fold lengthening, decreased arytenoid compression, pharyngeal widening, descent of laryngeal carriage and velar ascent, i.e., lengthening of hypopharynx (model used with permission from Blue Tree Publishing)

of using IP with singers with MTD is that it provides a bio-mechanical "re-set" of the musculature.[19] With the opening/widening of the ventricle, the lowering of the larynx and increase of the hypopharynx and the decrease of anteroposterior constriction that happens upon inhalation phonation, the vocal mechanism along with the respiratory and support mechanisms are cued for optimal coordination and efficiency.[20] IP also can be particularly helpful in educating the singer in the symbiotic relationship between the inhalation at the level of the larynx (natural lowering of the larynx) and the activity of rib expansion and descent of the inspiratory diaphragm and pelvic floor as specific mind-body preparation.[21] The IP (from a glottal perspective) prepares the vocal apparatus for a more muscular appropriate phonation when immediately followed by exhalation and when combined with the coordinating breath management/balance mechanisms. Immediately following the IP with sung or spoken exhalation generalizes the appropriate muscle patterns from inhalation phonation to phonation; the open pharyngeal and ventricular architecture of the IP is maintained in the phonation. Singers with tension in the tongue and jaw are also given a perfect model for tongue and jaw release during IP. Ultimately, through repetitive IP practice, motor learning of the IP muscular posture and flow-based phonation takes place and the hyperfunctional muscle patterns are replaced with optimal physiology and function. The singer gains improved proprioception of efficient phonation, flow, and phonatory control of the coordinating support mechanisms with mindful practice of IP, and inhalation phonation is eventually replaced with mindful inhalation (without sound) with the positive benefits of IP.

Another benefit of and rationale for using IP with singers with phonatory muscular imbalances is the organic nature of the IP. We all use IP prior to sneezing, in laughter, as a gasp, etc.[22] Most singers are capable of producing reverse or inhalation phonation without difficulty. Most are even able to match pitch on inhalation, which facilitates the exhalation on pitch.

Singers who demonstrate MTD often have associated pressed phonation and complain of vocal fatigue from the increased effort. IP models flow-based phonation by naturally eliminating the ventricular compression behind the pressed phonation. Singers may experience lightheadedness when initially working with this technique because of the restoration of increased flow through the vocal mechanism. This is a normal and temporary side effect of the new flow rate and is a sign that flow phonation is being restored with the IP technique.

The vocal fold adduction promoted in the IP phase by a reverse Bernoulli effect also restructures the nature of vocal fold adduction in exhalation to a more aerodynamic event, replacing the muscular effort. This inverse mucosal wave is responsible for improved amplitude and symmetry of vibration and overall vibratory characteristics of the vocal folds,[23] which is ideal in singers who may have secondary mucosal trauma from habitual pressed phonation. From a singing voice production perspective, this change in muscular behavior also results in clearer phonation. The natural contraction of the cricothyroid muscle during IP thins and elongates the body of the vocal fold. This stretching maneuver also can aid in improving the symmetry of vibration of the vocal folds, particularly helpful for any vocal fold stiffness or a neurological weakness such as a superior laryngeal nerve paresis. As the vocal folds respond more

symmetrically during phonation, the singer doesn't have the need to compensate. This aids in and reinforces the restructuring of muscle tension patterns.

One by-product of hyperfunctional muscle tension patterns in singers is often a decrease in habitual fundamental frequency (F_0). This can result in loss of ease of singing in the upper and/or lower range, increased vocal fatigue, and discomfort in the throat musculature. By using inhalation phonation in the speaking voice, the singer can naturally recalibrate the physiological F_0 to one that is more appropriate, along with ameliorating the negative consequences in the singing voice technique. Reinforcement of optimal voice production in the speaking voice also helps to generalize the singing voice.

Exercises for the Singing Voice

As with any new pedagogic concept, it is always best to begin with training IP in isolation. Many singers will be able to produce IP without difficulty, but some will find it counterintuitive and challenging. Producing IP in an organic form may be the easiest training tool (e.g., sneeze, laugh, gasp). Once the IP is established, practice the IP in the speaking voice and gradually transition into inhalation/exhalation hum. The IP hum is helpful in decreasing the drying effect that can occur with the production of IP. The singer will be able to become more sophisticated in its production over time and a natural hierarchy of IP exercises will emerge. Because the benefits of IP have been described primarily when immediately followed by exhalation/phonation, that is the manner in which to always train and practice. It is also important to cue a relaxed inhalation with the impetus in the respiratory musculature (expanded ribs, contraction of inspiratory diaphragm, and relaxation of abdominal musculature and pelvic floor).

Suggested Hierarchy for Inhalation Phonation (IP)

- Start by performing an IP in isolation organically (as in a gentle gasp, an inhalation following a laugh, etc.) with a cue to initiate the inhalation with rib expansion and a subsequent low breath. This avoids a high, clavicular breath and associated head and neck tension. The IP serves as the inhalation for the duration of the exercises. The exhalation part of the exercise immediately follows the IP without a gap in phonation; the vocal folds do not abduct until after exercise is complete. Encourage the singer to notice the posture of the jaw, tongue, larynx, pharynx, and velum during IP (and phonation). IP is always produced at a comfortable frequency (Hz).
- Progress to an IP on /a/ followed by an exhaled /a/-sigh (speaking voice). Repeat 5 times slowly transitioning from IP to phonation.
- Progress to an IP with a closed mouth followed immediately by an exhaled /m/ or hum. Repeat 5 times, slowly transitioning from IP-hum to hum.
- Progress to an IP with a closed mouth followed immediately by a sustained hum at a comfortable pitch.
- Progress to an IP sustained hum followed immediately by descending 3-note scale on a closed vowel. Transition (upward and downward) by half-steps through a comfortable vocal range.
- Progress to an IP sustained hum followed immediately by singing descending 5-note scale on a closed vowel. Transition (upward and downward) by half-steps through a comfortable vocal range.
- Progress to an IP hum followed immediately by singing a descending arpeggio (8–5–3–1) on a favorite vowel. Transition (upward and downward) by half-steps through a comfortable vocal range.
- Progress to an IP slide (1–3) with a closed mouth followed immediately by a 3–1 slide. Transition (upward and downward) by half-steps through a comfortable vocal range.
- Progress to repertoire by using an IP before singing each phrase.
- Progress to using IP on the first word of each phrase of a song followed by exhaled phonation (EP); simply just singing of the remainder of the phrase.
- Progress to singing part of each phrase in IP followed immediately by EP for the remainder of the phrase.
- Progress to using the feel of IP as a prephonatory gesture but without sound prior to phonation.

DISCUSSION

Some negative reports in the literature regarding IP need consideration.[24] The most reported is a potential for drying the mucosa because of the increased movement of airflow through the glottis. Some easy ways of mitigating the drying effects include the following:

- use of steam inhalation prior to, during and/or following the period of IP practice;[25]
- positive systemic hydration—half your body weight in ounces of water;[26]
- perform the IP with the mouth closed in a reverse hum followed by hum, respectively;
- decrease the duration and intensity of the IP (limits over-doing of IP).

Kelly and Fisher warned against mucosal irritation triggered by prolonged durations of IP.[27] This could be mitigated with the same techniques used to avoid mucosal drying. The same authors subsequently reported a slight increased risk for hematoma, and an increased risk of mucosal lesions with excessive IP. It is important to always cue gentle IP production and to work with this beneficial technique in isolation and not in combination with other facilitating techniques.[28] Singers with an airway irritation (asthma, acute viral or bacterial infection) are not good candidates for this technique.

CONCLUSION

The physiological changes reported in the literature associated with inhalation phonation are well documented and clearly promote a more ideal manner of phonation when immediately followed by exhalation phonation.[29] IP essentially allows for a muscular re-set. The improvements in phonation include release of jaw and tongue tension, amelioration of pressed phonation, a natural lowering of the larynx, and subsequent widening of the hypopharynx. These improve resonance and laryngeal stability, increased flow phonation, improved vibratory characteristics of the vocal folds, a natural stretching of the vocal folds through the contracted cricothyroid muscle, the optimizing of fundamental frequency, and a symbiotic training tool for coordinating phonation and respiration/breath management. Thus, it seems reasonable that IP would be an ideal tool for a singer with established muscle tension patterns consistent with MTD, whether the patterns of tension are mild, moderate, or severe. As with any singing technique, proper understanding of vocal production and necessary cues to optimize correct production is indicated and the possibly drying effects of the technique be heeded. Overproduction of IP would be counterproductive and detrimental.

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Kate A. Emerich, soprano, BM, MS, CCC-SLP, owner, Vocal Essentials, has specialized in care of the professional voice as both a voice pathologist and a singing voice specialist for 25 years. She is also a voice instructor, previously as faculty at The University of Denver Lamont School of Music where she taught Voice, Advanced Vocal Pedagogy, and Acting the Song, and The National Theatre Conservatory (NTC), where she taught Singing Techniques to the MFA candidates. Prior to starting her own private practice, Kate worked as a voice pathologist, singing voice specialist and research associate with Robert T. Sataloff, MD, DMA, FACS, and Ingo R. Titze, PhD at the National Center for Voice and Speech. She holds an undergraduate degree in Vocal Performance and a graduate degree in Communicative Disorders, both from the University of Wisconsin-Madison. Kate has been an active performer in opera and recital. She also lectures frequently on the care of the professional voice and has led a number of voice master classes. Kate has written articles on care of the profes-

sional voice topics seen in *The NATS Journal*, *Journal of Voice*, *Journal of Singing*, *Otolaryngology Head and Neck Surgery*, *Current Opinion in Otolaryngology*, *Head and Neck Surgery*, *Perspectives on Voice and Voice Disorders*, *Otolaryngology Clinics of North America*. She has also published several book chapters and has served on the editorial board of the *Journal of Voice* for 20 years. She continues to be an active researcher on the biomechanics of breathing and phonation.

Ona Reed is a lyric soprano, voice teacher, performer, and future speech-language pathologist, originally from Denver, Colorado. As a soloist Ona has a wide range of styles in her repertoire. She performed in all mainstage operas during her time at Denver University's Lamont School of Music and was part of the chorus of Opera Colorado's *Un ballo in maschera* by Verdi when she was 18 years old. She also has experience performing music theater, contemporary, folk, and jazz music styles. As a teacher, Ona aims to individualize her lessons based on student wants and needs, while focusing on healthy vocal production, artistic expression, and the tenants of music theory. She seeks to make her students well rounded musicians and teaches all her students a balance of both classical and contemporary styles. Ona has taught privately since 2007 and has voice coached for Regis Jesuit High School's Theater Department, individuals seeking improved public speaking skills, and a glam rock band. Though voice is her passion, Ona also has a number of years' experience as an instrumentalist, including violin, piano, guitar, and electric bass. Since finishing her bachelor's degree in 2012, Ona has found a love for medicine and voice science and is currently pursuing her master's degree in Speech-Language Pathology at Hofstra University in Hempstead, New York.

Blow, blow, thou winter wind
Thou art not so unkind
As man's ingratitude;
Thy tooth is not so keen,
Because thou art not seen,
Although thy breath be rude.

Heigh-ho! sing, heigh-ho! unto the green holly:
Most friendship is feigning, most loving mere folly:
Then heigh-ho, the holly! This life is most jolly.

Freeze, freeze, thou bitter sky,
That does not bite so nigh
As benefits forgot:
Though thou the waters warp,
Thy sting is not so sharp
As friend remembered not.

"Blow, Blow, Thou Winter Wind,"
William Shakespeare