How I Do It

Repair of High-Grade Posterior Glottic Stenosis: A Novel Criocarytenoid Joint Release Technique

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INTRODUCTION

Intubation injury is the most common cause of posterior glottic stenosis (PGS).[1] Bogdasarian has classified PGS into four types.[2] In particular, type 3 and 4 PGS, which include dense interarytenoid scar and ankylosis of one or both cricoarytenoid joints (CAJ), are very challenging problems to treat. Various open and endoscopic surgical approaches have been described to treat PGS, including ablatives techniques such as arytenoidectomy or posterior cordotomy.[3,4] However, these procedures often sacrifice some of the phonatory function at the expense of glottic airway. More recently, a nonablative approach with excision of the interarytenoid scar and interposition of a postcricoid advancement flap was introduced; however, vocal cord mobility could not be restored in grade 3 or 4 PGS.[5,6]

We report on five patients with a type 4 PGS who were treated using a modified endoscopic technique to restore vocal cord mobility by removing the inter- and periarytenoid scar, circumferentially incising the CAJs, mobilizing both arytenoids, and reconstructing the interarytenoid area with a rotational advancement mucosal flap from the medial piriform sinus.

MATERIALS AND METHODS

If not already present, a tracheostomy is performed in the usual fashion, which obviates the need for an oroendotracheal tube during surgery and improves exposure of the posterior commissure. A surgical laryngoscope is inserted to expose the interarytenoid scar, which is incised using a handheld CO_2 laser while extending the incision down to the cricoid cartilage (Fig. 1). A potassium-titanyl-phosphate (KTP) laser on pulsed mode is helpful to identify the joint space correctly by ablating the scar medially around the CAJ capsule (Fig. 2). An inferiorly based trap-door flap is elevated off the anterior surface of the cricoid plate. Leaving a small area of scar attached to the cephalad edge helps prevent the flap from tearing when later reconstructing the posterior commissure. On both sides, the joint capsule is incised medially with curved microlaryngeal scissors and examined to assure that cricoid and arytenoid facets are smooth and not remodeled by fibrosis or bone before a full circumferential incision of the capsule with release of the CAJ is performed (Fig. 3). At this point, the arytenoid can be fully lateralized and the glottic airway will enlarge dramatically. Any scar and fibrotic capsule components, usually located anterior to the CAJ and inferior to the arytenoid, can now be easily visualized and ablated with the KTP laser (Fig. 4). The CO_2 laser is then used to raise a postcricoid–piriform sinus flap by extending two parallel mucosal cuts from the medial to the lateral along the postcricoid surface and, for adequate length, further into the medial piriform sinus. The mucosal flap is raised off the posterior cricoarytenoid muscle from the lateral to the medial and advanced into the interarytenoid space, where it is secured to the previously elevated trap door flap with a single mattress stitch using a 4-0 Vicryl suture (Fig. 5). A tracheostomy cannula with the cuff inflated is kept for at least 10 to 12 days.

RESULTS

This retrospective study was approved by the institutional review board of the University Hospitals of Cleveland Medical Center. Five patients with a type 4 PGS were identified between 2015 and 2017 with an age range from 12 to 72 years and a follow-up period from 6 to 18 months (Table I). In all cases, the etiology of PGS was prolonged intubation. All five patients had a type 4 PGS, with interarytenoid fibrosis and ankylosis of both CAJs resulting in a severely impaired glottic airway with stridor. Four of the five patients had a tracheostomy at initial presentation, and one patient underwent a tracheostomy as part of the surgical management of PGS. None of the patients had prior surgical attempts to treat their PGS. All patients underwent the endoscopic procedure described herein. Postoperatively, all five patients initially had a completely normal vocal cord mobility with full abduction on both sides. Over the course of several weeks, some of the patients developed
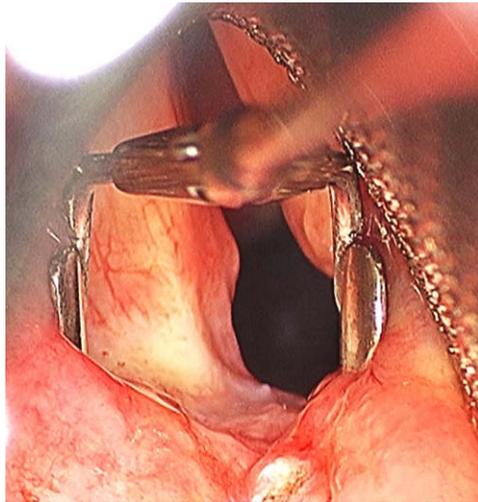
Fig. 1. Type 4 posterior glottis stenosis with fibrosis around both cricoarytenoid joints. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

a hypomobile arytenoid on either one or both sides. In three of the five patients, a hypomobile vocal cord was observed bilaterally, yet with a much improved glottic airway with no stridor, even during moderate exertion. Two patients maintained arytenoid mobility, which appeared to be close to normal, on one side, whereas the other side developed more significant hypomobility (Fig. 6). In three patients, no obvious voice changes were noticed postoperatively, whereas two patients had worsening of their voice with a new onset of mild breathiness. All patients were decannulated between 6 and 12 weeks. Three patients were able to start a soft per os diet immediately after surgery, whereas two patients required a temporary nasogastric feeding tube for up to 10 days. No permanent dysphagia was observed in any of the five patients.
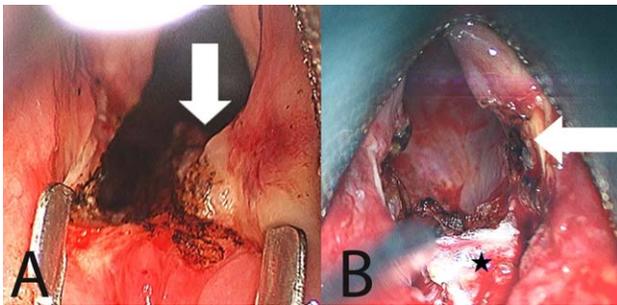

Fig. 2. (A) CO_2 laser was used to incise the intrarytenoid scar. (B) The superior cricoid plate (asterisk) has been exposed. The trap door flap is then raised inferiorly into the cricoid lumen. The KTP laser is helpful to identify the joint capsule medially. Thick scar (arrow) is noted along the undersurface of the arytenoid extending into the cricoid, which is later, once the arytenoid is fully mobilized, ablated with the KTP laser to prevent re-ankylosis.
KTP = potassium-titanyl-phosphate. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]
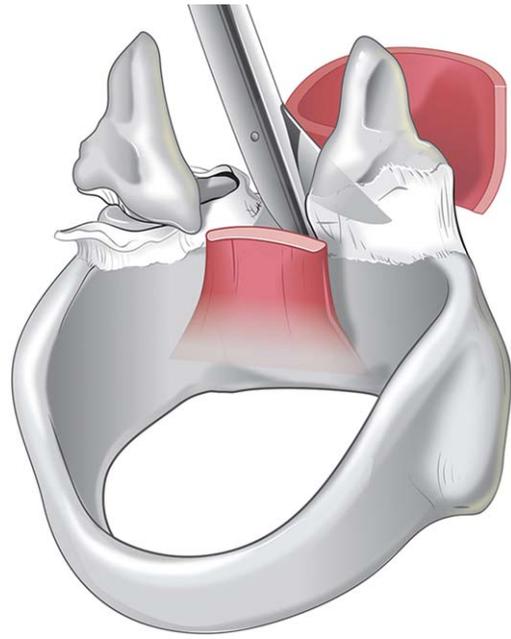

Fig. 3. Cricoarytenoid joint release is performed by incising the capsule circumferentially with microlaryngeal scissors. The trap door flap has been elevated anteriorly into the cricoid lumen. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

DISCUSSION

Treatment of grade 4 PGS is very challenging, and full laryngeal function with vocal cord mobility can often not be reestablished. Ablative laryngeal procedures such as complete or partial unilateral arytenoidectomy or posterior cordotomy remove some of the posterior glottis while trying to balance breathing and phonation, but
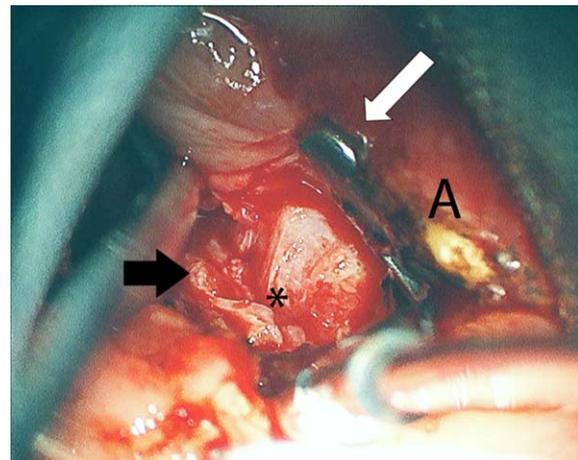

Fig. 4. Vocal cord spreader placed under the arytenoid joint facet (white arrow), with lateral rotation of the arytenoid body demonstrating full mobilization. Cricoid (asterisk) and arytenoid joint facets (A) are both smooth and intact. Thick scar is seen anterior to cricoarytenoid joint capsule (black arrow), which is best ablated by using potassium-titanyl-phosphate laser on pulsed mode to reduce risk of re-ankylosis. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]
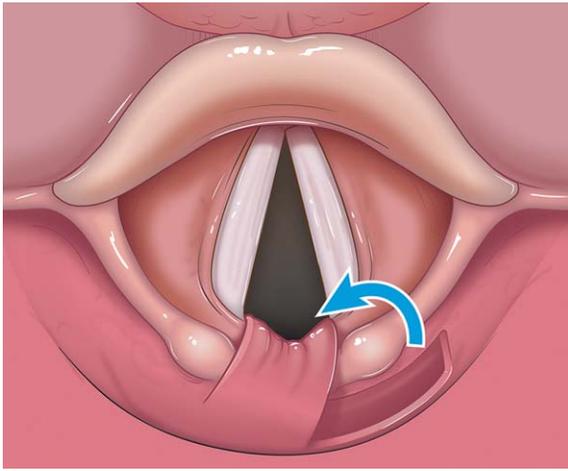
Fig. 5. An adequately long and wide mucosal flap is raised from the medial pirifrom sinus and the postcricoid area. It is rotated and advanced into the interarytenoid space and secured to the trap door flap with a single mattress stitch to reconstruct the posterior commissure. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]
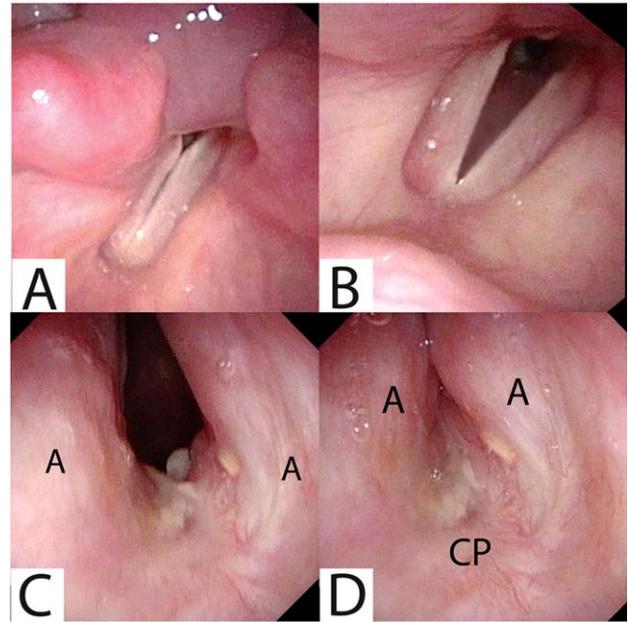

Fig. 6. Following repair of a type 4 posterior glottic stenosis. (A) The mucosal flap is seen in the posterior commissure. (B) During inspiration, the left arytenoid shows full abduction, whereas the right side is hypomobile. (C) subglottic view through tracheostoma shows a well-healed posterior commissure with good arytenoid abduction during inspiration. (D) During phonation, glottic closure is complete.
A = arytenoid; CP = cricoid plate. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

even the best attempts can leave patients with breathy hoarseness and sometimes with dysphagia.

Nonablative laryngeal procedures, however, attempt to repair PGS without sacrificing vocal cord tissue with the theoretical advantage of improving both, voice, and breathing. Simple incision of the interarytenoid scar in high-grade posterior glottic stenosis does not address the arytenoid ankylosis and usually leads to re-stenosis. Complex reconstructive procedures with interarytenoid mucosal flaps have been proposed to prevent interarytenoid scar formation, but to date none of the proposed surgical techniques address the arytenoid fixation or have been able to regain vocal cord mobility in type 3 or 4 PGS.[7,8] Thus, the challenge of the treating CAJ ankylosis to restore vocal cord mobility remains unsolved.

Our new approach differs from previously described techniques because it fully mobilizes the ankylosed arytenoid. The scar around the CAJ capsule is removed with a KTP laser, and the capsule incised circumferentially with microlaryngeal scissors, which allows for full arytenoid mobilization and at least partial recovery of vocal cord mobility. Although no objective pulmonary function testing was done, all five patients reported improved breathing allowing for exertion. Another advantage of this nondestructive procedure is that it will not obviate any other laryngeal procedures in case of

TABLE I.
Demographics, History, and Outcomes.

Patient	Age	PGS Grade	Etiology	Follow-up (months)	Postoperative Arytenoid Mobility	Decannulation	Dyspnea-Related Limitations (patient rated)	Long-term Dysphagia	Postoperative Voice
1	54	4	Intubation	6	Impaired R, greatly improved L	Yes	No	No	Unchanged
2	12	4	Intubation	18	Bilaterally impaired	Yes	No	No	Unchanged
3	72	4	Intubation	14	Impaired R, greatly improved L	Yes	No	No	New onset of breathy dysphonia
4	18	4	Intubation	11	Bilaterally impaired	Yes	No	No	Unchanged
5	66	4	Intubation	8	Bilaterally impaired	Yes	No	No	New onset of breathy dysphonia

L = left; R = right.

failure, such as a cordotomy or an arytenoidectomy. This novel technique could thus be considered a preferred first-line approach to high-grade PGS.

A few additional surgical observations are worthy of mention:

1. The mucosal flap described herein is raised from the piriform sinus and has several advantages. It is a rotational flap, which is longer than the previously described postcricoid advancement flap.[7] As a result, it can be advanced deeper into the cricoid plate, where it can be sutured to the trap door flap without any tension. Also, if designed wide enough, the flap has a stenting effect and will keep the arytenoids in a lateral position.

2. Incision of the CAJ capsule does not result in arytenoid destabilization or arytenoid tilting because all muscular attachments to the arytenoid are kept intact, holding the arytenoid in proper position.

3. The use of a KTP laser in pulsed mode was found to be helpful for this procedure by ablating the scar medially and anteriorly around the joint, which helped identify the joint space before incising the capsule. After full arytenoid mobilization, the surgeon can fully view and treat the scar anterior to the CAJ and inferior to the vocal process. This area is usually not accessible unless the arytenoid is fully released, as described herein.

4. Careful KTP laser ablation of the fibrosis medially and anteriorly around the CAJ, followed by mucosal flap reconstruction, is important to reduce the risk of re-ankyloses. Although all of our patients clinically had a type 4 PGS, the degree of fibrosis found anterior to the CAJ and extending into the posterior and lateral cricoid cartilage ring varied quite significantly. If involvement was more extensive, patients were less likely to achieve full arytenoid mobility postoperatively.

Further experience is needed to determine if these cases would benefit from additional modification of our technique or additional serial procedures, such as dilations or steroid injections. In addition, long-term follow-up is important to assess patients for re-stenosis.

CONCLUSION

High-grade PGS is difficult to repair due to CAJ fibrosis and fixation combined with interarytenoid scar. This technique differs from previously reported PGS repair techniques by performing a circumferential incision of the CAJ with full release and mobilization of the arytenoids. The rotational advancement flap, harvested from the postcricoid and piriform sinus, is robust and adequately long to reconstruct the posterior glottis. This technique led to partial restoration of joint mobility and decannulation in all cases, with very acceptable voice results and no dysphagia. The amount of fibrosis along the anterior joint space seems to be a limiting factor to restore full vocal cord mobility.

BIBLIOGRAPHY

1. Gardner GM. Posterior glottic stenosis and bilateral vocal fold immobility: diagnosis and treatment. *Otolaryngol Clin North Am* 2000;33:855–878.
2. Bogdasarian RS, Olson NR. Posterior glottic laryngeal stenosis. *Otolaryngol Head Neck Surg* 1980;88:765–772.
3. Bosley B, Rosen CA, Simpson CB, McMullin BT, Gartner-Schmidt JL. Medial arytenoidectomy versus transverse cordotomy as a treatment for bilateral vocal fold paralysis. *Ann Otol Rhinol Laryngol* 2005;114:922–926.
4. Kashima HK. Bilateral vocal fold motion impairment: pathophysiology and management by transverse cordotomy. *Ann Otol Rhinol Laryngol* 1991;100:717–721.
5. Goldberg AN. Endoscopic postcricoid advancement flap for posterior glottic stenosis. *Laryngoscope* 2000;110:482–485.
6. Damrose EJ, Beswick DM. Repair of posterior glottic stenosis with the modified endoscopic postcricoid advancement flap. *Otolaryngol Head Neck Surg* 2016;154:568–571.
7. Damrose EJ, Samji H, Hartl T, Morzaria S. Postcricoid mucosal advancement flap for posterior glottic stenosis. *Oper Tech Otolaryngol* 2012;23:192–1z96.
8. Semmler M, Keck T, Reiter R, Gruen PM. Endolaryngeal posterior mucosal flap for surgical repair of posterior glottic stenosis. *Auris Nasus Larynx* 2011;38:608–611.