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Techniques for Adenotonsillectomy (T&A)

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1. Introduction

Adenotonsillectomy (T&A) is one of the most commonly performed surgical procedures in children. An estimated 530,000 children undergo tonsillectomies each year in the United States.[1] Various instruments are available currently to perform adenotonsillectomy. In Walner et al, monopolar electrocautery was used most often for total tonsillectomy. Monopolar electrocautery alone or in conjunction with the adenoid curette or the microdebrider were the top three instruments.[2] In this chapter, we review the currently available technologies for performing T&A in children. We first review indications for T&A before discussing specific technologies and then discuss specific applications of these technologies for T&A.

2. Indications for T&A

The indications for tonsillectomy have shifted over the past 40 years. In the early 1970s, close to 90% of tonsillectomy procedures in the United States were performed in response to infections. Current trends in T&A suggest obstructive sleep apnea (OSA) as the indication for tonsillectomy in younger children, ages 0-8 years, while infection is the most common indication in children ages 9-18 years.[3] Today, most procedures are performed to treat sleep disordered breathing (SDB), which is defined as a continuum from primary snoring to OSA. This trend reflects not only improved control of the complications of group A streptococcal pharyngitis with antibiotics but also increased rates of childhood obesity, a concomitant and perhaps related factor in the diagnosis of SDB, and a greater awareness of the impact of SDB on children's educational progress and cognitive development. In 2011, the American Academy of Otolaryngology Head and Neck Surgery Foundation published *Clinical Practice Guideline: Tonsillectomy in Children*, (see chapter 4, Section Mouth, Head & Neck in this Manual) which discusses perioperative management of tonsillectomy patients and offers recommendations for when tonsillectomy should be considered for infection and obstruction.[4] The clinical practice guideline with regards to tonsillitis/pharyngitis recommends documenting a frequency of seven or more episodes of tonsillitis in the preceding year, *or* five or more episodes in each of the preceding two years, *or* three or more episodes in each of the preceding three years; sore throat with associated clinical features such as temperature > 38.3°C, *or* cervical lymphadenopathy (tender lymph nodes of > 2 cm), *or* tonsillar exudate, *or* positive culture for group A *Streptococcus pyogenes* (GAS); and history of treatment with antibiotics for streptococcal pharyngitis episodes. For children with SDB and tonsillar hypertrophy, the guideline recommends that

clinicians counsel caregivers about comorbid conditions that might improve after tonsillectomy, including growth retardation, poor school performance, enuresis, and behavioral problems. Recommendations include caregiver counseling for health benefits of tonsillectomy in children with abnormal polysomnography. Tonsillectomy may also be performed for suspected neoplasia, multiple antibiotic allergy/intolerance, or for immunologic disorders such as periodic fever, aphthous-stomatitis, pharyngitis, adenitis (PFAPA) syndrome. It is important to keep in mind that these recommendations pertain to the pediatric population, with total tonsillectomy with or without adenoidectomy as a primary mode of treatment, and do not apply yet to intracapsular or partial tonsillectomy.

Some argue that technique is predicated upon indication; for example, children with obstruction may be treated by intracapsular tonsillectomy although infectious indications mandate total tonsillectomy. In our experience, both infection and obstruction may be treated effectively with intracapsular techniques.[5] Most otolaryngologists (97.4%) use total tonsillectomy techniques; however, they use subtotal tonsillectomy techniques at least some of the time (27.4%). For obstruction, 2.6% use subtotal tonsillectomy only, 72.6% total tonsillectomy only, and 24.8% both total and subtotal techniques. For infection, 2.6% use subtotal techniques only, 88.7% total tonsillectomy techniques, and 8.7% both total and subtotal techniques.[3] We recommend total tonsillectomy for suspected neoplasia and PFAPA. For neoplasia, cold techniques or monopolar electrocautery dissection generally is used to permit analysis of surgical margins. Tonsil tissues are sent for permanent pathology only if significant differences in size between the tonsils are noted, if the surface of the tonsil is irregular with a "fish flesh" appearance, or if any other concerns for neoplasia arise. Fresh frozen specimens are useful in making the diagnosis of lymphoma if this is a concern. When a microdebrider is used, a suction sock is needed for specimen collection when neoplasia is suspected or microbiology is required. Coblation® is useful in special circumstances where monopolar electrocautery may be dangerous, as in patients with a cochlear implant.

3. Available Tonsillectomy Technology

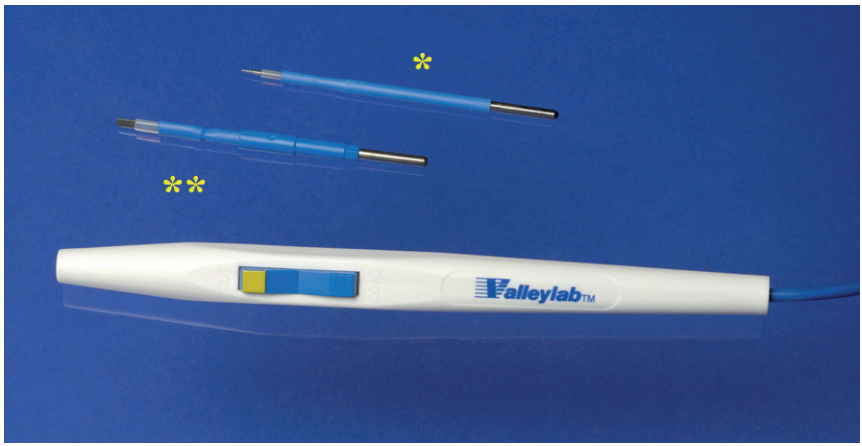
Tonsillectomy tools are classified as either "cold" (not requiring electricity) or "hot" (requiring electricity). Cold tools traditionally used for tonsillectomy include scissors, snares, and tonsillotomes. Tonsillotomes are guillotine-like devices with a sharp blade and a slot in which the blade travels. The slicing motion of the blade truncates the tonsillar tissue. Both total and subtotal tonsillectomies were performed using tonsillotomes in the past. Snares have evolved into a single hand trigger apparatus with a wire that makes a loop at the distal end that encircles and extricates the inferior pole of the tonsil after cold instruments are used to incise the tonsillar pillars and dissect the tonsil away from the pharyngeal wall. In addition to the traditional cold steel instruments, there are various electrosurgical instruments available for adenotonsillectomy.

3.1. Monopolar electrocautery

Monopolar electrocautery (Bovie), because of its low relative cost, speed, and ease of use, is one of the most common instruments used for total or

traditional tonsillectomy (**Figure 1**). Its disadvantage lies in thermal spread into surrounding tissues and very high temperature, up to 400 to 600°C with attendant perioperative concerns of tissue trauma leading to more postoperative pain and potential complications, such as lip burns and airway fires.[6]

Figure 1. Monopolar electrocautery (Bovie). Valley Lab pencil design hand piece with Teflon-coated guarded needle point (single asterisk) and spatula tip (double asterisk). (Valleylab, Boulder, CO).



3.2 Coblation®

Coblation® (ArthroCare ENT, Austin, TX) is the application of a bipolar radiofrequency wand device that generates a localized plasma field by energizing the protons in the saline delivered along the shaft of the wand (**Figure 2**). The resulting plasma field ablates tissue and simultaneously provides vessel coagulation. Larger vessels may be addressed separately with the cautery-only setting. Intraoperative tip cleaning is by abrasion against a thick cloth towel while hitting the "ablate" foot pedal; suction of mildly soapy saline will prevent wand clogging.[7] This technique provides a clean, hemostatic plane-of-dissection with minimal thermal damage (60-70°C) compared with the monopolar cautery.[8] Because the ablation setting easily dissects through tissue, it is important to ensure only the "coagulate" setting is applied to cauterize vessels. This technology can be used for either traditional or intracapsular techniques. As with monopolar electrocautery, caution must be exercised to avoid thermal injury to mucosa and skin.

Figure 2. Coblator and Coblation® Technique. Equipment. Note exposed metallic electrode (arrow) that warrants caution particularly during adenoidectomy. 1A) EVac® Xtra HP. © 2008, ArthroCare Corporation. Used with permission. 1B) Coblator® foot pedal. © 2008, ArthroCare Corporation. Reproduced with permission.

3.3 Powered microdebrider

The microdebrider is an oscillating tool that consists of a variably sized, serrated blade within a hollow cylinder coupled with a suction sock in the cylinder that pulls tissue into a partial opening at the tip, permitting tissue resection and optional tissue collection through a specimen trap (**Figure 3**). Saline within the unit prevents clogging. The typical speed setting for adenotonsillectomy varies from 800 to 1800 revolutions per minute (RPM). Precise application is critical as the microdebrider is designed to resect even bony structures.

Figure 3. Powered Microdebrider. © Medtronic, Inc. Reproduced with permission.

3.4 Harmonic scalpel

The harmonic scalpel uses an ultrasonic frequency of 55.5 kHz that provides high-speed vibratory tissue dissection. This instrument is thought to deliver lower amounts of thermal damage, limiting the extent of postoperative pain and morbidity. Increased reports of intraoperative hemorrhage are balanced against reported lower rates of postoperative hemorrhage and improved healing attributed to decreased thermal spread.[9]

4. Tonsillectomy: General Surgical Principles & Techniques

Tonsillectomy in the United States is typically performed with the patient under general anesthesia. The patient is placed supine with the neck extended and a shoulder-roll in place. For neck extension in children with trisomy 21 (Down syndrome) who have a higher concern for atlantoaxial subluxation, additional preoperative tests may be considered. Ventilation may be performed using an endotracheal tube or laryngeal mask airway. Dentition should be inspected for looseness or chipping, and any concerns should be documented before and after the procedure.

Exposure to the oropharynx is achieved using a McIvor (Novo Surgical, Oak Brook, IL) or Crowe–Davis-style (Specialty Surgical Instrumentation, Antioch, TN) mouth gag, and suspension is usually achieved by hooking the device to a Mayo stand across and above the patient's chest. Exposure to the nasopharynx can be achieved after insertion of bilateral, transnasal, non-latex catheters to retract the soft-palate cephalad.

Lidocaine (1%) with 1:100 000 epinephrine is injected through the anterior tonsillar pillar into the peritonsillar space. This allows for added hemostasis, improved pain control, and "hydrodissection." The fluid-filled peritonsillar space

is particularly useful with Coblation®. Injection further facilitates surgery by medializing the tonsillar tissue, which is very helpful for endophytic tonsils.

4.1 Traditional (total) tonsillectomy

Traditional tonsillectomy may be performed with any number of instruments (eg, cold steel, monopolar or bipolar cautery, plasma knife, or Coblation® devices). Although subtle differences exist between the use of each device whether intra- or extracapsular, the underlying principles are optimizing exposure and tissue tension and then finding and staying in the proper plane-of-dissection. In total tonsillectomy, the tonsil is grasped with an Allis clamp. The tonsil is then retracted medially and a curvilinear mucosal incision is made at either the lateral margin on the tonsil or at the superolateral aspect of the anterior pillar. The incision can be made with a sickle knife in the case of cold-steel tonsillectomy, with monopolar cautery, or using the ablate function on the Coblation® wand. The tonsil is then retracted inferomedially using the Allis clamp and dissection begins along the tonsillar capsule. The fibrous tonsillar capsule is recognized when loose areolar tissue is encountered. Once the superior pole is freed from the tonsillar fossa, it is often necessary to reposition the Allis clamp to provide constant surgical tension; however, multiple passes at grabbing tonsillar tissue often leads to fragmentation and bleeding, thus compromising further dissection. Once the fibrous capsule is identified, dissection along this plane typically continues in a superior-to-inferior manner.

For the cold steel technique, a number of instruments may be used to perform this dissection, including a Hurd dissector, a Fisher knife, or a Freer elevator. The Fisher knife has a serrated, hockey-stick-shaped end. It is manipulated by placing the serrated edge into the plane-of-dissection and slowly pushing the instrument forward to elevate the tonsil from the underlying musculature while simultaneously providing continuous medial traction with the tenaculum. Monopolar electrocautery and Coblation® techniques proceed in a similar manner: the surgeon applies medial traction and rotation of the tonsil firmly grasped with Allis tenaculum that enables visualization of the lateral extent of the tonsil while slowly cauterizing or coblating through the potential space immediately lateral to the tonsillar capsule. With the use of either device, areas of hypervascularity may be “precoagulated” to provide improved hemostasis prior to dissection.

Dissection is continued in a systematic manner inferiorly toward the inferior pole, which is the site of significant blood supply. Loss of the plane-of-dissection by violating the tonsil tissue or the constrictor musculature should be immediately recognized, either by a change in the tissue’s smell (“burnt flesh” if the tonsil is entered) or by a visualized loss of the sheen of the tonsillar capsule, and corrected. Use of surgical magnifying loupes for tonsillectomy will greatly aid in identifying subtle changes in intra- versus extracapsular planes. Frequently, the tonsil tissue lacks an obvious inferior extent and instead blends into the lingual tonsil tissues. As the inferior pole is approached, a decision must be made to dissect through some of the lymphoid tissue. To prevent excessive bleeding, avoid extensive dissection inferiorly. Rather, Coblation® on “coagulate” or

electrocautery to truncate the inferior pole is recommended unless the tonsil snare is used to truncate the tonsil at the inferior pole.

Patients with obstruction usually have more easily separable planes between the tonsillar capsule and constrictor musculature whereas patients with recurrent infections may have relatively hypervascular and/or fibrosed planes which can be challenging to clearly identify and dissect.

4.2 Intracapsular tonsillectomy

Intracapsular tonsillectomy (ICT), also referred to as partial tonsillectomy or tonsillotomy, involves the exteriorization of tonsillar crypts by removing most of the lymphoid tissue of the tonsil and leaving a thin rim of tissue against the tonsillar capsule. The pharyngeal musculature is not exposed. Preserving a thin rim of tonsil tissue facilitates healing, expedites recovery, and reduces dehydration as well as returns to the operating room for hemorrhage.[10] The most common approaches to ICT today are microdebridement and Coblation®.

Microdebrider ICT is performed using straight and angled blades at a variable rate of oscillation between 800-1800 RPM.[11] Instead of grasping the tonsil with a tenaculum, the tonsillar tissue is presented using a Hurd retractor. Gradual lateral tissue resection proceeds from the center of the tonsil to the upper pole and allows for optimal tissue removal. The surgical limit of dissection is identified by noting the stringy appearance of pericapsular fibers, which are best appreciated when using magnifying surgical loupes. Hemostasis is achieved using monopolar electrocautery.

Intracapsular Coblation® tonsillectomy employs two techniques for partial tonsillectomy: the "lop-off" technique for large, exophytic tonsils and the "reduction" technique for endophytic tonsils.

The lop-off technique, with large, exophytic tonsils is similar to that taken during total tonsillectomy. The body of the tonsil is grasped with a tenaculum that is then used to medialize the tonsil. Once the lateral extent of the tonsil is appreciated via palpation with the instrument, a curvilinear mucosal incision is made slightly medial to the superolateral incision on the anterior pillar customarily made for traditional tonsillectomy. This enables the tonsillar capsule to be left down within the fossa. By employing a slow, deliberate brushing technique with the ablate mode, the surgeon will expose a shiny, white plane of tonsillar capsule best recognized by using surgical loupes. This tissue should be preserved and left within the fossa as the lymphoid tissue is excised. Firm medial tonsillar retraction protects the capsule and the pillars. Spot hemostasis can be achieved during dissection by switching to the coagulate mode to cauterize any individual vessels encountered. Once the tonsil has been removed, hemostasis can be completed with the coagulate setting.

The reduction technique, with small, endophytic tonsils, can be approached in a slightly different manner. With a tenaculum, the tissue is grasped and retracted medially. The lateral extent of more endophytic tonsils can often be difficult to appreciate. In this circumstance, the ablate setting can be used to first shave the tonsil down along the sagittal plane of the pillars while keeping the tip of the wand directed medially at all times. This will inevitably result in stumps

of lymphoid tissue, likened to small growths of shrubbery, that are left behind within the tonsillar fossa. This remaining tissue can be reduced by switching to the coagulate setting and directing the wand laterally. This same technique can be applied in the case of chronic or recurrent tonsillitis. In this circumstance, the cryptic and friable tonsillar tissue can be difficult to grasp or retract with the tenaculum and may be ablated in a piecemeal manner. The advantage of ICT is that the pharyngeal musculature is not exposed and the tonsil tissue that is coagulated within the fossa forms a protective biological dressing.

4.3 Hemostasis

Regardless of technique, hemostasis must be achieved following removal of lymphoid tissue. A tonsil sponge can be used to apply pressure to the tonsillar fossa followed by judicious application of electrocautery using monopolar (Bovie) or bipolar (Coblation®) techniques or 3-0 chromic sutures with tapered needles. Severe bleeding refractory to cautery or sutures may require tissue sealants (fibrin) or hemostatic agents (thrombin). Pillar placation may also be applied in such difficult cases with the additional benefit of opening the pharyngeal airway further as adjunctive management for obstructive indications. The authors recommend relaxation of the transnasal catheters and removal from suspension with closure of the mouth gag for a defined time period (30 seconds by the clock) to permit vessels that may have been "pulled" closed during retraction to declare themselves and permit hemostasis upon re-exposure. In addition, relaxation permits edema of the soft palate, lips, and tongue and allows the uvular edema to regress. During dissection with electricity and during cauterization, any metal instrument used for retraction or visualization purposes should be buffered from the oral mucosa by a gloved finger to prevent thermal burns

5. Adenoidectomy: General Surgical Principles & Techniques

The patient is positioned in the same fashion as for tonsillectomy mentioned above. Again, exposure to the nasopharynx is achieved using bilateral transnasal, non-latex catheters to retract the soft palate cephalad for enhanced visualization and protection of the palate from an injury during adenoidectomy. Often a small stump of adenoid tissue is left behind at the level of the soft palate to prevent potential velopharyngeal insufficiency (VPI).

5.1 Curette with monopolar cautery

Cold steel technique for adenoidectomy can be performed using adenotome or adenoid curette. The adenotome is a guillotine-like instrument with a slot for collection of the tissue. More often used is the adenoid curette. The adenoid curette is positioned similarly in the nasopharynx and is guided using the left thumb to slice through the adenoid pad. Progressive smaller curettes may be used to facilitate tissue removal by "feathering" down the remaining adenoidal tissue after bulky tissue is removed using a large curette. Following the surgical removal of the adenoid pad, the nasopharynx is packed with tonsil sponges, often for the duration of the tonsillectomy. The sponges are then removed and monopolar suction cautery is used for further hemostasis. Use of the adenoid curette permits a quick removal of bulky adenoids. Forceps may be used to grasp additional adenoidal tissue especially at the choanae which cannot be effectively

reached with curettes. Cold steel methods are advocated for instances when histopathologic or microbiologic evaluation of tissue is needed.

5.2 Microdebrider adenoidectomy

Microdebrider is an efficient tool for adenoidectomy regardless of the degree of the hypertrophy. It resects the tissue and also enables collection of the tissue into a specimen trap connected to the suction port for any histpathologic or microbiologic evaluation. Removal of tissue is precise as the rotating blade within the barrel can be directed exactly to the location of the heaped tissue. Hemostasis may be achieved using electrocautery.

5.3 Monopolar cautery

Monopolar cautery alone can be used to ablate the adenoid tissue by gently heating up and suctioning away the tissue. A mirror is used to view the adenoids. The goal is to remove adenoid tissue high up in the nasopharynx causing obstruction of the pharynx, but more importantly, the choana. At the end of adenoidectomy, posterior septum should be easily visualized. Care is taken not to aggressively cauterize the adenoid tissue at the choanal rim to avoid choanal stenosis resulting from excessive scar formation.

5.4 Coblation® adenoidectomy

The Coblation® wand is placed one millimeter from the tissue and the adenoid tissue is gently brushed down moving in a superior to inferior direction by pressing down on the abate pedal. Hemostasis is achieved using the coagulation setting. The setting should be changed from the tonsillectomy settings of 7 ablate and 3 coagulate to 9 ablate and 5 coagulate for adenoidectomy. Subsequently, during achieving hemostasis in the nasopharynx and a second look at the tonsillar fossa, the setting should again be changed to 1 ablate and 5 coagulate to prevent inadvertent injury to adjacent vasculature.

5.5 Hemostasis

Achieving good hemostasis after adenoidectomy often takes patience. The surgeon's view is via the mirror and the depth at which the bleeding stems from can be difficult to determine if any residual adenoid tissues remain. Judicious use of monopolar suction cautery, bipolar cautery, or Coblation® on the coagulate setting are effective.

6. Conclusion

A variety of T&A techniques and technologies are available today. Careful application of a particular surgical technique and instrumentation for discrete indications should optimize surgical results.

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