Medialization laryngoplasty (ML) was popularized by Isshiki et al in 1974 and remains the gold standard for the long-term treatment of hoarseness related to glottal insufficiency. Odynophonia is a less common manifestation of glottal insufficiency related to vocal fold motion impairment (VFMI), and ML is hypothesized to relieve pain associated with this condition.

**Methods**

We conducted a retrospective review of medical records of 8 patients from 2 tertiary care laryngology centers who underwent ML for the chief complaint of odynophonia. Demographic data, chief complaint, associated symptoms, diagnosis of VFMI, and presence of other laryngeal diagnoses were recorded. Details of treatment were recorded, including the use of speech therapy, history of vocal fold injection augmentation, and techniques used for ML. All procedures were performed by 1 of the senior authors (A.L.M. or L.S.). Pain with voice use was the chief complaint for all patients in the study, and relief of their pain was assessed by patient self-report following intervention. Preoperative Voice Handicap Index 10

**RESULTS**

All eight patients (5 women and 3 men; mean age, 42 years) had durable relief of their discomfort postoperatively (average follow-up, 14 months). Mean VHI-10 scores improved significantly from 17.9 preoperatively to 6.3 postoperatively ($P = .001$), while perceptual voice parameters as measured by CAPE-V were unchanged. There were no complications.

**CONCLUSIONS AND RELEVANCE**

In select cases of VFMI, ML can relieve pain related to voice use, even in the absence of significant hoarseness.


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Medialization Laryngoplasty for Odynophonia

Table. Patient Demographics and Clinical Summary

<table>
<thead>
<tr>
<th>Patient No./Sex/ Age, y</th>
<th>Diagnosis</th>
<th>Etiology</th>
<th>Symptomsa</th>
<th>Procedure</th>
<th>VHI-10 Pre-ML</th>
<th>Post-ML</th>
<th>CAPE-V Pre-ML</th>
<th>Post-ML</th>
<th>Pain Relief With ML</th>
<th>Other Treatments Prior to ML (Response)b</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/F/65</td>
<td>Right VF</td>
<td>Chemotherapy</td>
<td>Throat pain, vocal fatigue</td>
<td>Right ML Gore-Tex</td>
<td>15</td>
<td>2</td>
<td>9, 0, 11, 10, 0, 0</td>
<td>9, 0, 0, 18, 7, 10</td>
<td>Complete</td>
<td>Voice therapy</td>
</tr>
<tr>
<td>2/M/41</td>
<td>Right VF</td>
<td>Mediastinal metastases</td>
<td>Throat pain, otalgia, dysphonia</td>
<td>Right ML Gore-Tex</td>
<td>15</td>
<td>11</td>
<td>37, 37, 0, 55, 25, 10</td>
<td>5, 55, 0, 37, 53, 24</td>
<td>Complete</td>
<td>Voice therapy, trial injection (pain relief)</td>
</tr>
<tr>
<td>3/M/41</td>
<td>Right VF</td>
<td>Idiopathic</td>
<td>Throat pain, tightness, dysphonia</td>
<td>Right ML Gore-Tex</td>
<td>22</td>
<td>4</td>
<td>6, 0, 0, 20, 0, 0</td>
<td>11, 0, 7, 13, 0</td>
<td>Complete</td>
<td>Voice therapy, trial injection (pain relief)</td>
</tr>
<tr>
<td>4/F/34</td>
<td>Left VF</td>
<td>Thyroidectomy</td>
<td>Throat pain</td>
<td>Left ML Gore-Tex</td>
<td>18</td>
<td>3</td>
<td>11, 12, 0, 13, 10, 0</td>
<td>9, 6, 0, 0, 0, 0</td>
<td>Complete</td>
<td>Voice therapy, trial injection (partial pain relief)</td>
</tr>
<tr>
<td>5/F/46</td>
<td>Left VF</td>
<td>Vagal glomus resection</td>
<td>Throat pain, cough</td>
<td>Left revision ML Gore-Tex and AA</td>
<td>10</td>
<td>7</td>
<td>NA NA</td>
<td>NA NA</td>
<td>Complete</td>
<td>Trial injection (no relief), ML without AA (no relief)</td>
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<tr>
<td>6/M/34</td>
<td>Left VF</td>
<td>Idiopathic</td>
<td>Throat pain</td>
<td>Left ML Gore-Tex</td>
<td>21</td>
<td>2</td>
<td>NA NA</td>
<td>NA NA</td>
<td>Complete</td>
<td>Voice therapy, trial injection (pain relief), pregabalin (weaned postop)</td>
</tr>
<tr>
<td>7/F/41</td>
<td>Right VF</td>
<td>Endotracheal intubation</td>
<td>Throat pain, mild dysphonia</td>
<td>Right ML Gore-Tex</td>
<td>20</td>
<td>7</td>
<td>NA NA</td>
<td>Near complete</td>
<td>Voice therapy, trial injection (pain relief)</td>
<td></td>
</tr>
<tr>
<td>8/F/31</td>
<td>Left VF</td>
<td>Idiopathic</td>
<td>Throat pain, dysphonia</td>
<td>Bilateral ML Gore-Tex</td>
<td>22</td>
<td>14</td>
<td>NA NA</td>
<td>Near complete</td>
<td>Voice therapy, trial injection (pain relief), pregabalin (continued postop)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: AA, arytenoid adduction; CAPE-V, Consensus Auditory-Perceptual Evaluation of Voice; ML, medialization laryngoplasty; NA, not applicable; postop, postoperatively; VF, vocal fold; VHI-10, Voice Handicap Index 10.

a Chief complaint was throat pain for all patients; other associated symptoms listed were minor relative to patients' pain.

b CAPE-V parameters are reported as overall severity, roughness, breathiness, strain, pitch, and loudness, respectively.

c Relief of pain with injection augmentation or voice therapy was transient.

Results

Eight patients underwent ML for the chief complaint of odynophonia and throat discomfort over a 2-year period. Mean follow-up time was 14.1 months. Five patients were women, and 3 were men; mean age at the time of ML was 42 years (age range, 31-65 years). Results and patient characteristics are listed in the Table.

All patients presented with a chief complaint of throat pain. Although dysphonia was not the primary complaint in any of the cases reviewed, 4 patients reported mild hoarseness. In these patients, dysphonia was a minor complaint compared with pain, even in the setting of vocal fold paralysis. Other symptoms reported included vocal fatigue, throat tightness, and cough triggered by voicing, all of which were minor complaints relative to the patients' chief complaint of pain.

Videostroboscopy was performed in all patients at initial evaluation and during their postoperative visits. Six patients were found to have subtle asymmetries and were diagnosed with unilateral vocal fold paresis, while 2 patients had unilateral vocal fold paralysis. Pronounced glottal insufficiency was not found in any patients, and most had complete closure. Patient 4 had a left vocal fold granuloma, and patient 8 had bilateral vocal fold scarring; no other patients had vocal fold lesions apparent on stroboscopy.

Seven of 8 patients had undergone a program of voice therapy prior to undergoing ML. While most patients had transient improvement in their pain with voice therapy, some experienced lasting pain relief. Vocal fold injection augmentation with a temporary material had been performed prior to ML in 7 patients (88%), and 6 of these 7 patients reported temporary improvement of their pain after injection.

Gore-Tex (W.L. Gore & Associates Inc) was used for the ML in 6 patients, and Silastic (Dow Corning Corporation) was used in the other 2 patients. Patient 8 underwent bilateral ML, while the other 7 patients had unilateral surgery. All 8 patients experienced relief of odynophonia following ML through the duration of the study period, and 6 patients had complete resolution of their pain. Of the 2 patients who did not achieve complete resolution of their pain, patient 7 continued to feel mild twinges of pain with yawning at last follow-up, and patient 8 is a schoolteacher who experiences occasional transient pain toward the end of the work week. Patient 5 had un-
dergone ML without arytenoid adduction previously for vocal fold paralysis, which improved her voice but did not relieve her pain. Revision ML with the addition of arytenoid adduction achieved complete resolution of odynophonia. Patient 4 had resolution of her vocal fold granuloma following ML. Two patients were also treated with pregabalin for their throat pain: patient 6 was able to be weaned to a lower dose (50 mg, twice daily) postoperatively, and patient 8 maintained a dose of 25 mg, twice daily throughout the study period.

The VHI-10 scores were significantly improved, from a mean of 17.9 preoperatively to 6.3 postoperatively ($P = .001$). In the 4 patients for whom perceptual voice parameters (CAPE-V scores) were available, there was no significant difference between mean preoperative and postoperative scores (65 and 79, respectively; $P = .50$). There were no surgical complications.

Case Vignettes

We present 2 case vignettes to demonstrate examples of patient presentations and clinical decision processes that resulted in pain relief following ML. While there was significant variability among our study population, these 2 cases are representative of the presenting symptoms and clinical courses of patients in this study.

Patient 1
Patient 1 was a woman in her 60s who, while undergoing chemotherapy, had developed numbness and paresthesias in the extremities, transient weakness in her face and tongue, and a sore throat and odynophonia. She presented with complaints of strain with talking and throat pain of 3 to 4 severity on a scale of 10. At initial evaluation, her VHI-10 score was 15, and her CAPE-V scores were 9 for overall severity, 0 for roughness, 10 for breathiness, 11 for strain, 0 for pitch, and 0 for loudness (0 is normal and 100 is most severe). Maximum phonation time was 60 seconds. Videostroboscopy showed mild bowing of the right true vocal fold with full abduction and adduction of the vocal folds bilaterally. High-pitched phonation resulted in rotation of the posterior larynx to the left, and pharyngeal squeeze was mildly weak on the right side (Figure 1, A and B).

The patient underwent speech therapy without significant relief of her pain. Videostroboscopic findings remained stable. She underwent right ML with a small Silastic implant under local anesthesia. Intraoperatively, flexible laryngoscopy demonstrated improved contour of the right vocal fold, and perceptual analysis of her voice ensured that her preoperative vocal quality was maintained.

By 6 weeks postoperatively, she reported complete resolution of her throat pain and odynophonia. Her VHI-10 score decreased to 2, while CAPE-V scores were stable to slightly increased to 9 for overall severity, 0 for roughness, 0 for breathiness, 18 for strain, 7 for pitch, and 10 for loudness. Videostroboscopy examination showed minimal change from preoperative examination, with decreased right vocal fold bowing and complete glottal closure (Figure 1, C and D). Relief of her pain remained durable at 6 months after ML.

Patient 3
Patient 3 was a man in his 40s who presented with chief complaints of throat pain and tightness, vocal fatigue and discomfort, and inability to project his voice. The symptoms
had begun 10 years earlier after he had sustained minor head trauma. His VHI-10 score was 22, and CAPE-V scores were 6 for overall severity, 0 for roughness, 0 for breathiness, 20 for strain, 0 for pitch, and 0 for loudness. Videostroboscopy at initial presentation demonstrated mild atrophy and bowing of the right true vocal fold with complete glottal closure and severe anterior-posterior supraglottic compression (Figure 2, A and B). He was initially treated with speech therapy for muscle tension dysphonia. He noted significant relief of his symptoms during speech therapy and with laryngeal massage but was unable to maintain the improvement outside of his therapy sessions.

Right vocal fold injection augmentation was performed in the office with hyaluronic acid. He reported complete relief of his symptoms that lasted approximately 2 weeks before gradually declining to his baseline vocal strain and odynophonia. Four months later, he underwent right ML with a Gore-Tex implant under local anesthesia. Intraoperative flexible laryngoscopy and perceptual voice analysis confirmed improved vocal fold contour and voice quality. Five weeks postoperatively, he had complete relief of his throat pain and dramatic improvement in vocal effort. His VHI-10 score decreased to 4, while CAPE-V scores were relatively stable at 11 for overall severity, 0 for roughness, 7 for breathiness, 13 for strain, 0 for pitch, and 0 for loudness. Videostroboscopy showed the implant in good position with mild right infraglottic fullness, improvement in vocal fold contour, good glottal closure, and decreased anterior-posterior supraglottic compression (Figure 2, C and D). His symptoms remained relieved at last follow-up, 8.5 months after ML.

Discussion

Odynophonia, or pain with voice use, is an important symptom that affects a small but significant proportion of patients with voice disorders. The presence of pain or discomfort may be underappreciated by the clinician who is focused primarily on voice quality. In this study, we describe 8 patients who underwent ML for the unique primary indication of odynophonia, all of whom achieved relief of their pain. Only half of these patients also complained of mild hoarseness; these cases are uncommon because the primary indication for ML was pain with voice use rather than voice quality. This case series provides support for odynophonia as an indication for ML that, to our knowledge, has not yet been presented in the literature.

Pain with voice use is a recognized symptom of VFMI, affecting 15% of patients with unilateral paresis,4 but its pathophysiology has not been described. Compensatory supraglottic hyperfunction is common in patients with glottal insufficiency,11 and the resulting muscle strain is presumed to be the predominant underlying cause of odynophonia in these patients. This is supported by the clinical presentation of patient 3 with muscle tension dysphonia whose pain improved with laryngeal massage and ultimately resolved with surgical correction of his mild glottal insufficiency. Vocal tract discomfort has been reported in 62% of patients with hyperfunctional voice disorders, and muscle overuse and postural strain are well-recognized causes of musculoskeletal pain in general.12
It is also possible that compensatory hyperfunctional voice use causes pain indirectly by contributing to the development of contact lesions. Voice overuse and abuse are well-described causes of contact granulomas of the larynx, and approximately half of these lesions present with pain or discomfort.\(^3\) In the present series, we identified only 1 patient (patient 4) with a laryngeal contact lesion to explain her pain.

Pain associated with VFMI may also be neurogenic in origin. Mechanosensitive C-fiber receptors have been implicated in neuropathic pain syndromes\(^4\) and represent a significant proportion ofafferent laryngeal innervation.\(^5\) Morrison and colleagues\(^6\) have described hyperexcitability of sensorimotor pathways resulting from habitual muscle misuse and stimulation of sensory receptors. It may be hypothesized that the increased closing force needed to overcome glottal insufficiency for voice production may increase stimulation of nociceptors in the larynx, leading to hyperexcitability of sensory pathways from the larynx and neuropathic pain.

All 8 patients in the present study reported significant pain relief after ML, with 6 patients reporting complete resolution of their pain. We hypothesize that relief of odynophonia is a result of reduced muscle strain in most of these patients. Although most patients had complete or nearly complete glottal closure at initial presentation, the slight improvement in glottal closure pattern achieved by ML would reduce vocal effort and muscle strain. Contact lesions would resolve by the same mechanism.

Another possibility is that pain relief may simply be a placebo effect from surgery. Placebo response has been historically reported to be as high as 35%.\(^7\) Although more recent reports suggest that this high placebo response rate may be overstated, there remains a modest but significant response to placebo in patients with pain.\(^8\) It seems improbable that pain could be consistently relieved by placebo effect alone in our series, particularly considering that 6 patients had injection augmentation procedures prior to ML that also resulted in significant pain relief. Nonetheless, because pain is a subjective complaint that is strongly influenced by an individual’s experiences and emotional state, nonphysiologic influences such as a placebo effect cannot be ignored.

It is interesting to note that VHI-10 scores were significantly improved following ML, even in patients who did not complain of voice quality concerns preoperatively. By contrast, clinician perceptual analysis of voice quality did not demonstrate any improvement postoperatively. This finding suggests that pain and patient perception of voice quality are intrinsically associated, with the sensation of physical pain substantially influencing voice-related quality of life. The opposite effect may also occur, with perceived alterations of voice quality affecting the sensation of physical pain. This phenomenon was described in a study of 62 teachers in which vocal tract discomfort was found to be significantly correlated with self-assessment of voice quality, while there was little correlation between patient discomfort and clinician perceptual analysis of voice.\(^9\)

These cases support the role of ML in the clinical algorithm for patients with throat pain. Careful patient selection is critical to success. Pain proportional to voice use is a key feature and is highly suggestive, even when findings of laryngeal motion abnormality are ambiguous or difficult to perceive. In our experience, in cases that pose diagnostic challenges owing to the subtlety of laryngeal asymmetries, unilateral supraglottic hyperfunction and unilateral vocal fold atrophy are the most suggestive of a vocal fold paresis. Temporary relief of pain in response to voice therapy is encouraging although not a prerequisite for relief from ML in our series. We consider relief of pain from trial injection augmentation to be the most compelling test. Our current algorithm for patients with a chief complaint of pain related to voice use and VFMI begins with a course of voice therapy. Injection augmentation with a temporary material so as not to interfere with subsequent framework surgery is performed if the patient still complains of discomfort after therapy. If there is any improvement in pain after injection, then ML is recommended. Medialization is performed on the side of motion impairment, but we have a low threshold for performing bilateral medialization, particularly in cases of vocal fold atrophy in which the contralateral side is also affected. If the patient is on a pharmacologic regimen for controlling pain, weaning from these medications is begun 1 month postoperatively.

Conclusions

The conclusions from this study are made with caution, limited by a small number of patients and retrospective design. While the effect of pain relief from ML has been durable in our patients, we do not yet have long-term follow-up data. Pain assessment before and after surgery was not formally measured in our patients, only by patients’ verbal descriptions of whether their pain was relieved. Use of a validated patient-completed measure of vocal tract discomfort, such as the Vocal Tract Discomfort scale,\(^10\) would be helpful for formal assessment of odynophonia in future studies. Odynophonia is an important symptom of VFMI; it may be present in patients without significant hoarseness. Medialization laryngoplasty can relieve pain related to voice use in select cases of VFMI. The VHI-10 scores improved following ML in our patient group even when perceptual analysis of voice quality was unchanged.
**Previous Presentations:** This research was presented as a poster at the American Laryngological Association meeting; May 15, 2014; Las Vegas, Nevada; and was presented from the podium at the Fall Voice Conference; October 24, 2014; San Antonio, Texas.

**REFERENCES**


