15 The Utilization of Transoral Robotic Surgery in the Pediatric Patient

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15.1 Introduction

Transoral robotic surgery (TORS) was first described in head and neck cancer cases in adults and, over time, expanded into treatment for adult obstructive sleep apnea (OSA). As the technology involving this technique and its associated instrumentation has improved, its utilization has expanded. More recently, through a series of publications, there has been an evolving interest in the treatment of pediatric airway ailments.

TORS in the pediatric population was first described in 2007, and in the past 8 years, only a few articles have been produced on this topic. The topics published began with feasibility and developed into examinations of surgical results [1]. To date, TORS has been described in the pediatric population for palatine tonsillectomy, oropharyngeal reconstruction, laryngeal cleft repair, lingual tonsillectomy, and base of tongue reduction/resection [1–6]. Recently it has been shown to be both feasible and effective in the treatment of refractory OSA when surgically addressing BOT and lingual hypertrophy [2].

The small size of the pediatric oral cavity can often limit the view and maneuverability of manual instrumentation in this patient population. This is where the three-dimensional endoscopic view, two active instrumentation arms, and the increased dexterity/rotational capability can be of great assistance for a more complete and effective surgery. Needless to say, as technology further develops and instrumentation becomes even smaller, the scope of surgical options will increase. Currently, the youngest patient managed through TORS in our practice or published was 15 months of age [6]. Unfortunately, the prolonged robotic docking time, cost, and sparse data are currently limitations to this technique.

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15.2 General Robotic Setup

1. Anesthesia
   (a) General
   (b) Laser-protected oral or nasal intubation
2. Patient and robotic unit positioning (Fig. 15.1)
   (a) Shoulder roll placed.
   (b) Operating table positioned 90–180° from anesthesiologist.
   (c) Oral retractor positioned and secured on surgical stand or supported on patient's chest with or without towels.
      (i) Dingman, Crowe-Davis, and McIvor retractors can be used for oral exposure including BOT.
      (ii) It is the authors' opinion that the Feyh-Kastenbauer (F-K) retractor is the most versatile and is good for hypopharynx and larynx exposure.
   (d) Surgical assistant is positioned at patient's head.
   (e) Robotic unit is positioned at patient's right side.
      (i) Transorally a 12 mm video endoscope (0 or 30°) with a laterally placed instrumentation (5 mm) and cautery.

Fig. 15.1 Oral cavity access in pediatric patient for lingual tonsillectomy and base of tongue reduction

15.3 Procedures Performed

1. TORS of the lingual tonsil and base of tongue
   - (a) Surgical procedure
     - (i) McIvor or Dingman retractor is placed using a flat tongue blade.
     - (ii) 5 mm spatula cautery and Maryland forceps are utilized.
     - (iii) 30 degree 12 mm video endoscope provides a superior view of region.
     - (iv) Care is taken to place the distal aspect of the tongue blade at the circumvallate papillae in order to expose the base of tongue and lingual tonsillar tissue.
     - (v) The lingual tonsillar tissue is taken in two specimen sections starting from midline and moving laterally.
       1. This improves visualization and enables the two specimens to be taken en bloc.
     - (vi) The muscular aspect of the base of tongue is removed in similar medial to lateral fashion.
       1. Care is taken not to extend deep into the base of tongue laterally in order to avoid the lingual artery.
     - (vii) Area is irrigated and allowed to heal by secondary intention.
   - (b) Complications
     - (i) Intraoperative:
       1. Hemorrhage
       2. Dental trauma
       3. Accidental extubation/loss of airway
     - (ii) Postoperative
       1. Pain
       2. Dehydration
       3. Bleeding
          - (a) Minor bleed
          - (b) Lingual artery hemorrhage
       4. Infection
2. TORS for the treatment of laryngeal cleft
   - (a) Surgical procedure
     - (i) Patient is intubated for TORS-directed laryngeal cleft repair.
     - (ii) Patient is suspended and the larynx is secured transorally using the F-K retractor.
     - (iii) 5 mm spatula cautery and Maryland forceps are utilized.
     - (iv) 0 degree 12 mm video endoscope provides a good view of the supraglottis and glottis.
     - (v) The supraglottic interarytenoid region is isolated.
     - (vi) Cautery is utilized on coagulation setting of four to incise the interarytenoid mucosa beginning at the deepest center portion of the cleft and moving laterally (Fig. 15.2).
     - (vii) Submucosal flaps are elevated and dissected using Maryland forceps.
     - (viii) Both the esophageal and laryngeal sides of the cleft are elevated.
     - (ix) At least two sutures are placed: one on the esophageal side and one on the laryngeal aspect using 4-0 or 5-0 polydioxanone (PDS) suture (Fig. 15.3).
       1. Care is taken to begin within the defect to ensure that both knots are buried.

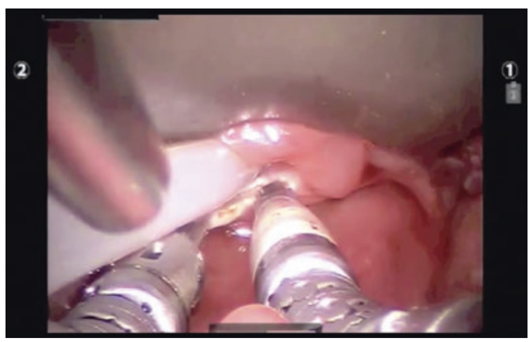

Fig. 15.2 Electrocautery used to create open edges of interarytenoid space

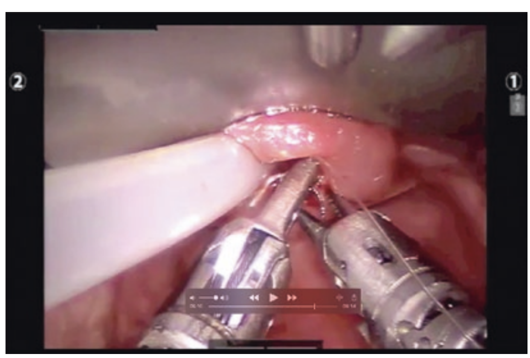

Fig. 15.3 Maryland forceps utilized to place suture to repair cleft

(b) Complications
  (i) Intraoperative
    1. Accidental extubation/loss of airway
    2. Accidental laryngeal or esophageal injury
    3. Dental trauma
  (ii) Postoperative
    1. Pain
    2. Dehydration
    3. Bleeding
    4. Infection
    5. Suture dehiscence post-repair
    6. Granulation formation at site of repair
    7. Esophageal stricture
    8. Supraglottic stenosis
    9. Dysphagia (aspiration or penetration)

15.4 Discussion

With a well-established role in adult otolaryngology, TORS in pediatric head and neck surgery is evolving, and its uses are broadening. To date, efficacy data is primarily limited to the above described procedures and oropharyngeal stenosis.

When examining TORS for BOT resection and lingual tonsillectomy, it is argued that in certain patients the ease of dissection and superior view allows for a more accurate and complete resection with limited increased risk [2, 5]. A recent examination of TORS for pediatric BOT and lingual tonsil surgery reported a greater than 50 % reduction in obstructive apnea-hypopnea index (O-AHI) score postoperatively [2]. In the same study, the majority of patients were discharged on postoperative day 1, and no intraoperative complications were reported [2]. This data, though limited by patient population size, is indeed promising as TORS further develops.

Laryngeal cleft surgery is often tedious and difficult for the pediatric otolaryngologist who is limited by patient oral cavity size, visualization, instrument rotation, human tremor, and the need to protect the patient's airway. TORS has been described as an option for these surgeries [6]. The ability to have a suitable view of the interarytenoid region and laryngeal cleft while maintaining airway safety through intubation is a noted benefit to these procedures. Recently Leonardis and colleagues described their experience with TORS-assisted LC repair in the pediatric population [6]. In this particular study, five patients were examined; all were extubated without complication and all passed subsequent 4-week postoperative swallowing examinations, demonstrating successful results [6]. The authors cited visualization, increased range of motion, and filtration of surgeon tremor as potential benefits in their experience [6].

For the treatment of pharyngeal stenosis, similar limitations, as previously described in the pediatric population, remain true with the addition of a more limited view secondary to scar tissue and contracture. In a case series published, TORS technology was utilized for access to significant nasopharyngeal stenosis in an 8-year-old child [7]. Through the use of TORS visualization and operative instrumentation, scar division, flap elevation, and proper nasopharyngeal port creation were achieved [7]. This report, though limited, does demonstrate the expanding utilization of this technology.

Conclusion

In the pediatric population, limitations exist secondary to child size and associated access. Studies on this subject are sparse, but published data has demonstrated feasibility and promising outcomes without excessive complications when compared to traditional surgical technique [1–3, 5, 6]. Though this chapter focuses primarily on TORS directed at lingual, BOT, and laryngeal cleft surgical options, TORS has been reported to be successful for the treatment of pharyngeal stenosis and other oropharyngeal pathology in the pediatric population [7].

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