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Pediatric Epiglottopexy Using an Endoscopic Suturing Device

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INTRODUCTION
Laryngomalacia is the most common cause of stridor in a newborn, typically manifesting within the first few weeks of life. Olney et al. described the most widely used classification scheme for laryngomalacia, with type III laryngomalacia involving posterior displacement and prolapse of the epiglottis. Various surgical approaches have been described for management of epiglottic prolapse in children. These approaches include use of external sutures (exo-endolaryngeal suturing), endolaryngeal-only sutures, laser supraglottoplasty, or a combination of these techniques. No study to date has demonstrated superiority of any one technique.

A variety of instruments have been used to perform epiglottopexy, including microlaryngeal graspers, needle holders, knot pushers, and the Lichtenberg needle driver. We have previously described the use of laparoscopic needle holders and knot pushers during epiglottopexy. Despite the array of available instruments, endolaryngeal suturing remains technically challenging.

In the present article, we describe the use of an automated suture device used in laparoscopic surgery, the Endo Stitch (Medtronic, Minneapolis, MN, USA), for epiglottopexy. The Endo Stitch has previously been used to place temporary retraction sutures during endoscopic Zenker’s diverticulostomy to provide proximal traction on the cricopharyngeal bar for improved visualization. To our knowledge, this is the first described use of an automated suturing device for complete endolaryngeal surgery.

METHODS
A retrospective chart review was performed of a 15-month-old tracheostomized child with type III laryngomalacia who underwent epiglottopexy using the Endo Stitch. He had previously undergone an unsuccessful endolaryngeal epiglottopexy at an outside hospital. Institutional review board (IRB) approval was sought, and this project was determined to be IRB exempt.

Surgical Instrument
The Endo Stitch is an auto-suturing device (Fig. 1) with a diameter of 10 mm. The design centers around a double-ended...
straight needle which is passed between two graspers located at the end of a shaft. A handle at the opposite end of the shaft is used to fire the graspers, which close together. When closed, a switch on the handle allows the surgeon to toggle the needle to the opposite grasper. When the handles are released, the graspers return to their open position. Multiple types of suture are available, including nonabsorbable and absorbable.

RESULTS

Surgical Procedure

Sleep endoscopy was performed and confirmed complete epiglottic prolapse consistent with type III laryngomalacia (Fig. 2). Anesthesia was induced through the patient’s tracheostomy tube with inhaled sevoflurane and intravenous propofol bolus, then maintained via administration of intravenous ketamine and propofol. The patient was placed into suspension with a toddler-sized Benjamin Lindholm laryngoscope.

Fig. 2 Images of epiglottic prolapse consistent with Type III laryngomalacia, taken during sleep endoscopy of the patient in the operating room.

Fig. 3 Image of the Endo Stitch during its insertion through the toddler-sized Benjamin Lindholm laryngoscope.

Fig. 4 (A) image of the Endo Stitch in horizontal orientation just prior to placing the first bite of a mattress suture in the midline base of tongue. (B) image after placement of the mattress suture, with the suture ends left free, prior to tying down with a laparoscopic knot pusher.
(Karl Storz Endoscopy America, Inc., El Segundo, CA) with the aid of a self-retaining laryngoscope holder (Karl Storz Endoscopy America, Inc.) secured to a Mayo stand. An operating microscope (Zeiss, Ontario, CA, USA) set to laryngeal work focal length was used to visualize the surgical field. When necessary, the surgical site was further assessed with rigid endoscopy via 4-mm 0° Hopkins telescope passed through the laryngoscope. The Lumenis Ultrapulse Duo flexible fiber CO2 laser (Lumenis Inc, San Jose, CA) was used to denude the lingual surface of the epiglottis and the base of the tongue.

The Endo Stitch was then passed through the laryngoscope (Fig. 3). Using a 4–0 Polysorb stitch, a horizontally-oriented mattress suture was placed under direct visualization with the Hopkins telescope. The first bite was taken through the base of tongue, and the second was taken through the mucosa of the epiglottis (Fig. 4). The Hopkins telescope was withdrawn after the graspers were closed to allow the surgeon to toggle the needle to the opposite side, then the telescope was re-inserted to directly visualize the needle exiting the tissue. A vertically oriented stitch was then placed through the left lateral base of the tongue and the left lateral epiglottis in one bite. The sutures were hand tied and the knots were pushed down using a laparoscopic knot pusher. Postoperative pictures revealed a patent airway (Fig. 5).

Postoperatively the patient was observed in the pediatric intensive care unit prior to discharge from the hospital the following day. A 2-week follow-up revealed maintenance of the epiglottopexy stitch. Due to the presence of suprastomal collapse on direct laryngoscopy and bronchoscopy, the decision was made to proceed with laryngotracheal reconstruction.

**DISCUSSION**

Endolaryngeal suturing is challenging due to the narrow anatomy of the airway as well of range of motion limitations imposed on the wrist through a laryngoscope. Laparoscopic surgery has similar constraints to endolaryngeal surgery, with a restricted space for operating instruments and limited visibility. The ENDO CLOSE (Tyco Healthcare, Mansfield, MA, USA), a device used for closure of laparoscopic surgery ports, has previously been used to aid with vocal cord lateralization in bilateral abductor vocal cord paralysis. This technique still required an external suture and second procedure to remove the suture, however. Research supporting a decrease in operative time with the Endo Stitch was first published by Adams et al. in 1995 in laparoscopic urology surgeries, and it has subsequently been utilized in a variety of surgical procedures. We presented a case where the Endo Stitch was used to perform an epiglottopexy within the endolarynx through a toddler Benjamin Lindholm laryngoscope. No external sutures were required.

For this surgical technique, a wide laryngoscopic exposure with adequate visualization of the base of the tongue and the epiglottis is important. The Endo Stitch in the present diameter (10 mm) occupies a significant portion of the laryngoscope. If possible, a laryngoscope one size larger than usual should be used. Telescopic guidance allows for direct visualization during placement of the sutures. In order to include adequate base of tongue tissue in the stitch, the Endo Stitch must be pushed into the base of the tongue. While passing the suture through the epiglottis, care is taken not to cause epiglottic distortion. Laterally, a single vertical stitch can be placed through the base of the tongue and the lateral free margin of the epiglottis.

The straight alignment of the Endo Stitch handpiece, owing to its original design for use in the abdomen, obstructs the line of vision within the airway. A redesign of the device with a smaller instrument diameter and an angled handpiece would make it more suitable for the pediatric larynx. Despite these criticisms, we believe that the automated suture device is a useful tool in the airway surgeon’s armamentarium. Other possible applications for the device include management of laryngeal clefts, vocal fold laterization, and endoscopic repair of tracheal injuries. Further studies are needed comparing speed and accuracy of endolaryngeal suturing with the Endo Stitch versus conventional techniques to establish its efficiency and cost effectiveness.

Fig. 5 Postoperative images of the patient after CO2 denudement of the lingual surface of the epiglottis and the base of the tongue followed by endolaryngeal suture epiglottopexy using the Endo Stitch, revealing a patent airway.
CONCLUSION

The Endo Stitch is a useful tool for the endolaryngeal surgeon. Modifications to the design may be made to make the device more convenient to the endolaryngeal surgeon. Further studies are needed comparing use of this device to conventional technique.

BIBLIOGRAPHY