

Tonsillectomy and Adenoidectomy: Current Techniques and Outcomes

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ABSTRACT

Tonsillectomy and Adenoidectomy continues to be one of the most commonly performed surgical procedures in the pediatric population with over 500,000 procedures performed annually. Decreasing pain, maintaining hydration, and minimizing the risk of post operative hemorrhage has brought attention to novel surgical technique and instrumentation. Electro-cautery remains the most common technique used across the United States, however newer technologies have evolved claiming improved recovery with expedited return to normal activity and diet. The current literature remains of significant debate as to the modality that offers the best outcomes. In this review, we describe some of the newer technologies and more common modalities used in practice and discuss the current literature findings.

Keywords: Adenoidectomy, Hemorrhage, Pain, Tonsillectomy.

Source of support: Nil

Conflict of interest: None

How to cite this article: Sharma S, Andreoli S, Josephson GD. Tonsillectomy and Adenoidectomy: Current Techniques and Outcomes. *Int J Head Neck Surg* 2016;7(2):104-108.

INTRODUCTION

Tonsil and adenoid surgeries have evolved over the past 3,000 years. Tonsillectomy was first described in ancient Hindu writings from approximately 1000 BC, outlining a partial tonsillectomy using fingernail dissection. In the first century AD, Cornelius Celsius described total tonsillectomy (TT) using a fingernail and metal hook followed by vinegar irrigation for hemostasis.¹ Galen later described the snare tonsillectomy, and this technique was employed for approximately 400 years. The partial tonsillectomy was again described by Aetius in 490 AD as a means to minimize hemorrhage. In 1828,

Philip Syng Physick developed the tonsillitome, a device based on the French guillotine which would serve as the basis for multiple subsequent modifications. In the early 20th century, American and British otolaryngologists began to popularize the modern cold steel TT. Parallel to the timing for commonplace endotracheal intubation in the 1950s, the electrocautery tonsillectomy began to gain popularity.

Although improved antibiotics and evolving guidelines have decreased the number of adenotonsillectomies performed, it remains one of the most commonly performed surgeries in the United States. Peaking in 1959, the number of tonsillectomies has steadily decreased from 1.4 million to approximately 500,000 cases performed annually.² During this time, the most common indication has evolved from recurrent tonsillitis to sleep-disordered breathing. As surgical indications have evolved, similarly new techniques, instrumentation, and perioperative algorithms have emerged. Despite the high volume of adenotonsillectomies, optimal technique continues to be debated in the literature with respect to postoperative hemorrhage, pain, and return to normal diet. In this review, we describe the most common modalities and newer technologies in use today. It is not in the scope of this review article to discuss all techniques and in particular those less frequently used.

TECHNIQUES

Total Tonsillectomy

Performance of TT, despite instrumentation used, follows a similar approach. A curvilinear incision is made along the anteromedial surface of the palatoglossus muscle. Dissection is performed to enter the plane between the tonsillar capsule and the superior constrictor muscle. The tonsil is retracted medially and excised from superior to inferior.

Cold Tonsillectomy

The traditional technique for tonsillectomy continues to be practiced by up to 10% of otolaryngologists. An incision is made using a #12 blade or scissors. The tonsil is retracted medially and blunt dissection using spatula or sponge is performed. The snare is used to lasso the inferior pedicle and the tonsil is removed with ligature

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or diathermy for hemostasis. Cold tonsillectomy has gradually fallen out of favor among many otolaryngologists secondary to increased intraoperative blood loss and advances in powered instrumentation. However, cold tonsillectomy is associated with less postoperative pain.^{3,4}

Electrocautery

Monopolar cautery has become the most common technique for the performance of tonsillectomy. Using electrical current which creates temperatures from 400 to 600°C, dissection is performed with minimal intraoperative bleeding. Concurrent hemostasis shortens surgical time; however, increased delivery of energy results in increased pain and odynophagia. Additionally, because of the monopolar current applied to the patient, electrocautery may interfere with or damage pacemakers, vagal nerve stimulators, and cochlear implants.

Coblation

Coblation[®] (Arthrocare Corporation, Sunnyvale, CA, USA) technology uses radiofrequency ablation for tissue removal. Continuous saline delivery coupled to bipolar electrodes at the device tip generates a charged plasma field. This charged “glow discharge plasma” breaks down cellular bonds and results in tissue ablation. Dissection within this plasma field allows for hemostasis during dissection, but with significantly less energy delivery ranging from 40 to 70°C.

PEAK PlasmaBlade

The PEAK PlasmaBlade (Medtronic, Jacksonville, FL, USA) uses radiofrequency technology for combining cutting and hemostatic activity. Radiofrequency allows it to perform coagulation at significantly lower temperatures (40–170°C) compared with electrocautery. Energy output from an electrosurgical generator, utilizing varying pulsed waveforms and duty cycles for both the cut and coagulation modes, induces electrical plasma along the cutting edges of a thin (nominally 12.5 µm), 99.5% insulated electrode. Unlike traditional electrosurgical tools, the PEAK PlasmaBlade maintains its cutting effectiveness and hemostatic ability even when submerged in liquefied tissue or blood.

Harmonic

Harmonic (Ethicon, Somerville, NJ, USA) technology employs ultrasonic vibration for tissue dissection. The Harmonic operating tip vibrates at 55 kHz allowing for tissues to be cut and coagulated simultaneously. Because no electrical energy is delivered directly to the tissue,

the Harmonic generates little heat and thermal spread operating at less than 100°C.

Intracapsular Tonsillectomy

Revived by Dr. Peter Koltai during the 1990s, intracapsular tonsillectomy (IT) is the subtotal resection of tonsil tissue, avoiding violation of the tonsillar capsule. This serves to limit the amount of energy delivered to the tonsillar fossa musculature. Because the constrictor muscles are not exposed, the larger and more proximal branches of the blood vessels perfusing the tonsils are not transected.

During IT, the palatoglossus muscle is retracted laterally. The removal device is then used to excise tonsillar tissue from medial to lateral until the tonsillar capsule is approached. This technique is associated with decreased pain and postoperative hemorrhage. Similar to adenoidectomy, a small amount of tissue is left in place and tonsil regrowth may occur in 3% of patients. Intracapsular tonsillectomy is routinely performed only on patients with sleep-disordered breathing caused by adenotonsillar hypertrophy as reinfection may occur with tonsil regrowth in children with recurrent tonsillitis.

Microdebrider

Powered intracapsular tonsillectomy and adenoidectomy uses a Microdebrider (Medtronic, Minneapolis, MN, USA) for tissue removal. This instrument uses a rotating blade at high revolution per minute connected to a suction to precisely cut and extract tissue. The tonsil is removed leaving the capsule without disruption. Hemostasis is performed with monopolar suction cautery to the tonsillar bed.

Coblation

The ablative technology offered by coblation allows for tonsillectomy to be performed as either TT or IT. Similar to microdebrider IT, coblation is used to remove tonsil tissue from medial to lateral without disruption of the tonsillar capsule. The coblation IT offers the additional advantage for concomitant hemostasis and single hand piece utilization for both tonsil and adenoid removal.

PK Diego

Combining the powered intracapsular technique with a bipolar tip, the PK Diego (Olympus, Center Valley, PA, USA) offers the ability to perform microdebrider adenotonsillectomy with concurrent hemostasis.

ADENOIDECTOMY

As with tonsillectomy, a variety of new techniques and procedures for adenoidectomy have emerged in recent

years. During adenoidectomy, a nasopharyngeal mirror is used to visualize the adenoids and surrounding nasopharyngeal structures. The adenoids are removed while leaving the Eustachian orifice undisturbed. For the prevention of velopharyngeal insufficiency, a small adenoid remnant is left over Passavant's ridge. In addition to hemorrhage, velopharyngeal insufficiency, trauma to the Eustachian tubes, septum, and cervical spine are rare but feared complications from the procedure.

Curettage

The most widespread type of adenoidectomy remains surgical removal using a curette. During this technique, the adenoids are removed from superior to inferior with a single pass of an adenoid blade. The resultant adenoid bed is packed with a tonsil sponge. Some providers elect to use monopolar suction cautery for hemostasis.

Electrocautery

Electrocautery adenoidectomy is performed using suction electrocautery to ablate and coagulate the tissue simultaneously. Studies have shown greater incidence of neck pain in patients using electrocautery.

Microdebrider

Similar to IT, this technique involves using a rotating blade at high revolutions to precisely cut and extract tissue. It has shown to require shorter time for hemostasis compared with curettage, but intraoperative blood loss is similar. It is often combined with electrocautery for hemostasis. The PK Diego offers the advantage of concurrent hemostasis while using the microdebrider.

Coblation

As described above, coblation uses radiofrequency ablation for tissue removal and coagulation at much lower temperatures than electrocautery. In addition to the precision and minimal intraoperative blood loss of coblation, there also appears to be far less damage to underlying tissue, leading to lower rates of postoperative neck pain.

PEAK PlasmaBlade

PlasmaBlade technology offers a single hand piece with a changeable head for adenoid removal. There is both a cutting and coagulation mode that allows for directed adenoid tissue removal while offering hemostasis. There is an additional suction coagulation head which is smaller in diameter for difficult to access areas, such as high in the choanae or in Rosenmuller's fossa. This tip also serves well to control unexpected or difficult to control bleeding areas.

DISCUSSION

While adenotonsillectomy is one of the most common surgical procedures performed in the United States, there continues to be little consensus among otolaryngologists regarding optimal instrumentation and technique needed for the procedure. Since its introduction, monopolar cautery continues to enjoy widespread popularity. However, various new instruments have been introduced into the market as described above in an effort to achieve lower hemorrhage rates, reduced OR time, reduced damage to surrounding tissue, less pain, and quicker return to normal diet and activity.

Hemorrhage

Postoperative hemorrhage is one of the most feared complications from tonsillectomy. Hemorrhage can occur within the first 24 hours (primary hemorrhage) or days later during eschar extrusion (secondary hemorrhage). While monopolar cautery was noted to decrease both OR time and intraoperative blood loss, rates of secondary hemorrhage are noted to be higher with cautery compared with cold techniques.⁵ Recent review of 15,734 patients in National Tonsil Surgery Register in Sweden found the incidence of secondary hemorrhage to be 2.8 times higher after cold dissection + hot hemostasis, 3.2 times higher after coblation, and 4.3 times higher after diathermy scissors, compared with cold technique.⁶ Coblation was also found to have slightly higher rate of postoperative bleeding in Cochrane review done by Burton and Doree,⁷ although the data on that have been mixed. Hong et al⁸ compared monopolar cautery with radiofrequency ablation regarding primary and secondary hemorrhage rates and reported no significant difference. Thottam et al⁹ demonstrated a similar overall postoperative hemorrhage rate of 2.0% with no significant difference stratified between monopolar cautery, radiofrequency ablation, and PlasmaBlade.

Pain

Monopolar cautery works through application of concentrated heat at very high temperatures (400–600°C) to remove ablate tissues. While this is effective for hemostasis, postoperative pain is noted to be significantly higher with this procedure compared with cold techniques.⁵ Coblation, Harmonic, and PlasmaBlade technologies are able to provide coagulation benefits of monopolar cautery at much reduced temperatures. Studies have shown decreased rates of dehydration and postoperative pain with these technologies.¹⁰ Wilson et al¹¹ found in their direct comparison of coblation with electrocautery that patients in the coblator cohort returned to a normal diet 1.51 days before electrocautery and were able to be

weaned off pain medication sooner. However, their data were potentially confounded by the fact that the technique used with coblator was intracapsular *vs* extracapsular with electrocautery. In addition, the Burton and Doree⁷ Cochrane review on coblation showed tendency toward lower pain, but there was no statistical significance in pain difference between the two techniques.⁷ Currently, there are no studies that directly measure postoperative pain comparing PEAK PlasmaBlade technology with electrocautery.

Total vs. Intracapsular Tonsillectomy

In addition to the instruments used for the procedure, IT *vs* TT dissections have also been an intensely debated topic. Walton et al showed significantly superior recovery outcomes in patients with IT compared with TT. In their systematic review, majority of studies reported earlier return to normal diet, earlier return to normal activity, and less use of analgesics compared with the TT group. Studies have shown no difference in the rate of primary hemorrhage between groups, and for secondary hemorrhage, the IT group had a significantly lower bleeding rate.¹² Proponents of IT favor this technique especially in patients undergoing the procedure for adenotonsillar hypertrophy and sleep-disordered breathing. There is a risk of tonsillar regrowth and therefore this technique is not recommended in patients undergoing the procedure as treatment for recurrent tonsillitis. Sorin et al¹³ examined outcomes in 278 patients after IT and cited the regrowth rate of tonsillar tissue with snoring as 3.2%. Therefore, patients should be counseled on the possibility of tonsillar regrowth and the need for revision surgery with this approach as compared with the benefit of shortened duration of pain by 2 to 2.5 days and the reduced risk of secondary hemorrhage.¹²

Cost

Another salient consideration related to new technologies is the cost associated with specific instruments. Table 1 lists the hand piece cost of each instrument. The price of each hand piece can be quite variable, along with setup equipment that is also required for each technology. Few studies have also focused on operative time, which in itself increases the overall cost of each procedure. In their cost analysis when comparing intracapsular coblation and microdebrider with extracapsular electrocautery, Wilson et al¹¹ extrapolated the OR costs to a per-minute model plus the additional cost of instrumentation and reported the average cost to be the least for the microdebrider technique at \$2205.20, followed by cautery at \$2825.10, and last the coblator at \$2837.1. When comparing only extracapsular procedures, Thottam et al⁹ looked at

Table 1: The hand piece cost of instruments

Instruments	Cost (US\$)
Monopolar needle cautery	5.42
Suction coagulator	7.88
ProCise XP plasma wand	225
PEAK PlasmaBlade TnA dissection device	228.77
Xomed microdebrider blade	91.2
Gyrus blade	100

cautery, coblation, and PlasmaBlade and compared them over a large patient population and noted a significantly shorter surgical time when monopolar cautery was used compared with radiofrequency ablation and PlasmaBlade ($p < 0.001$). Surgical time required is a big contributor to overall cost of modality chosen and as such can be an important confounder.

One missing aspect of this analysis was added cost secondary to readmission for dehydration and other complications. As mentioned before, IT as well as coblation technology has been shown to reduce overall pain associated with the procedure. Emergency room visits and admission for dehydration add significant cost to the overall expenditure on tonsillectomy and may change the cost associated with each technology.

CONCLUSION

We have several techniques available for performing safe adenotonsillectomy. However, the search for the most cost-effective, safe, and efficient modality that provides the maximum relief while minimizing morbidity is still ongoing. While the new technologies offer certain advantages over the gold standard treatment of electrocautery, they require a learning curve, additional costs, and complications associated with them. More multicenter controlled trials are required as we search for the "ideal" instrument for adenotonsillectomy.

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