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Transoral robotic surgery in the pediatric patient

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Although the role of transoral robotic surgery (TORS) is rapidly expanding in its surgical management options for both benign and malignant head and neck pathology in the adult population, its role is currently less defined in the pediatric population. Results using TORS to perform lingual tonsillectomy, laryngeal cleft repair, and oropharyngeal reconstruction with local flaps are promising, nevertheless, this technology is still in its infancy with respect to use in pediatric airway disease. The following text describes indications for utilization of TORS, operative techniques, and expected postoperative outcomes and complication profiles in the pediatric patient.

Introduction

Since establishing the safety and feasibility of transoral robotic surgery (TORS) several years ago,[1] its role in head and neck surgery has been rapidly expanding. The combination of 3-dimensional movement, magnification, and stereoscopic visualization that robotic surgery provides gives an unprecedented ability to perform minimally invasive procedures in anatomical areas that have been traditionally challenging to approach, including the oropharynx and base of tongue. As such, its use has been shown to minimize morbidity in the treatment of a wide array of diseases in the adult population, from obstructive sleep apnea[2] to pharyngeal and base-of-tongue malignancies.[3–5]

Although there is a clearly established role in adult head and neck surgery, significantly less is known with respect to the role of TORS in the pediatric population. Rahbar et al. first described robotic surgery to be a feasible option for the pediatric airway in 2007; however, access to oropharyngeal structures was limited by the size of the surgical instruments.[6] Since then, advances in robotic technology have allowed miniaturization of the instrumentation, which has dramatically expanded the scope of surgical options.[7]

To date, performance of lingual tonsillectomy,[8] laryngeal cleft repair,[9,10] and oropharyngeal reconstruction with local flaps have been accomplished in pediatric patients with positive results and an acceptable operative and postoperative complication profile. The following text describes indications for robotic surgery, operative technique, and postoperative management of pediatric patients undergoing robotic-assisted surgical care.

Indications

As visualization of anatomy and space for instrumentation become increasingly more difficult as the site of surgical intervention extends further from the oral opening, the use of robotic assistance becomes increasingly more valuable with progression past the anterior tonsillar pillars.[11] This advantage is magnified in the pediatric population, in whom spatial limitations are even greater.

In children, indications for lingual tonsillectomy include, but are not limited to, obstructive sleep apnea, dysphagia, and recurrent tonsillitis. As such, the lingual tonsils can be hypertrophied and act as a source of mechanical obstruction

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or nidus for infection. Nonrobotic lingual tonsillectomy is performed transorally using a headlamp and monopolar cautery or laser microsurgery.[4] Increased visualization provided by robotic technique enables a more complete excision and greater protection of surrounding structures, which may help reduce swallowing and breathing complications postoperatively.

With respect to laryngeal cleft repair, the surgical approach varies based upon the type and location of clefting. Before the advent of robotic surgery, the cleft was approached through an open method or endoscopically using suspension laryngoscopy.[9] To date, both type 1 and type 2 laryngeal clefts have been successfully repaired using the TORS approach.[6] In this setting, the robotic surgeon eliminates the need for long, rigid tools that not only limit mobility and visualization but also act as a fulcrum to magnify fine tremor movement. In contrast, the robotic system's 540° rotation capability and filtering of tremor are major advantages over traditional approach. These advantages also make closure an easier task; as suture site dehiscence is a well-known complication following laryngeal cleft repair, the increased ease of laryngeal suturing provided by robotic use is a powerful advantage.[12]

For oropharyngeal reconstruction with local flaps, the robot is able to elevate and inset local flaps with relative ease, providing exceptional access to the lateral pharyngeal wall and tongue-base junction with the soft palate. Once again, this setting traditionally requires long, rigid instruments for closure of the surgical site, and similar concern for surgical site dehiscence in this setting is improved by robotic use.

Technique

Following the induction of general anesthesia, a laser-safe oral or nasal endotracheal tube of appropriate size is placed, based upon surgeon preference and patient anatomy. After proper patient positioning, a shoulder roll is placed and the operating table is turned 90°-180°. An appropriate oral retraction device is chosen depending upon individual anatomy and indicated procedure, inserted, and may be hooked on the edge of a mayo stand positioned over the patient's chest (Figure 1). Given its 3-dimensional adjustment capability, the Feyh-Kastenbauer (F-K) retractor (Gyrus, ACMI, Southborough, MA) is the most versatile retractor. It is used for laryngeal and hypopharyngeal exposure and can provide greater base-of-tongue visualization when necessary.[13] The Dingman mouth gag provides oral cavity exposure, while the Crowe-Davis mouth gag opens the oral cavity wider than other instruments, providing oropharyngeal exposure, namely to the tonsillar region and base of tongue.[13] The McIvor blade (GerMedUSA Inc, NY) is a tongue retractor with a curved blade and flat handle used to press down on the tongue during a tonsillectomy.[14]

The robotic patient unit is brought into the field and positioned at the patient's right with a bedside surgical assistant positioned at the patient's head (Figure 2). Robotic arms are positioned with a central 12-mm, 0° or 30° 3-dimensional video endoscope and flanking cautery and grasper trocars (Figure 3). Five-millimeter instruments are ideally suited for the pediatric patient because of additional space limitations. If suturing is performed, a bed-side assistant is responsible for passing suture to the surgeon-controlled instruments. Particular attention is given to hemostasis, which is often aided by the use of Floseal (Baxter Healthcare, Deerfield, IL) or other hemostatic agent.

Figure 1 The Dingman mouth gag is inserted into the mouth and secured to the mayo stand to provide stability to perform RALT. An assistant is positioned on the patient's right side to provide suction. RALT, robotic-assisted lingual tonsillectomy. (Color version of figure is available online.)

Robotic-assisted lingual tonsillectomy

After securing the airway and protecting the teeth, a tongue stitch is used to retract the tongue anteriorly. A McIvor mouth gag is used with a flat tongue blade. Care is taken to get full exposure of the lingual tonsils therefore the tip of the

Figure 2 Positioning of the surgical robot over the patient is shown. The assistant is positioned on the patient's right side to provide suction. (Color version of figure is available online.)