

**TITLE: Tonsillitis, Tonsillectomy, and Adenoidectomy**

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## **History**

Tonsillectomy and adenoidectomy has been performed by otolaryngologists, general surgeons, family practitioners and general practitioners. However, in the past 30 years the recognition for the need of standardization of surgical technique resulted in a shift in practice patterns so that it is almost exclusively performed by otolaryngologists.

The history of tonsillectomy dates back over 2000 years when the first primitive scalpel was used by Celsus in approximately 50 A.D. to remove tonsil tissue. The earliest description of the procedure was by Paul of Aegina in 625. Not until the mid-eighteenth century did Caque of Rheims perform tonsillectomies on a regular basis. The early instruments that were used for tonsillectomy were actually first developed for removal of the uvula. Phillip Syng invented what would become the forerunner for the modern tonsillotome. The early version of adenoidectomy involved using a ring forceps through the nasal cavity to remove adenoid tissue by William Meyer in 1867.

## **Anatomy**

The circular band of lymphoid tissue within the pharynx consisting of the adenoids, the palatine tonsils, and lingual tonsils is known as Waldeyer's ring. The palatine tonsils are lymph tissue with prominent germinal centers. A capsule of connective tissue separates the tonsils from the lateral pharyngeal walls. The tonsil lies within a bed of three muscles that make up the tonsillar fossa. The anterior pillar is the palatoglossus muscle. The posterior pillar is the palatopharyngeus muscle. The superior constrictor muscle makes up the bed of the fossa. Medially, the tonsil crypts lay exposed to the oropharynx with specialized stratified squamous epithelium. The tonsil parenchyma can vary in its extent, sometimes extending into the nasopharynx causing nasal obstruction, and sometimes inferiorly causing extreme dysphagia. The tonsils are continuous with the lymphoid tissue in the base of the lingual tonsils. The point of attachment is known as the plica triangularis and must be transected during tonsillectomy.

The tonsils are well vascularized with the majority of the blood supply arising from the

tonsillar branch of the facial artery. The ascending pharyngeal, descending palatine, and the dorsal lingual branch of the lingual artery also contribute to the vasculature of the tonsil. The internal carotid artery lays just two centimeters posterolateral to the deep surface of the tonsil; however in 1% of the population, it is found just deep to the superior constrictor muscle. The nerve supply of the tonsils arise from the ninth cranial nerve and descending branches from the lesser palatine nerves. The tympanic branch of CN IX is thought to account for the referred ear pain in some cases of tonsillitis. The tonsils have no afferent lymphatic vessels. Their efferent lymph drainage is through the upper cervical nodes, especially to the jugulodigastric group. The base of the tonsil is separated from the underlying muscles by a dense collagenous hemi-capsule. The luminal surface of the tonsils is covered by deeply invaginated clefts of stratified squamous epithelium. These clefts are lined by specialized squamous epithelium which transports antigens by M type cells to be presented and processed by Antigen presenting cells. These are next transported to the extrafollicular area which has abundant T- lymphocytes which aid in the differentiation of B- lymphocytes. The lymphoid follicle is encased by the mantle zone where mature B- lymphocytes reside. At the core of the lymphoid follicle is the germinal center where B- lymphocytes produce antigen-specific immunoglobulin.

The adenoids are midline folds of respiratory epithelium in the nasopharynx. The fossa of Rosenmueller is between the adenoid and the Eustachian tube. Gerlach's tonsil is the tissue within the lip of the fossa of Rosenmueller which extends into the Eustachian tube. Passavant's ridge is the most inferior aspect of the adenoid which may overlap the superior constrictor muscle. The ascending pharyngeal and sphenopalatine arteries provide blood supply to the adenoids.

The surface of the adenoids differs from the tonsils in that the adenoids have deep folds and few crypts. The ciliated pseudostratified columnar epithelium plays an important role in mucociliary clearance. After repeated or chronic infections, this layer thins resulting in stasis of secretions and impaired mucociliary clearance (3). The increase in antigen exposure from mucus stasis is thought to lead to an increased inflammatory response within the adenoid.

## Clinical Evaluation

Tonsillar disease can be divided into recurrent acute tonsillitis, chronic tonsillitis, and obstructive tonsillar hyperplasia.

Group A Beta hemolytic *Streptococcus* (GABHS) is the most common bacterial cause of acute tonsillitis, but only accounts for a small percentage of tonsillitis overall. It is most often initially evaluated by primary care physicians. Otolaryngology evaluation often takes place after resolution of the acute symptoms. In typical acute tonsillitis, symptoms of odynophagia or decreased oral intake progress to fever and tender cervical lymphadenopathy. Unfortunately, the history is often confusing when a patient is referred, as many of the supporting documents may be diagnosed as pharyngitis, URI, or viral syndrome. Certain key findings have been used to include patients in diagnosing the frequency of tonsillitis. These include fever greater than 38.5, positive GABHS culture, tender cervical lymphadenopathy > 2cm, and erythematous or exudative tonsils. It is important to differentiate viral from bacterial tonsillitis, because patients with viral tonsillitis do not require antibiotics. Patients with viral pharyngitis will often have a lower grade fever and less tonsillar exudates. A CBC will usually show a higher WBC in

bacterial versus viral tonsillitis, as well as a higher shift in granulocytes versus lymphocytes. In about half of patients referred to an otolaryngologist, the actual number of infections does not correlate with the history given by patient or family. Therefore, in evaluating a patient with normal appearing tonsils and a subjective history supporting recurrent tonsillitis, serial examinations of the patient by the otolaryngologist to document the frequency and severity of infection are appropriate. Recurrent acute tonsillitis is documented as 4-7 episodes of acute tonsillitis in one year, five episodes per year for 2 years, or three episodes per year in 3 consecutive years. These numbers are not required to proceed with surgery, however. The severity of infections and associated complications, as well as lost productivity or school absences must also be considered.

The differential diagnosis of exudative tonsillitis includes mononucleosis, scarlet fever, diphtheria, tularemia, toxoplasmosis, and malignancy (lymphoma, leukemia, and carcinoma).

Infectious Mononucleosis is caused by the Epstein-Barr Virus (EBV). It causes an exudative, almost necrotic tonsillitis and impressive cervical lymphadenopathy and sometimes hepatosplenomegaly. Heterophile antibodies (monospot) help confirm the diagnosis, but may remain negative early in the disease. Titers of IgM and IgG are most specific. Treatment is usually supportive. In cases in which adenotonsillitis is so severe that airway symptoms emerge, steroid and antibiotic therapy may be necessary. Ampicillin and Amoxicillin have been associated with a rash in 90% of EBV patients and should be avoided.

The symptoms of scarlet fever are similar to those of pharyngitis. The sandpaper rash begins over the upper trunk and spares the palms and soles. The tongue may have a white coat through which red papillae project (strawberry tongue). Primary infection by *Corynebacterium diphtheriae* is most often tonsillopharyngeal. It begins as only mild erythema or gray spotting, but progresses to form a confluent darker gray pseudomembrane often extending beyond the tonsil onto the pharyngeal walls. Once definitive confirmation is made, the diphtheria antitoxin should be administered immediately. Neisseria gonorrhoea and acute HIV can also be causes of non-exudative pharyngitis.

Complications of GABHS pharyngitis include cervical adenitis, neck abscesses, peritonsillar abscess, intratonsillar abscess, and internal jugular bacterial thrombophlebitis (Lemierre's syndrome), and post streptococcal Glomerulonephritis.

Post streptococcal glomerulonephritis is usually seen in 2 to 6 year olds with pharyngitis during the winter months. Joint pain and oliguric renal failure develop 10 days after the pharyngitis. Most patients have circulating antibodies against streptococcal enzymes such as antistreptolysin O (ASO). Treatment focuses on eliminating the streptococcal infection with antibiotics and providing supportive therapy or diuretics until the glomerular inflammation resolves. The prognosis is excellent in children, whereas adults are more prone to permanent renal damage.

## **The Adenoids and Airway Obstruction**

The triad of hyponasality, snoring, and open mouth breathing normally indicates enlarged obstructing adenoids. Patients being evaluated for obstructive airway symptoms will have

varying degrees of snoring with apneic episodes and choking or gasping episodes. The sleep pattern is often disrupted with frequent awakenings and restless sleep. Associated findings may include daytime hypersomnolence, nocturnal enuresis, and behavioral disturbances. The most seriously affected patients may present with heart failure and failure to thrive. In cases in which the history is questioned, nocturnal videotapes or audiotapes of the child sleeping may be helpful to both the parents and the physician.

Sleep disordered breathing in children is usually caused by enlarged tonsils and/or adenoids. A standardized grading classification of the tonsils has been adopted based on the ratio of the tonsil size in relation to the oropharynx as measured between the anterior pillars:

GRADE	Percent Obstruction
0	0
1	<25%
2	25-50%
3	50-75%
4	>75%

The gold standard for diagnosis of obstructive sleep apnea is the polysomnography (PSG). In adults, the test is imperative in the diagnosis and documentation of OSA. Obstructive Sleep Apnea is diagnosed as an RDI >5, SpO<sub>2</sub> <90%. Upper airway resistance syndrome is diagnosed as a RDI <5, and SpO<sub>2</sub> >90%, and primary snoring when RDI <1 and SpO<sub>2</sub> >90%.

In children, an adequate and convincing history in combination with physical evidence of adenotonsillar hypertrophy is relied upon in lieu of a sleep study. The dilemma concerning PSG is that the current economic environment makes it difficult to obtain a PSG in every case. For a child in whom the diagnosis is unclear or who has an unusual risk for surgery, PSG should be performed.

## Medical therapy

Recent recommendations by the Texas Children's Health Plans recommend confirming streptococcal pharyngitis before beginning antibiotics. This can be done by a rapid Strep test and/or a throat culture. If strong suspicion of Strep is present, a negative Strep test should be confirmed with a throat culture. If the test is negative, treatment should be symptomatically with NSAIDS/Acetaminophen, and fluids. Antibiotics, if given, should be discontinued if results are negative. If the Strep test or culture is positive, then the child should be treated with the antibiotic of choice.

GABHS is exquisitely sensitive to penicillin. Traditionally, a 10 day regimen with oral penicillin or injectable penicillin was most commonly used. Cephalosporins first became available in the 1970's and have demonstrated a greater eradication rate of Streptococcus. Co-colonizing beta lactamase producing organisms (BLPO) that are most frequently cited as co-pathogens are *Staphylococcus aureus*, *M. catarrhalis*, *H. influenzae*, and anaerobes. In these patients, antibiotics with high potency against GABHS and that are beta lactamase stable, such as Augmentin, clindamycin, or cefdinir are superior to penicillin in eradication of GABHS. The macrolides are mainly used for patients with proven penicillin allergy. Erythromycin and

clarithromycin should be used for 10 days as therapy. Azithromycin can be used for 5 days. The proper azithromycin dosing for GABHS tonsillopharyngitis is 12mg/kg/day (double dosing). Three day treatment with azithromycin has shown inferior eradication rates.

Adenotonsillar size may be reduced enough to relieve airway obstruction symptoms in 10-15% of children treated with a one month course of antibiotics against BLPO. Adenoid hyperplasia also may respond to a 6 to 8 week course of intranasal steroids.

## **Indications for Surgery**

The indications for tonsillectomy have dramatically changed and are today more clearly defined. In adults, the most common indication is recurrent tonsillitis. The most common indication in children is obstructive sleep apnea. The only absolute indication for adenoidectomy is airway obstruction with secondary cardiopulmonary complications and failure to thrive. The relative indications include chronic nasal obstruction with rhinorrhea or recurrent sinusitis, recurrent otitis media with effusion, recurrent and chronic adenoiditis, speech and swallowing abnormalities, and suspected neoplasia. In children with chronic sinusitis, adenoidectomy is usually the first surgical intervention for two reasons: 1) approximately 67% will respond after adenoidectomy alone and 2) the high failure rate of pediatric sinus surgery. Children older than 4 experiencing recurrent otitis media have shown to benefit from adenoidectomy with the second set of tympanostomy tubes. Only limited benefit has been shown for adenoidectomy in conjunction with the first set of tubes. On the other hand, for chronic otitis media with effusion, initial tympanostomy tube placement without adenoidectomy is associated with a higher rate of repeat surgeries.

Contraindications for adenoidectomy include cleft deformities and velopharyngeal insufficiency.

The absolute indications for tonsillectomy include severe dysphagia, failure to thrive, and cor pulmonale. Relative indications include recurrent acute tonsillitis, chronic tonsillitis, obstructive sleep apnea, peritonsillar abscess, suspected neoplasia and halitosis. Patients with a prior history of recurrent tonsillitis and prior peritonsillar abscess may be more likely to develop another peritonsillar abscess and are candidates for tonsillectomy. Recurrences of peritonsillar abscess are more common within the first year and in patients younger than 40. The overall recurrence rate for peritonsillar abscess is 10-15% (17). The need for tonsillectomy in adults with significant tonsil asymmetry is generally accepted, because of the need to exclude malignancy. In children, tonsil asymmetry is usually secondary to benign lymphoid hyperplasia and the asymmetry is often an illusion created by a difference in the depth of the tonsillar fossa (8). Associated symptoms such as night sweats, persistent fevers, weight loss, or cervical nodes may be indicators of tonsillectomy with microscopic examination.

## **Innovative Surgical Techniques**

There is now a wide variety of safe and effective surgical techniques for tonsillectomy and adenoidectomy. Current discussions about the choice of surgical technique are centered on morbidity such as pain, return to normalcy, perioperative and postoperative hemorrhage, and operating room time. There are a number of devices that challenge the standard tonsillectomy,

including the intracapsular partial tonsillectomy, the Harmonic scalpel tonsillectomy, Laser assisted tonsillectomy, and tonsillar ablation and coblation.

Electrosurgery has provided improvements in surgical technique by decreasing operating time and improving hemostasis. However, until the development of nonflammable anesthetics, such as halothane in the 1950's, the application for tonsillectomy and adenoidectomy was limited. Electrosurgery has proved itself to be equivalent or superior to the other methods of tonsillectomy (13). It is currently the most popular technique for tonsillectomy (10). When compared to cold dissection, there is no difference in postoperative hemorrhage rates, but electrosurgery increases pain (13). The reduction in operative time and intraoperative blood loss has made it the most commonly performed technique of tonsillectomy.

Intracapsular power-assisted partial tonsillectomy utilizes a 45 degree microdebrider at 1500 rpm to remove the tonsil from medial to lateral under direct visualization. The dissection is stopped when the tonsil capsule is approached. The proponents of the microdebrider tonsillectomy claim that there is significantly less postoperative pain and a quicker return to normal diet (day 3). It appears to be as effective as standard tonsillectomy in relieving airway obstruction (12). By performing a medial to lateral microdebridement, the tonsil capsule is left intact as a biological dressing overlying the pharyngeal musculature. Also, the medial to lateral dissection is performed distal to the arborization of the tonsillar vessels thereby exposing only the smaller arterioles, which theoretically could decrease the risk of delayed hemorrhage. Tonsil regrowth may occur since a rim of tonsil tissue is left on the capsule, so chronic tonsillitis is currently considered a contraindication for the procedure.

The harmonic scalpel uses ultrasonic technology to cut and coagulate tissues at lower temperatures than electrocautery. Rather than electrical current, the harmonic scalpel creates mechanical energy and heat by vibratory motion resulting in much less lateral heat displacement. The advantages include better visibility because of less smoke, and a smaller risk of stray energy shocks or burns (22). Several small studies show similar intra-operative blood loss and post-operative hemorrhage rates, but significant improvements in post operative pain and comfort, when compared to other techniques.

Radiofrequency tonsil reduction procedures include tonsillar ablation and coblation. Tonsil ablation involves injecting an electrolyte solution into the target tissue and delivering direct radiofrequency energy with resultant tissue contracture and volume reduction. Tonsil coblation involves medial to lateral surface application of similar energy. The coblation procedure has proved to be superior to ablation for several reasons. The amount of tonsil reduction is very unpredictable with ablation, with resection rates ranging from 30-70% despite standardization of technique. Tonsil ablation causes a much higher rate of airway swelling and was abandoned early in comparison trials with coblation. Finally, the ablation procedure is limited to the treatment of airway obstruction. The tonsil coblation procedure's claimed advantages include early elimination of pain, reduced pain medicine usage, and early resumption of normal diet (6). The coblation is now being used as a capsular dissector in place of the electrocautery in complete capsular tonsillectomy. The greatest limitation for use in adenotonsillectomy is that the current hand piece is inadequate in coagulating and suctioning the adenoid tissue.

## Adjuvant therapy

The main areas of controversy regarding adjuvant therapies with adenotonsillectomy include perioperative injection of local anesthetics, postoperative use of antibiotics, intraoperative steroid use, and postoperative pain management.

The most commonly used perioperative local anesthetic has been 0.25% bupivacaine with 1:100,000 epinephrine. The injection is typically into the tonsillar fossa pre or post tonsillectomy. The advantages include ease of dissection, less intraoperative bleeding, and early postoperative pain improvement. There have been a few serious side effects including early airway obstruction, cardiac dysrhythmias, and seizures and cerebrovascular accidents. Studies investigating this adjuvant therapy have been too small to show a significant benefit and therefore are not recommended as standard of care.

Perioperative use of antibiotics has traditionally been included in the treatment regimen of children undergoing adenotonsillectomy. When compared to saline for post operative treatment, patients who received oral ampicillin had significantly fewer episodes of fever, less offensive odor, improved oral intake, less pain, and fewer days to return to normal activity(21). Antibiotic choices should include an antibiotic that is active against oral flora, usually oral penicillin. There is still some controversy regarding the best type of antibiotic and duration of use given the increasing emergence of antibiotic resistant bacteria. Use of prophylactic antibiotics should be routinely used when performed on a patient with a cardiac abnormality. (Following American Heart Association guidelines)

Dexamethasone has been the most studied and most accepted intraoperative steroid among otolaryngologists. It is given at a dose of 0.15-1.0 mg/kg intraoperatively. A meta analysis by Steward showed that, when compared to control subjects, children given steroids were two times less likely to have an episode of emesis the first day after tonsillectomy and were more likely to advance to eating a soft diet (18). Other advantages include possibly reducing postoperative pulmonary distress, decreasing subglottic edema, and pain reduction.

Inadequate control of pain after tonsillectomy may result in poor oral intake, sleep disturbances, behavioral changes, emesis, and hospital re-admission. Unfortunately the ideal analgesic is not available. Tylenol and Tylenol with codeine are the most commonly used post-operative pain medicines. The use of NSAIDS has shown similar postoperative pain control as opiates but without the CNS effects. However, the theoretic increased risk of hemorrhage after NSAID use makes them less attractive, and controversial in managing post-tonsillectomy pain.

## Complications

The mortality rate for adenotonsillectomy is 1 in 16000 to 35000, mostly from anesthetic complications and hemorrhage. The incidence of postoperative hemorrhage is 0.1- 8.1%. Transfusion is required in 0.04% of bleeding patients and mortality occurs in 0.002%.

Anesthetic complications include fire, laryngospasm, kinking of the endotracheal tube, and iatrogenic premature extubation. In cases of a large airway leak, wet sponges with strings placed around the endotracheal tube and frequent suctioning of accumulated gases can prevent

fire. Meticulous attention to the removal of all resected tissues and suctioning of the pyriform sinus help to reduce laryngospasm.

Eustachian tube injury due to excessive lateral resection of adenoid tissue or secondary to burns can predispose the patient to COME or a patulous Eustachian tube. Excessive resection and scarring can lead to velopharyngeal insufficiency. VPI is usually transient, but clinically significant in 1 in 1500-3000. If VPI persists beyond 2 months, speech therapy is indicated. Surgical intervention with pharyngeal flaps or palatal pushback may be indicated for persistent VPI.

Nasopharyngeal stenosis is a dreaded complication of Adenotonsillectomy. Fusion occurs between the soft palate, and lateral and posterior pharyngeal walls. Treatment is very difficult. Surgical options include pharyngeal or palatal flaps.

Long standing upper airway obstruction provides the patient with a mild auto- PEEP. Some patients may experience a significant change in pressure across the alveoli after adenotonsillectomy, resulting in a transudation of fluid and pulmonary edema. Initial management includes reintubation and administration of PEEP and gentle diuresis.

Because of the nature of the surgical procedure, it is not unusual for patients to complain of neck discomfort. However, in patients who complain of limited neck range of motion, flexion and extension lateral neck views should be obtained to evaluate for atlantoaxial subluxation. Children with Down's syndrome should all be screened as well. If identified pre-operatively, intraoperative neck immobilization is mandatory. In the postoperative period, neurosurgery should be immediately consulted and the neck should be immobilized.

Indications for twenty-three hour inpatient monitoring include the following:

1. Age younger than 3.
2. Those with obstructive sleep apnea or craniofacial syndromes involving the airway.
3. Systemic disorders which would put the patient at increased perioperative risk.
4. Poor socioeconomic situation or other situation which would limit the patient's ability to return quickly to the hospital.
5. When the procedure is done for a peritonsillar abscess.
6. Those experiencing vomiting or hemorrhage.

The most common causes for unanticipated inpatient stays are emesis, hemorrhage, airway obstruction, and pulmonary edema. Children younger than 3 years old should be observed overnight.

### **Management of Postoperative Bleeding**

The best management of postoperative bleeding is prevention during surgical resection. It is thought that the cause of early and delayed bleeding is inadequately coagulated tonsil vessels that retract into the pharyngeal musculature to later remerge and bleed. Any amount of bright red blood coming from the mouth or nose should create the suspicion of a postoperative bleed. The subjective report of unwitnessed bleeding may not always be accurate, but it is safer to air on the side of caution and overestimate the reported bleed. Overnight observation and

venous access is warranted. A CBC should be obtained to assess the degree of hemorrhage and also to establish a baseline level in case of further bleeding. Coagulation testing with proper hematology consultation for abnormal values should also be obtained. For the cooperative patient, gargling with ice water and Afrin can help to reduce or stop bleeding in order for an adequate examination. If a small punctuate lesion is found, local injection with lidocaine with epinephrine and silver nitrate or bovie cautery can be performed. Patients who are uncooperative or bleeding heavily should be taken to the OR immediately. Careful intubation with the otolaryngologist at the bedside is mandatory. Any fresh clot should be removed and recauterized. Carotid angiographies should be performed when there is any suspicion of possible injury to the carotid artery.

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