

CASE SERIES REPORT

Muscle Tension Dysphonia in Singers and Professional Speakers with Ankyloglossia: Impact of Treatment with Lingual Frenuloplasty and Orofacial Myofunctional Therapy

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Introduction: Muscle tension dysphonia (MTD) describes a condition affecting the feeling or quality of the voice due to increased muscle tension in and/or around the neck and larynx. Ankyloglossia is a condition of restricted tongue mobility that has been shown to be associated with increased muscle tension. This case series explores outcomes for voice users with MTD who have been treated for ankyloglossia.

Methods: Twelve professional or recreational voice users diagnosed with ankyloglossia were surveyed on their symptoms of MTD before and after treatment with lingual frenuloplasty and pre- and post-operative orofacial myofunctional therapy (OMT), a multidisciplinary approach known as functional frenuloplasty. Two investigators independently compiled a list of themes reported by participants and agreed upon common themes.

Results: Eleven out of twelve patients (91.6%) reported clinical improvement in the use of their voice after functional frenuloplasty; one patient reported no change. Five primary themes were noted: improved voice quality, improved ease of singing and/or speaking, increased stamina, increased pitch range, and improved breath support.

Discussion: OMT with lingual frenuloplasty can be an effective adjunctive intervention for treatment of symptoms of vocal tension and fatigue for singers and professional speakers with ankyloglossia. These findings suggest a possible association between MTD and restricted tongue mobility presumably due to underlying myofascial tension.

Keywords: voice, ankyloglossia, singer, tethered oral tissues, orofacial myofunctional disorder, myofunctional therapy

INTRODUCTION

Muscle tension dysphonia (MTD) is a common voice disorder characterized by excessive muscle tension in and around the neck and larynx. Vocal fatigue is a common symptom associated with MTD or vocal hyperfunction, the overuse of musculoskeletal activity during voice production.²³ Patients with MTD may also report unreliable voice, voice breaks, breathy voice, difficulty singing, hoarse and rough vocal quality, and increased vocal effort. MTD may be a compensatory behavior secondary to an underlying abnormality in the larynx (secondary MTD), or primarily associated with acquired muscle imbalance in the laryngeal or perilaryngeal muscles (primary MTD). Psychosocial mechanisms, autonomic system

reaction, respiratory mechanisms, postural mechanisms, inflammatory mechanisms, and neuromuscular mechanisms have been noted as possible contributing factors to MTD.⁶

Voice therapy along with treatment of any underlying organic laryngeal pathology are currently the gold-standard treatments for MTD. Voice therapy helps the patient improve vocal function and reduce symptoms through exercises and techniques geared at improving the way speech-production subsystems (respiratory, phonatory, resonatory) work together to create voice. Nevertheless, some patients still experience vocal tension despite extensive efforts and diligence with voice therapy and training.²²

Professional and recreational voice users are a subset of patients that place uniquely high demands on their voice.^{21,14} Without treatment, vocal fatigue or hyperfunction can pose a challenge to these people who need to sing, speak, and project their voice as part of their profession.⁷

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Ankyloglossia is a condition of altered tongue mobility due to the presence of a restrictive lingual frenulum between the tongue and the floor of the mouth.^{26,27} The lingual frenulum is a three-dimensional structure composed of collagen, mucosa, and fascia.¹² In cases of ankyloglossia, the lingual frenulum is affected in such a way as to impose restrictions in the mobility of either the anterior (tongue-tip) or posterior (mid-body) aspects of the tongue or both. Depending on the severity and presentation of the tongue-tie, a restrictive lingual frenulum can contribute to altered tongue posture and mobility. The tongue range-of-motion ratio (TRMR), validated in a cohort study of 1,052 patients,²⁵ is used to grade the restriction of lingual mobility from 1 to 4, where Grade 1 is TRMR >80%, Grade 2 is 50-80%, Grade 3 is < 50%, and Grade 4 is < 25%. Grades may also include compensations, defined as floor of mouth elevation, muscular neck engagement, and inability to perform isolated movements with the tongue without moving the jaw.²⁶

These restrictions, in turn, affect functions that depend on tongue mobility (speech,¹⁸ swallow, oral hygiene), and/or may lead to compensatory overuse of accessory facial and neck muscles. The functional implications of tongue-tie have been noted to impact oral resting posture, speech, sleep, and swallow function.^{1,2,9,11} Moreover, in a study of 348 patients with ankyloglossia who underwent a lingual frenuloplasty and pre- and post-operative orofacial myofunctional therapy (OMT), a multidisciplinary approach known as functional frenuloplasty, one of the reported benefits was improved vocal singing quality. Other improvements included decreased neck and shoulder tension, improvements to breathing, and decreased clenching.²⁷

These findings suggest a possible interaction between restricted tongue mobility, compensatory overuse of accessory facial and neck muscles, and muscle tension dysphonia. Previous studies have shown a role for combining voice therapy and physical therapy in patients with muscle tension dysphonia.^{14,17} The purpose of this case series was to explore whether functional frenuloplasty, a recently validated protocol for treatment of restricted tongue mobility,²⁷ improves symptoms of MTD in professional voice users seeking management of ankyloglossia for MTD.

METHODS

This paper reports a prospective case series of 12 professional or recreational voice users with self-reported symptoms of MTD who presented for treatment of ankyloglossia to improve symptoms of vocal tension and fatigue. Participants were recruited

from an otolaryngology clinic specialized in the diagnosis and treatment of ankyloglossia.

The treatment protocol included approximately five pre-operative and five post-operative sessions of OMT, with a lingual frenuloplasty procedure in between. The OMT sessions consisted of individualized exercises that target functional goals and objectives. Patients worked on assigned OMT exercises in sessions and at home to improve oral resting posture, promote nasal breathing, improve lingual range of motion, dissociate the tongue and jaw, decrease muscle strain during speech and swallowing, practice tongue placement to the incisive papilla for functional tasks and oral placements for speech, strength and resistance training, and/or improve lingual-palatal suctioning. All patients underwent a lingual frenuloplasty completed by the senior author (SZ). The procedure is completed using either scissors or a CO₂ LightScalpel[®] laser to release the restrictive mucosa, fascia, and/or genioglossus muscle fibers. Dissolvable sutures are placed under the tongue as well.

Investigators reviewed records of all patients who underwent functional frenuloplasty between 2017 and 2022, and selected patients for inclusion in the present series by screening the "social history: occupation" section of their intake paperwork. Inclusion criteria were: (1) self-report of using their voice or speech professionally/recreationally (teachers, singers, coaches, actors); (2) diagnosis of ankyloglossia based on previously established criteria²⁶; (3) treatment of ankyloglossia with functional frenuloplasty according to a published protocol²⁷; and (4) self-reported symptoms of muscle tension dysphonia. Participants consented to allow deidentified data to be used in clinical research (IRB Protocol 2019/07/14).

Pre- and post-operative evaluations followed a standard protocol of subjective interview with inclusion of a questionnaire that asked patients to rate a variety of symptoms, including self-perceived vocal strain, on a scale from 1 (best) to 7 (worst). Patients provided detailed insight to their experiences before and after participating in the functional frenuloplasty protocol. Subjective patient-reported outcomes using a survey and discussion in post-operative appointments were obtained to assess treatment efficacy.

Two investigators (IS and SZ) independently reviewed the patients' reports and listed outcomes by topic. From these, they grouped topics into themes. After discussion, the investigators revised, consolidated, and summarized a final list of five themes by consensus.

RESULTS

Section 1: Cases

Case 1. The patient was a 44-year-old world-renowned female opera singer who has received several scholarships and awards. She had a Grade 3 compensating to Grade 2 tongue-tie along with difficulty in speech articulation, shortness of breath, low vocal stamina, vocal fatigue, and vocal tension. She especially had difficulty with pronouncing and singing German words despite persistent practice. She underwent functional frenuloplasty and reported improvements in the previously mentioned symptoms during the first 2 weeks post-operatively. Her singing became progressively less difficult, and she stated that her voice felt very free. She previously spent extensive amounts of time on vocal warm-ups, but reported that the amount of time had significantly been reduced post-frenuloplasty. Going into the third week of healing during the contraction phase, she noted prior symptoms of tension returning; this was mediated with OMT exercises and stretches. She also reported that bodywork therapy helped relieve myofascial tension during a later interview.

Case 2. The patient was a 28-year-old male who is a classically trained opera singer and meditation teacher. He presented with a Grade 3 compensating to Grade 1 posterior tongue-tie. He reported symptoms of vocal fatigue, restricted tongue mobility, and sleep and breathing issues, and he had a prior history of a speech impediment during childhood. He expressed difficulty with singing certain notes and had trouble articulating vowels and consonants. He was unable to achieve a full low or high pitch range, but reported some improvements in his singing after undergoing OMT for approximately 7 months before his lingual frenuloplasty procedure. During the procedure, he described a feeling of fascial release through his neck that spread down to his lower back. Following the procedure, he reported feeling that his throat opened up and he experienced immediate improvements in tongue mobility, lingual trill capability, stamina in singing and speech, and the ability to produce low notes. He continued post-operative OMT as well. With increased tongue mobility, he was able to sing in a more comfortable range and reach high notes that were effortful for him in the past.

Case 3. The patient was a 46-year-old male who worked as a teacher and sports coach, both requiring extensive vocal demands. He had a Grade 4 compensating to Grade 1 tongue-tie. He had a history of vocal fatigue, severe neck tightness, snoring, orofacial tension, and occasional swallowing difficulty. He previously had a benign vocal fold lesion

that contributed to symptoms of vocal hoarseness and the overproduction of phlegm. The vocal fold lesion was excised prior to his lingual frenuloplasty procedure. Two weeks following the functional frenuloplasty, he reported approximately 95% reduction in his vocal tension and fatigue. He also noted that undergoing manual massage therapy and using mucus thinners seem to have contributed to his improvements.

Case 4. This patient was a 23-year-old female classical vocalist, actress, and dancer. She had recently graduated from an elite music conservatory where she studied classical vocal performance, theater studies, and acting. She reported first experiencing vocal tension and fatigue as a teenager, which negatively impacted her singing ability. She initially presented with a Grade 2 posterior restriction to her tongue. She noticed slight improvements after starting OMT, and then even more relief after she underwent a complete functional frenuloplasty. Following the procedure, she reported feeling an instant release of tension in her tongue as well as her soft palate. She was then able to sing for over an hour at a time, compared to her limited capacity of 20 minutes in the past.

Case 5. This patient was a 26-year-old female dancer and actress. She had a 3-year history of progressively worsening vocal tension and hoarseness. She had previously focused on vocal hygiene to reduce vocal misuse or phonotraumatic behaviors that may have been contributing to her hoarseness. She presented with a Grade 2 tongue-tie and underwent the functional frenuloplasty protocol. She reported significant relief in the tension of her voice, particularly while singing. She noted dramatic improvements in her vocal quality and stated that she felt as though she could finally take deeper diaphragmatic breaths.

Case 6. The patient was a 22-year-old female R&B/Soul singer-songwriter. She reported difficulty with long music recording sessions due to temporomandibular joint (TMJ) pain. She also noted that her bite changed due to orthodontic treatment. She has always felt restricted when singing and reported that she had a speech impediment during childhood, involving difficulty with articulation and ease of speaking. She experienced restricted mobility in her neck which she believed resulted in reduced range of motion and difficulty turning her head from side to side. She felt sore around her mouth and cheeks whenever she spoke or sang for prolonged periods. She mentioned experiencing low endurance for singing because her voice fatigued easily. She underwent two prior tongue-tie releases at another institution but experienced little to no relief. On

examination, she was noted to have persistent ankyloglossia, with Grade 3 compensating to Grade 1. She underwent an additional revision including OMT according to our functional frenuloplasty protocol. After the release, she noticed improvements in her posture and no longer felt that she was being pulled forward. She reported improved enunciation and stated that her voice sounds clearer and fuller. At a follow-up appointment, she reported that she could sing with ease with a wider vocal range, and was able to sing for longer periods of time without feeling strained.

Case 7. This patient was a 44-year-old female light lyric soprano who performed classical (opera, art song, oratorio), jazz, and musical theater, and taught voice and piano lessons. Despite her academic study, singing, teaching and years of training, she reported that her voice felt small, fragile and stunted. She often experienced vocal fatigue which limited her desire to speak. She presented with a Grade 3 compensating to Grade 2 tongue-tie and underwent functional frenuloplasty, which she reports resulted in immediate resolution of previously listed challenges. She felt that the tongue's increased mobility enabled the range of motion of her soft palate to grow which extended her pitch range and overall singing. She described the diaphragm as feeling limber and free. Her voice now feels accessible, strong, predictable, and reliable.

Case 8. This patient was a 19-year-old male student who sang and competed in speech competitions and debates. He had a history of bruxism, vocal tension and fatigue, and jaw and shoulder tightness. He reported that when he tried to sing loudly or for an extended period of time, the muscles behind his jaw would feel extremely tense. He also had difficulty singing high notes and his voice often felt strained. He also reported difficulty with ease of speech. He presented with a Grade 3 tongue-tie and underwent functional frenuloplasty. Since the release, he reported no longer feeling jaw tension or tightness and noted that his shoulders feel more relaxed. He was able to sing higher notes with ease and reported that his vibrato significantly improved. He reported increased endurance during speech competitions and that his voice no longer fatigued easily.

Case 9. This patient was a 43-year-old female who enjoyed singing, but reported TMJ and jaw pain and facial and neck tightness along with vocal tension, especially when singing or speaking excessively. She experienced significant muscle tightness and often felt as though she could not get enough breath while singing. She presented with a Grade 3 tongue-tie and underwent the functional frenuloplasty protocol. She reported that following the procedure, she no longer

felt facial pain or tightness while singing, and also felt a significant decrease in vocal strain. She felt more "open" and that she was able to take in more breaths and hold notes for longer periods of time while singing. She reported overall improvements in her singing quality.

Case 10. This patient was a 23-year-old female professional singer and songwriter. She reported increased vocal effort when trying to project or sing loudly. She had a Grade 3 tongue-tie that was treated with functional frenuloplasty. After the frenuloplasty, she reported an increase in both her upper and lower pitch range. She also reported that her voice sounded clearer and that she exerted significantly less effort to sing at the same volume and power that she previously had to strain to reach.

Case 11. This patient was a 29-year-old female who "has a passion for singing". She initially noted that she felt tension and strain in the diaphragm when singing. She also felt tension in the neck, shoulders, and facial muscles, and reported that her voice was hoarse, tense, sore, and overworked after singing. She also reported increased breathiness during vocal register transitions. She had a Grade 3 compensating to Grade 2 ankyloglossia and underwent functional frenuloplasty. Following the frenuloplasty procedure, she reported feeling release of the tension held in the diaphragm, allowing her to breathe more deeply. At a follow-up appointment, she reported that she was able to produce a stronger, smoother, and more controlled voice with increased resonance. She reported that her register transitions felt smoother, and her neck, shoulder, and facial muscles felt more relaxed.

Case 12. This patient was a 19-year-old female college student studying musical theater. She was an extremely talented singer but expressed mild difficulty with singing high notes. She had been working closely with a speech-language pathologist for voice, speech, and myofunctional therapy. She had a Grade 3 compensating to Grade 2 tongue-tie. Following functional frenuloplasty, she noticed increased tongue mobility but no appreciable change in her singing or perception of vocal tension.

Section 2: Summary of Therapeutic Outcomes

Reported outcomes were obtained through post-operative questionnaires filled out by patients, as well as through discussion with the patient post-operatively. Overall, 91.7% (Case 1-11) of patients reported an overall improvement of reported symptoms. One patient (Case 12) reported increased tongue mobility with no improvement or detriment to the voice. Patients' pre- and post-treatment ratings of

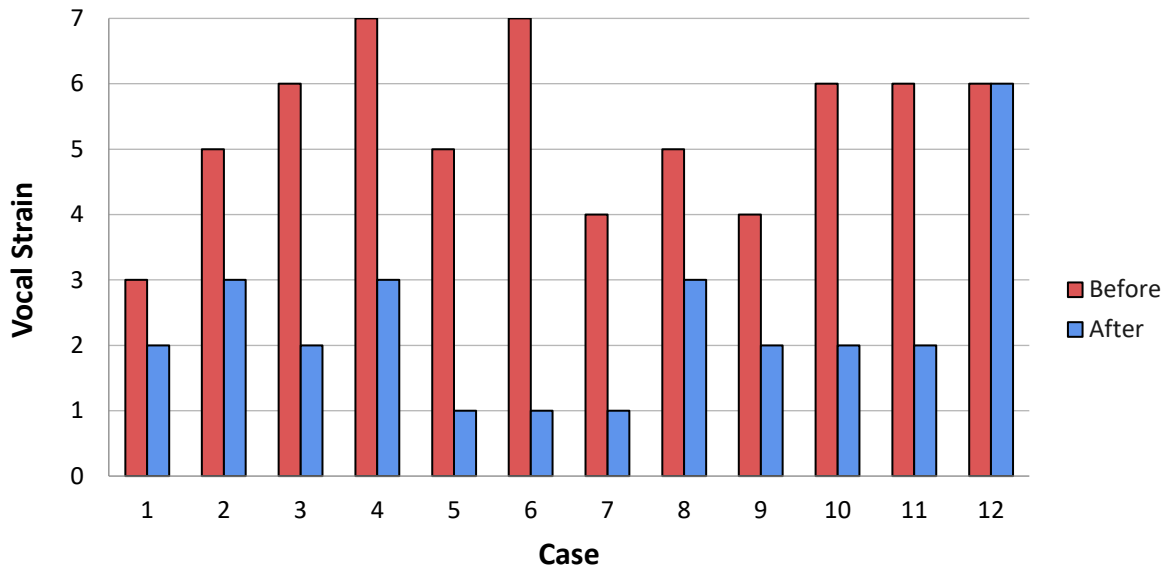


Figure 1. Patient ratings of self-perceived vocal strain before and after functional frenuloplasty. Ratings ranged from 1 (best) to 7 (worst).

vocal strain support this overall assessment, as illustrated in Figure 1.

The two investigators who reviewed patient reports extracted themes until they reached 100% agreement. Themes were chosen based on their mention in more than one patient report. Of all topics reported among patients, six major themes initially emerged regarding clinical outcomes when comparing pre- to post-treatment reports: increased stamina, wider pitch range, decreased shortness of breath, reduced vocal

strain, feeling of freedom, and reduced effort. After further consideration and consultation between the two authors and a voice specialist, a seventh theme was added: improved voice quality. Three themes (reduced vocal strain, feeling of freedom, and reduced effort) were consolidated into one: improved ease of singing/speaking, resulting in five overall themes. The final themes are listed in Table 1 in descending order of prevalence along with case numbers and sample comments.

Table 1. Summary of the five major themes derived from patient reports throughout the functional frenuloplasty protocol.

Theme	N (%)	Cases	Sample Comments
Improved voice quality	8 (67%)	2, 5, 6, 7, 8, 9, 10, 11	Dramatically improved hoarseness; voice sounds clearer, fuller, smoother, more controlled; increased resonance; improved vibrato
Improved ease of singing/speaking	7 (58%)	1, 2, 6, 7, 8, 9, 10	Increased feeling of freedom; less effortful speech; more easily accessible pitches; less effortful inhalation and exhalation
Increased stamina	6 (50%)	2, 3, 4, 6, 8, 9	Less fatigue over time when teaching or performing
Increased pitch range	5 (42%)	2, 6, 7, 8, 10	Increased pitch range; improvements in both upper and lower ends of pitch range
Improved breath support	4 (33%)	5, 7, 9, 11	More supported; able to sustain notes longer

DISCUSSION

The purpose of this case series report was to consider the impact of functional frenuloplasty on symptoms of MTD among individuals with high occupational and recreational vocal demands. Among the 10 singers and 2 professional speakers, all but one singer reported an overall benefit to the self-perceived feeling and functioning of their voice after undergoing a functional frenuloplasty protocol involving lingual frenuloplasty and pre- and post-operative OMT. These findings suggest possible relationships between restricted tongue mobility, compensatory overuse of accessory facial and neck muscles, and MTD.

When the tongue cannot easily elevate to the expected capacity, the surrounding muscles connected from the hyoid bone (i.e., genioglossus, hyoglossus and geniohyoid) may have increased tone. In addition, tension may be noted under the jaw and in the chest.²² Limited lingual range of motion may cause a disproportionate or compensatory pulling or retraction of the hyoid bone during function, and subsequently the other muscles of the tongue and jaw that support movement.^{26, 27}

To produce the range of sounds in speech and singing, the larynx should ideally be optimally relaxed. Excessive tension in the laryngeal and perilaryngeal muscles during voice production has been shown to contribute to MTD.³ As such, restriction of perilaryngeal muscles (including the suprahyoid muscles affected by ankyloglossia) may negatively impact laryngeal and vocal function.

It can be hypothesized that frenuloplasty may improve various aspects of the voice, including vocal stamina (less effort to move tongue and larynx), vocal range (larynx needs to be mobile for pitch change), and vocal strain (less tension on perilaryngeal muscles). Furthermore, diaphragmatic tension has been noted to restrict breathing during vocal use,²² so the release of this tension through the effects of lingual frenuloplasty on the deep front line of fascia (particularly around the diaphragm) may play a role in changes to symptoms of breathlessness, as well as vocal stamina, strain, and tension.²²

As described previously, voice therapy involves exercises and techniques intended to achieve balance across the speech-production subsystems and proper functioning of the laryngeal and perilaryngeal musculature.⁵ Other modalities investigated as adjunctive treatment options for MTD include vibrational therapy localized to the perilaryngeal muscles or the entire body²⁴ and vitamin B12 injections.²⁰ While these modalities focus on targeting

muscle tension/imbalance, they may not be sufficient in some cases in which anatomic restrictions are really the driving force behind the patient's muscle tension.

Improvement of tongue mobility through functional frenuloplasty may be a potentially effective adjunctive treatment option for patients with ankyloglossia and symptoms of MTD. Professional voice users with ankyloglossia may compensate for restrictions in the lingual frenulum with overly effortful vocal production. As such, a particular strength of this case series is that it suggests an additional factor that should be considered as a precursor to vocal tension in professional voice users, and presents a potential treatment for patients who are confirmed to have a lingual anatomic restriction.

The findings from this report may provide useful insights for other groups who are investigating underlying causes and adjunctive modalities for management of vocal tension, strain, and fatigue. However, there are inherent limitations to the case series study design including the absence of a control group. Another potential limitation of this project is patient bias if the participant visited the clinic for an expected result and experienced symptomatic improvement as a placebo effect. Lastly, this study did not use an objective measure to compare pre- and post-operative vocal function. All outcomes are patient-reported and did not use a clinically validated survey. Future studies may consider using a validated scale such as the Singing Voice Handicap Index,⁴ Vocal Fatigue Index,¹³ or the Evaluation of the Ability to Sing Easily¹⁶ to validly assess the patient's self-perception of voice production and impact. Furthermore, professional ratings of voice quality using a rating scale such as the GRBAS^{8,19} or the Consensus Auditory Perceptual Evaluation for Voice (CAPE-V)¹⁰ could be used to grade and compare pre- and post-operative voice quality.

In conclusion, it may be beneficial to include an assessment for ankyloglossia²⁵ in the comprehensive evaluation of MTD among professional voice users, in addition to videostroboscopy and other routine voice evaluations.¹⁵ Furthermore, treatment of ankyloglossia with functional frenuloplasty may be considered for patients with MTD who have had inadequate relief with other intervention modalities.

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Data availability statement: The data sets generated and/or analyzed during the current project are available from the corresponding author upon reasonable request.

Conflicts of Interest: The Breathe Institute currently has a financial relationship with authors Isabella Summersgill, BS (salaried employee); Leyli Norouz-Knutsen, BA (owner); and Soroush Zaghi, MD (owner). Robyn Merkel-Walsh has served as guest faculty for The Breathe Institute. Patients reported in this case series funded their own treatment. No other funding sources were used for this report.

Author Contributions:

Conceptualization: SZ, LN, RM, CG, GN
 Study design: SZ, RM, CK, HB, CG, GN
 Data collection: GN, CG, IS
 Data analysis and interpretation: IS, SZ, BR
 Writing/manuscript preparation: IS, SZ, BR, RM
 Critical revision: LN, CK, HB, IS, BR, SZ