The Laryngoscope

How I Do It

Management of Severe Suprastomal Collapse With Bioabsorbable Microplates

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INTRODUCTION

Laryngotracheal stenosis continues to remain a significant health issue within the pediatric population.[1–3] Originally introduced in 1972, laryngotracheal reconstruction (LTR) has evolved to include a variety of techniques for expanding the stenotic airway, including reconstruction with rib cartilage grafting.[4,5] With widespread use of open surgical techniques, success rates in achieving decannulation surpass 90%.[3,6] Failure to decannulate may be due to multiple causes, including obstructive peristomal granulation or suprastomal collapse.[7] Suprastomal collapse can approach 20% in young children with long-standing tracheostomies.[8] In some cases, this obstruction may be severe, resulting in unsuccessful decannulation.

To avoid primary resection and reanastamosis, several methods of repair have been reported and include internal stenting, anterior cricotracheal suspension, and autologous costal cartilage laryngotracheoplasty.[7,8] Bioabsorbable microplates have been used safely and effectively as an alternative to autologous cartilage grafts for single-stage LTR.[9] Additionally, Javia and Zur incorporated resorbable microplates into their reconstruction technique to support malacic lateral tracheal segments.[10] Most recently, external stenting has been used in cases of transverse, paramedian, and anteroposterior tracheal collapse, allowing decannulation of multiple tracheostomy–dependent patients.[11] In this technique, temporary endoluminal stenting for 3 to -6 months was performed prior to reevaluation of the airway and subsequent decannulation trials. Herein, we present our experience using bioabsorbable microplates both with minimal endotracheal stenting (5 days) and without any stenting in the management of severe suprastomal collapse leading to successful decannulation.

MATERIALS AND METHODS

A chart review was performed examining the evaluation and management of three patients with prior congenital subglottic stenosis who had successfully undergone LTR with anterior and posterior cartilage grafting. In all three patients, severe suprastomal collapse was limiting decannulation. Patient history, initial bronchoscopic evaluation, intraoperative technique, postoperative management, treatment outcomes, and complications were noted. Institutional review board approval from the Massachusetts Eye and Ear Infirmary was obtained.

In all three patients, the intraoperative technique of suprastomal plate suspension was similar. The procedure was performed in association with tracheocutaneous fistula closure, which has been described in detail previously.[12] After dissection was carried down to the airway, the strap musculature was divided superiorly to expose the suprastomal trachea to the level of the cricoid. At this point, intraoperative bronchoscopy was performed with needle placement providing endoscopic confirmation of the superior and inferior extent of tracheal collapse, which served as the length measurement. To support the suprastomal region, the RAPIDSORB Rapid Resorbable Fixation System, 1.5-mm, 2-hole × 18-hole (90 mm × 10 mm) resorbable strut (Synthes, West Chester, PA) made of 85:15 polymer (L-lactide:co-glycolide) was used.[13] The width of the trachea was also measured, and the curvature was obtained using an appropriately sized endotracheal tube for molding (Fig. 1). Depending on the airway dimensions, the plate was used longitudinally or transversely and trimmed according to measured specifications. Then, when placed in a hot water bath, the plate becomes malleable, which allows gentle rounding of the trimmed edges, as well as bending to obtain the appropriate contour. The plate was then secured to the outer surface of the trachea. The sutures were placed through the holes of the plate and then through the region of collapse in an interrupted, extraluminal manner to pull the malacic segment toward the stent for support. In our first two patients, absorbable sutures (4-0 Monocryl) were used. In our third patient, we transitioned to the use of nonabsorbable suture (4-0 Prolene) (Fig. 2).

RESULTS

Case 1

A 4-year-old female with subglottic stenosis had undergone LTR with anterior and posterior cartilage

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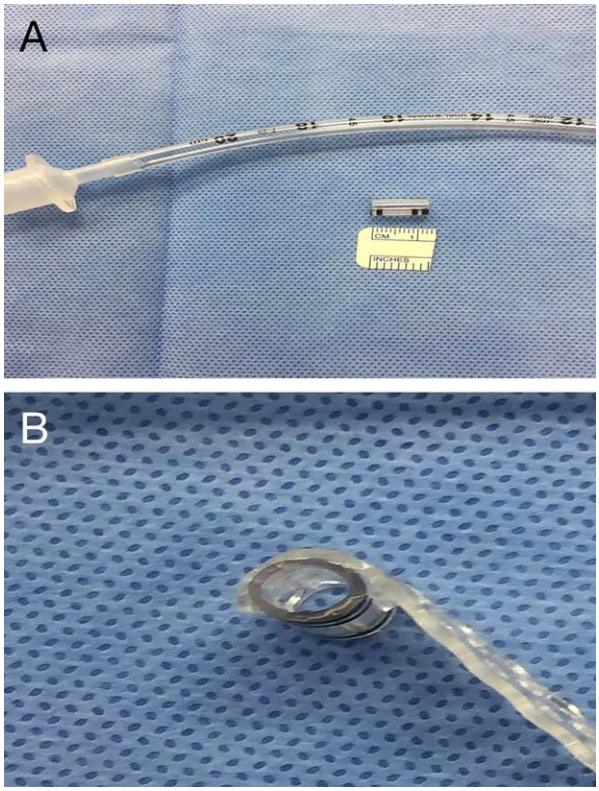

Fig. 1. Appropriately sized endotracheal tube trimmed to measured size (A) and serving as template for stent molding (B). [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

grafting. Nine months after the procedure, she continued to fail capping trials due to tracheal collapse. She underwent suprastomal plate suspension with nasotracheal intubation for 5 days. Postextubation bronchoscopy showed resolution of anterior tracheal collapse. There were no postoperative complications and she remains decannulated 14 months following the procedure.

Case 2

A 7-month-old male with subglottic stenosis underwent anterior and posterior cartilage reconstruction.

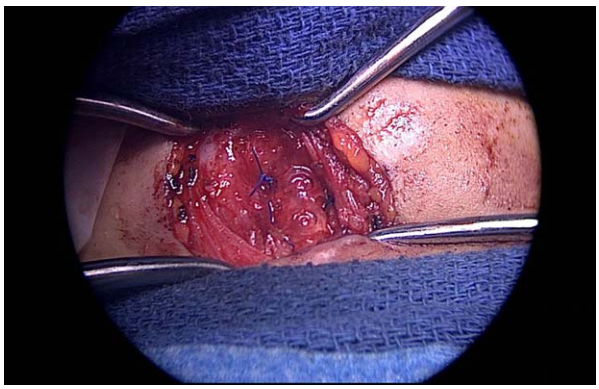

Fig. 2. Suprastomal plate shown in situ prior to closure. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

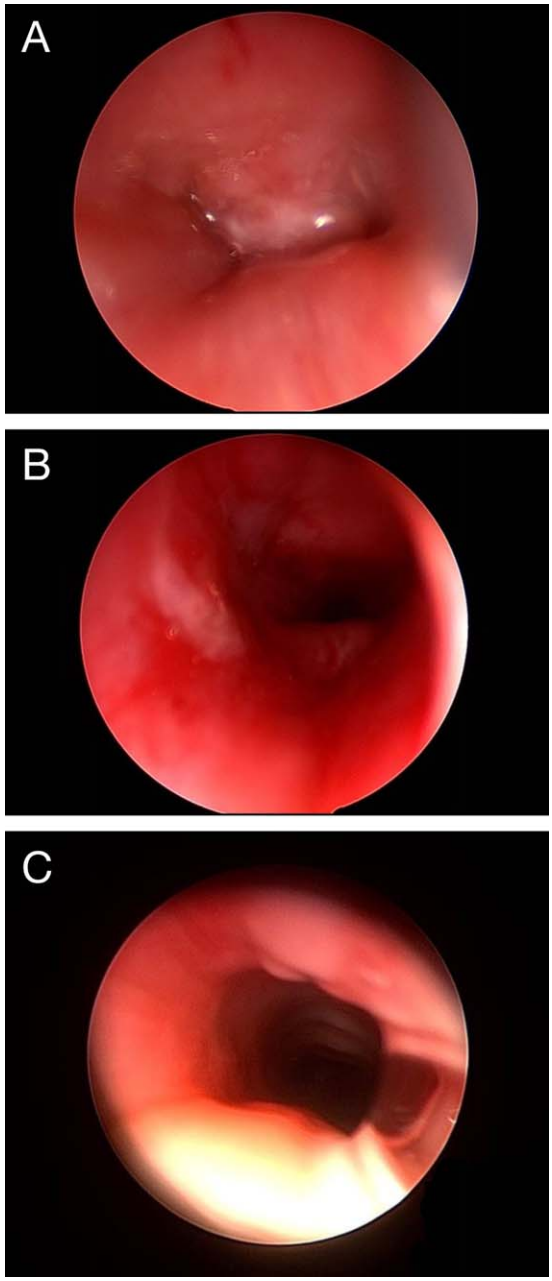

Fig. 3. Preoperative (A), intraoperative (B), and 2 weeks postoperative (C) bronchoscopy images from case 3. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

Twenty-four months after the procedure, severe suprastomal collapse continued to limit decannulation. Suprastomal plate suspension with nasotracheal intubation for 5 days was performed. Bronchoscopy performed in the operating room at the time of extubation revealed minimal anterior tracheal wall collapse. The patient did well and was transferred to the floor while awaiting a planned bronchoscopy 2 weeks following the procedure. Thirteen days after the initial procedure, the patient became upset with a substantial amount of yelling and crying. Immediately after, his neck had some increased swelling with slight crepitus noted on palpation. The patient did not exhibit any pain or

cardiorespiratory compromise. He was monitored overnight with plans to explore the neck during the time of scheduled bronchoscopy the following day. The neck was explored and a small opening in the trachea was identified inferior to the site of the plate, at the level of the tracheocutaneous fistula closure. The plate remained sutured in place without any evidence of migration. In addition, there was no fluid collection or purulence to suggest inflammation or infection. The incision was closed around a passive drain and a light pressure dressing was placed. The drain was removed after 2 days and there was no recurrence of subcutaneous emphysema. The patient remains decannulated 9 months following surgery without any further complications.

Case 3

A 24-month-old female underwent LTR with anterior and posterior cartilage grafting for subglottic stenosis. Two months postoperatively, she had near complete suprastomal collapse, which was limiting decannulation. Suprastomal plate suspension was performed, and intraoperative bronchoscopy revealed a widely patent airway (Fig. 3). As a result, this patient was extubated in the operating room and transferred to the pediatric intensive care unit for overnight monitoring. There were no postoperative complications and she remains successfully decannulated 7 months postoperatively.

DISCUSSION

When tracheostomy is necessary in the setting of laryngotracheal stenosis, one of the main goals of reconstruction includes eventual decannulation. Unfortunately, long-term tracheostomy can cause weakening of the suprastomal airway, leading to collapse and failure to achieve this milestone. Both internal and external approaches to repair have been proposed, with the method of choice often dependent on the degree of airway obstruction and the strength of the surrounding laryngotracheal complex.[7]

In cases of minor collapse, placement of an endotracheal tube for a few days has been shown to provide enough transient internal support to achieve decannulation.[7,14] With moderate collapse, pexing procedures have proven effective.[8,15,16] Sutures are placed through the weakened suprastomal segment and the overlying strap musculature, providing constant anterior traction during healing. Patients are generally left intubated between 24 and 72 hours to provide internal support during the early healing phase.[8,15,16] However, internal stenting remains necessary, because this technique does not provide a solid buttress for the anterior wall.[7]

When severe collapse is encountered, autologous costal cartilage laryngotracheoplasty has been utilized to strengthen the tracheal wall.[7,8] The airway is exposed from the cricoid to two tracheal rings inferior to the tracheostoma. The anterior airway that has lost cartilage support is excised. Costal cartilage is harvested and carved to provide flanges that are notably larger than used for anterior grafting in laryngotracheal reconstruction.[7] The graft is inserted into the tracheal defect while the extended flanges are sutured in place. The patient is intubated for 48 hours postoperatively to allow initial healing and limit the risk for posterior graft displacement.[7] Therefore, this technique provides more rigid support for the anterior wall, but requires the additional morbidity and operative time associated with costal cartilage harvest.

Bioabsorbable microplates have been used safely and effectively as an alternative to autologous cartilage grafts for single-stage laryngotracheal reconstruction, as well as treatment for malacic lateral tracheal segments.[9,10] Gorostidi et al. expanded the application of bioresorbable plates to the management of localized severe transverse, paramedian, and anteroposterior tracheal collapse.[11] However, temporary endoluminal stenting for 3 to 6 months was performed prior to reevaluation of the airway and subsequent decannulation trials. Herein, we have presented a combination and evolution of the previous techniques used to manage suprastomal collapse. We incorporated the use of bioabsorbable microplates to provide rigid airway support without the need for costal cartilage. In addition, we proceeded with a short period of endotracheal stenting (5 days) for our first two patients, but as our comfort with the procedure improved, it showed safety and effectiveness without any internal stenting. In the end, all three patients remain successfully decannulated at 9, 14, and 7 months following the suprastomal plate suspension procedure, respectively.

Of course, this is an off-label application for use of bioresorbable microplates. A full discussion was had with each family regarding the various treatment options and informed consent was obtained for each procedure. There were no minor or major complications that were directly related to the use of the plates, which is consistent with previous literature.[9–11] Case 2 warrants further discussion. Cervical emphysema is a potential complication for tracheocutaneous fistula closure. The patient did well in the immediate postoperative time period. We are unsure why there was such a delayed presentation, but regardless, the patient remained completely stable while the air leak was present. Due to the patient's stability, we could have elected to observe the subcutaneous emphysema until resolution. He was, however, already scheduled to return to the operating room for a 2-week postoperative bronchoscopy, which provided an opportunity to more definitively manage the complication. It is interesting to note that Sprecher had two patients who developed a tracheocutaneous air leak following extubation and removal of the penrose drain.[9] In both of his cases, the leak was present at the time of discharge, but resolved by the time of the first postoperative visit. Thus, our experience appears to support the safety for using bioresorbable microplates in the management of laryngotracheal reconstruction and particularly suprastomal collapse interfering with decannulation attempts.

CONCLUSION

With widespread use of open laryngotracheal reconstruction techniques, success rates in achieving decannulation surpass 90%. Severe suprastomal collapse can be one of the main causes for failure to decannulate. Several methods of repair have been reported and include internal stenting, anterior cricotracheal suspension, and autologous

costal cartilage laryngotracheoplasty. Although effective, these techniques may lack rigid support, require prolonged stenting, or involve additional morbidity and operative time due to cartilage harvest. Suprastomal plate suspension provides rigidification of weakened cartilage without additional procedures and with minimal, and possibly without, endotracheal stenting. Our preliminary experience with using bioabsorbable microplates for management of suprastomal collapse limiting decannulation has been favorable, and further investigation is warranted.

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