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ORIGINAL ARTICLE

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Transoral silastic medialization for unilateral vocal fold paralysis

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Abstract

Background: Medialization laryngoplasty has historically been performed through an external approach. The aim of our work is to demonstrate the feasibility of silastic vocal fold medialization transorally.

Methods: Patients with unilateral vocal fold paralysis requiring medialization laryngoplasty were included in this report. Silastic medialization was done through a transoral approach. A supraglottic laryngotomy is performed followed by dissection and tunneling in the paraglottic space. Silastic implant is inserted into the tunnel to medialize the vocal fold and the ipsilateral arytenoid. The laryngotomy is tightly closed by endoscopic sutures.

Results: A consecutive series of 22 patients are reported. All patients had dysphonia with significant glottic insufficiency. After endoscopic silastic medialization, voice and swallowing were significantly improved ($P < .001$). No postoperative complications or implant extrusion occurred in our series.

Conclusion: Silastic vocal fold medialization can be safely and effectively performed through a transoral approach with good results on voice and swallowing.

KEYWORDS

medialization laryngoplasty, R-TLM, reconstructive transoral laser microsurgery, silastic implantation, unilateral vocal fold paralysis

1 | INTRODUCTION

Unilateral vocal fold paralysis (UVFP) is the most common cause of glottic insufficiency and usually presents with dysphonia and often with hazardous problems such as aspiration, weak ineffective coughing, or even pneumonia, which may be life-threatening. If there is no recovery or if there is inadequate compensation after UVFP, procedures aiming to restore glottic competence include permanent and temporary vocal fold injections or laryngeal framework surgery, such as a type I medialization laryngoplasty. Relatively small glottic gaps between membranous vocal folds are generally accepted to be more appropriate for injection laryngoplasty, whereas larger glottic gaps with symptomatic posterior glottic gaps are found to be ideal for medialization laryngoplasty with or without the addition of an arytenoid adduction.[1]

Payr, in 1915, was the first to perform a form of medialization laryngoplasty, which was further developed in the early 20th century. Medialization laryngoplasty did not begin to be widely used until the development of the modern technique by Isshiki et al, in 1974.[2,3] Since Isshiki's introduction of the type I laryngoplasty technique, medialization laryngoplasty has become the most commonly performed surgical intervention for UVFP.[3-5] However, multiple technical modifications and implants of varying shapes and sizes have been proposed. Proper positioning in the paraglottic space is a known requirement and the limitations of laryngoplasty implant in closing the posterior glottis have been discussed.[6] However, the voice outcomes after medialization laryngoplasty continue to be inconsistent in the hands of many otolaryngologists, as evidenced by the wide variety of implants, techniques, and variability in reported outcomes and follow-up periods.[4]

Some laryngologists performs transnasal laryngoscopic examination to control glottic closure while inserting the medialization implant under local anesthesia through external approach, but patients could become restless and could have trouble cooperating especially when medialization is combined with arytenoid adduction which can substantially increase operative time. This causes suboptimal results in some cases due to a persistent glottic gap, undermedialization, and implant malposition or migration.

In this paper, we demonstrate the feasibility and safety of silastic vocal fold medialization using reconstructive transoral laser microsurgical (R-TLM) techniques to allow optimal positioning of the implant in the paraglottic space with direct binocular visualization from within the larynx.

2 | MATERIAL AND METHODS

2.1 | Patient selection and preoperative evaluation

A consecutive cohort of 22 adult patients undergoing endoscopic silastic medialization for UVFP was reviewed. All cases were at least 1-year post onset of symptoms of UVFP with variable degrees of glottic gap responsible for glottic insufficiency. All patients underwent transnasal flexible laryngostroboscopy under local anesthesia with a flexible endoscope (KayPENTAX, New Jersey) to confirm the diagnosis and to assess the mobility of the vocal folds and the arytenoids as well the glottic gap during phonation. All patients filled out a VHI-10 (voice handicap index-10), VRQOL (voice related quality of life), EAT-10 (eating assessment tool) questionnaires preoperatively, and 12 weeks postoperatively. The maximum phonation time (MPT) was measured preoperatively and 12 weeks postoperatively. Auditory-perceptual evaluation of the voice was also performed using the GRBAS (grade, roughness, breathiness, asthenia, strain) scale. Both MPT and GRBAS were calculated by a colleague speech-language pathologist as part of their care. All procedures performed were in accordance with the ethical standards of the institution and with the 1964 Helsinki declaration and its later amendments.

2.2 | Surgical technique

The procedure is performed under general anesthesia (Figure 1 and video). All patients are treated with a dose of preoperative systemic steroids (commonly 125 mg IVP of methylprednisolone, Solu-medrol, Sandoz, Basel, Switzerland) and broad-spectrum IV antibiotics (commonly, piperacillin-tazobactam 3.75 g IV, Zosyn, Pfizer, Inc., New York City, New York). An

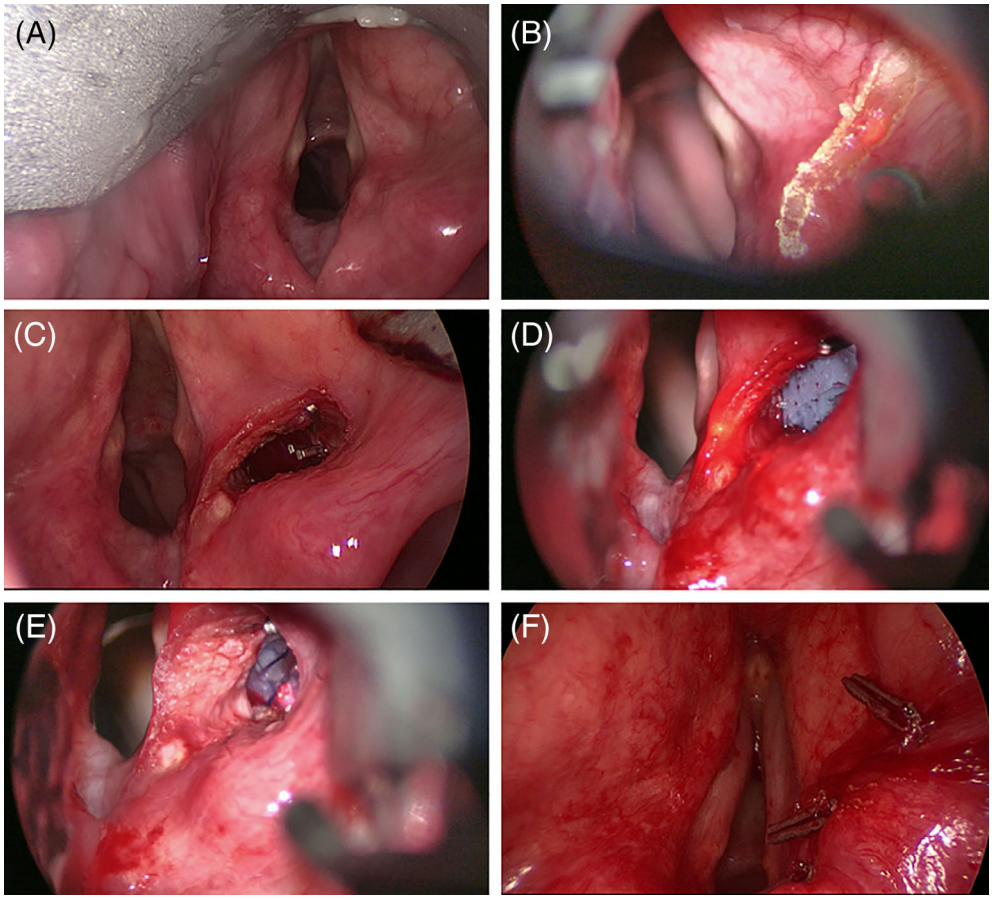

FIGURE 1 Endoscopic silastic medialization laryngoplasty. A, Endoscopic view of the larynx with right unilateral vocal fold paralysis. B, Sigmoid shape right supraglottic laryngotomy. C, Dissection in the paraglottic space and clipping of branches of the superior and inferior laryngeal arteries. D, Silastic implant inserted through the supraglottic laryngotomy in the paraglottic space. E, Fixation of the implant to the thyroid lamina using prolene sutures. F, Supraglottic laryngotomy closed. Right vocal fold medialized and shows increased bulk [Color figure can be viewed at wileyonlinelibrary.com]

oral endotracheal tube of an appropriate size is placed. A Lindholm laryngoscope (8587 A, KARL STORZ, Germany) is used for the suspension microlaryngoscopy, which provides a wide aperture for bimanual manipulation of instruments. The endotracheal tube is removed, and jet ventilation is used for the rest of the surgery. Low-frequency jet ventilation is performed using a jet ventilation tube positioned in the posterior commissure or through a metal tube connected and integrated into the laryngoscope to perform supraglottic jet ventilation.

The larynx is then examined with a 30°HOPKINS Telescope (49046 BA, KARL STORZ, Germany). Neuromuscular blockade is used to get the maximum abduction of the vocal folds.

A Leica F-40 operating microscope (Leica Model M-525, Germany) with an Encore II Ultrapulse scanning CO_2 laser and a digital AcuBlade robotic joystick controller (Lumenis, Israel) is used. A 0.9 to 1.2 mm circle scanning laser figure is used to perform a supraglottic laryngotomy which is an approach to the peri-arytenoid area through the supraglottic larynx involving a sigmoid laser incision on the paralyzed side through the aryepiglottic fold starting at the ventricular fold and extending to the anterolateral aryepiglottic fold. Laser and blunt dissection is performed until reaching the inner aspect of the thyroid lamina leaving a thin layer of soft tissue over it to use for anchoring the fixation suture. Suction cautery is often needed to control branches of the inferior and superior laryngeal arteries. Titanium clips (LIGACLIP EXTRA, LT200, Ethicon Endosurgery, Puerto Rico) are sometimes needed to control these branches. A pocket is created using blunt dissection in the paraglottic space at the level of the vocal fold. Copious irrigation of the surgical wound is performed before insertion of an adequate size silastic implant (Netterville PhonoForm Silicone Block, Medtronic Xomed, Florida) in the pocket through the supraglottic laryngotomy to medialize the arytenoid and the vocal fold in the paramedian position. The implant is fixed to the thyroid lamina and overlying soft tissues with a stitch (Prolene 4-0 on P-3 needle; Ethicon, Johnson and Johnson, Indiana) commonly passed twice through the tissue and twice through the implant. Again, copious irrigation with saline is performed before closure of the supraglottic laryngotomy with 2-4 figure-of-eight 4-0 monocryl sutures on a P-3 cutting needle. The stitches are all placed before closing the wound, which is then irrigated for the last time with copious amounts of sterile saline to clean the implant. They are secured by clipping with the same clips used for hemostasis. The excess suture is cut by the laser beam. At the end of the surgery, jet ventilation is stopped and an endotracheal tube is placed for wake up from anesthesia. The details of the R-TLM techniques used in this operation can be found in prior papers of ours.[7-10]

2.3 | Postoperative care

Patients are admitted and managed postoperatively in an intermediate care unit for the first day. Broad spectrum antibiotics are given, commonly piperacillin-tazobactam 3.75 g every 6 hours. After discharge, they are followed up in the outpatient clinic at 2, 6, and 12 weeks postoperatively then regularly for at least 1 year.

2.4 | Statistical analysis

A paired *t* test from GraphPad Prism software (version 5.01, La Jolla, California) was used to detect statistical significance in the dyspnea index data before and after transoral silastic medialization.

3 | RESULTS

Twenty-two patients were included in our study. Etiologies of UVFP were thyroid surgery (n = 5), idiopathic vocal fold palsy (n = 8), carotid surgery (n = 2), thoracic surgery (n = 2), penetrating neck trauma (n = 2), intubation (n = 2), and mediastinal tumor (n = 1). All patients had dysphonia with significant glottic insufficiency (mean VHI-10 = 30, mean VRQOL = 33, mean GRBAS scale = 10, mean MPT = 2.5 seconds, and mean EAT-10 = 16). Nine patients were seen with aspiration in addition to dysphonia. After endoscopic silastic medialization, voice and swallowing had improved (mean VHI-10 = 12 [$P < .001$], mean VRQOL = 18 [$P < .001$], mean GRBAS scale = 6 [$P < .001$], mean MPT = 12.5 seconds [$P < .001$], and mean EAT-10 = 5 [$P < .001$]). No postoperative complications such as airway obstruction or implant extrusion occurred in our series. The median postoperative stay was 2 days (interquartile range 1-3). Patients were followed up for at least 1 year.

4 | DISCUSSION

Despite the large variety of materials used for laryngoplasty implants, the common goal remains improvement of voice quality by moving the paralyzed vocal fold into a more ideal glottal posture for phonation. Although an external laryngoplasty is an effective treatment for UVFP, it is limited by an inability to close a wide posterior glottal gap due to the difficulty to aim the arytenoid by the implant through an external approach. Coupling medialization laryngoplasty with arytenoid adduction has been shown to overcome this limitation and improve vocal outcomes. Despite the benefit of the procedure, arytenoid adduction is performed less frequently than it should due to increased technical demands and time. Overrotation of the arytenoid and apparent shortening of the vocal fold can occur, mitigating procedural efficacy and

compromising voice quality. The benefits of medialization laryngoplasty with arytenoid adduction are also not well defined. Many studies evaluating the benefit of arytenoid adduction have compared postprocedure outcomes to patients only receiving thyroplasty, rather than analyzing the added benefit of performing arytenoid adduction after thyroplasty in the same patient. In addition, UVFP frequently causes height mismatch of the vocal processes which is considered by many laryngologists as a difficult issue to address with anything short of arytenoid adduction. The mismatch comes from laxity in the opposing muscle elements. Transoral silastic medialization pushes the arytenoid posteriorly and medially. Consequently, the vocal fold is straightened and no level mismatches were seen postoperatively in our series.

Our transoral approach of silastic medialization allows insertion of the implant under direct visual control at the optimal horizontal level of the vocal fold through a supraglottic laryngotomy thus avoiding any malposition of the implant. In addition, our approach permits medialization of the arytenoid and thus allows closure of a wide posterior glottic gap without any need to perform arytenoid adduction.

In the literature, it is advised that when creating the thyrotomy window, the inner perichondrium of the thyroid lamina should be carefully preserved to decrease the likelihood of implant extrusion and to prevent bleeding.[11] In our transoral approach of medialization laryngoplasty, the silastic implant is inserted medial to the thyroid lamina and its inner perichondrium, thus allowing adequate medialization without any risk of implant extrusion. Moreover, our approach allows direct control of any bleeding from branches of the superior or inferior laryngeal arteries during paraglottic dissection thus diminishing any risk of hematoma formation.

Wound infection could be one of the complications of external medialization thyroplasty.[1,11,12] We did not get any wound infections in our series, even though transoral medialization laryngoplasty is considered a potentially contaminated surgery. To avoid wound infections, we do copious saline irrigation during surgery, especially before wound closure. Moreover, the surgical wound (supraglottic laryngotomy) is always meticulously and tightly closed using our endoscopic suture technique, which has been described in our previous works.[7-10,13]

External medialization laryngoplasty is always performed under local anesthesia to allow the patient to phonate during surgery to determine the size of the implant and the degree of medialization. Our transoral approach of medialization laryngoplasty is done under general anesthesia with neuromuscular blockade to get the maximum abduction of the vocal folds and arytenoids. The degree of medialization is determined through direct visual control of the position and the size of the silastic implant that pushes in the vocal fold and the arytenoid in a paramedian position, thus closing any anterior and/or posterior glottic gap without any significant narrowing of the glottic aperture. Implant remodeling and resizing can sometimes be necessary to get optimal results. This was done in about 50% of our cases. The sizing is a matter of typical anatomy and the visible effect of the implant itself. The preoperative awake endoscopy gives the surgeon a general estimation of the size augmentation likely to be needed by the gap and mass asymmetry evident on videostroboscopy. With an operating microscope giving a three dimensional view of the larynx, the asymmetry is even easier to assess than in a monocular two dimensional view of the awake endoscopy. The implants were all about 10 to 13 mm in length and about 5 to 10 mm in thickness. If the chosen implant does not fit in, it could be removed and trimmed down. At the end, the position of the cords is verified by allowing the neuromuscular blockade wear off and look for the extent to which the cords close well. In addition, when transglottic jet ventilation is used, it is possible to actually hear an exhalational voice prior to reintubating the patient. The technique is so reliable that we do not specifically try to elicit this "indicator" but have seen it, unprovoked, about half the time.

Transoral medialization laryngoplasty can be performed by any skilled laryngologist without any assistance or specific instrumentation, but he has to be trained in techniques of R-TLM described above and in our previous works.[7-10] In addition, this type of surgery has a learning curve which impacts the success and the operative time. In fact, in the early senior author experience, there were two extrusions and two replacements for size increase. Extrusions occurred secondary to a neck trauma in one case and size mismatch in a second case. The 22 cases presented here are the sequential series compiled by two fellows during their year-long training program. In this series, proper implant sizing was determined as described above. Concerning the operative time, it can range from 2 hours and half in average to 1 hour when full experience is acquired.

This study describes successful endoscopic medialization laryngoplasty in 22 cases. It is not intended to criticize the current external approaches but to present this option for surgeons skilled in reconstructive trans oral laser microsurgery. With more laryngologists being trained in reconstructive transoral laser microsurgery, further multicentric studies with larger cohorts will be performed to confirm our results.

In conclusion, silastic vocal fold medialization can be performed through an exclusively endoscopic approach with good results on voice and swallowing. In addition to avoiding a scar on the skin, our technique allows optimal positioning of the implant in the paraglottic space.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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