A Brief Overview about Adenoidectomy techniques

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Abstract

Background: Adenoidectomy is a surgical technique used to remove the adenoid. Adenoidectomy can be done alone or frequently combined with other surgical operations (tympanostomy tube installation, tonsillectomy, etc.). Tonsillectomy was typically done with adenoidectomy over most of the 20th century. The criteria for adenoidectomy remain somewhat controversial even after over 50 years of research. Adenoidectomy is most commonly done on younger patients. *Adenoid curettage :* It is the most common and effective technique for adenoidectomy which involves the use of an adenoid curette. The long curved handle of the adenoid curette is perpendicular to a sharp edge. After positioning this sharp-edged blade in the nasopharynx, removing the adenoid is done by gentle curettage against the vomer and posterior pharyngeal wall. After removing the adenoid tissue, hemostasis is secured by using adrenaline or xylometazoline packing for 10 minutes or by electro-cauterization using bipolar diathermy or suction monopolar. Different curette sizes are offered based on the patient's age and to accommodate different nasopharyngeal diameters. Electro-cautery with a suction bovie: It involves shrinking or removing the adenoid by electro-cautery using a suction bovie. The bovie has a hollow center for sucking in blood or secretions and a metal contact rim for coagulation. The microdebrider is considered one of the most important innovations that have been brought into the field of rhinology. It is a cylindrical instrument that has a hollow tube with an inner and outer portion.

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The nasopharynx is the highest part of the pharynx. It lies above the soft palate and directly behind the posterior nasal openings (choanae). The nasopharynx is covered posteriorly and superiorly, whereas it is open anteriorly and inferiorly. The lateral walls enclose the nasopharynx. The superior and posterior walls of the nasopharynx are formed by the sphenoid bone's body and the occipital bone's basilar portion. The posterior and superior walls are one continuous wall. Together, these two are referred to as basisphenoid. As one descends deeper, the mucosa covering the superior constrictor muscles forms the posterior wall. The nasopharynx allows unrestricted flow between the nasal cavities and acts as the nasal cavity's posterior extension. The nasopharynx's lateral and posterior walls are inflexible and combine to form a domed constantly open area (**1**)**(2)**

The free posterior border of the septum divides the posterior nasal openings (choanae) medially. The vaginal process of the medial pterygoid plate and the body of the sphenoid bone combine to form their roof. The medial pterygoid plates constitute their lateral walls, while the palatine bone's horizontal plate forms their floor. The dimensions of each posterior nare are 12 mm transversely and 25 mm vertically. The posterior ends of the inferior nasal conchae extend into the choana (**3**).

The adenoid is a lymphoid organ that primarily arises from three sources: an epithelial component that originates from the lining of the primitive oro-nasal cavity, this epithelium grows into and is enveloped by connective tissue or mesenchymal stroma which is the second source. The third one is lymphoid cells that infiltrate the area **(4).** The resulting organ consists of a resident population of lymphoid cells with a more or less complex epithelial framework (the crypts) that has developed into and been encased in mesenchymal tissue **(5).**

Adenoid or nasopharyngeal tonsil forms in the nasopharynx near the midpoint of the roof and posterior wall. Adenoid comprises vertical ridges of lymphoid tissue separated by deep clefts and coated with ciliated columnar epithelium. The deep crypts enter the adenoid tissue from the surface. The crypts are lined with epithelial cells specialized for antigen absorption **(6)**. Adenoid is present from birth, increases in size with age, and undergoes spontaneous regression after puberty in most population **(7)**.

The adenoid is primarily covered laterally and inferiorly by ciliated respiratory epithelium, with scattered tiny patches of non-keratinized stratified squamous epithelium. Its superior surface is isolated from the periosteum of the sphenoid and occipital bones by a connective tissue hemi-capsule that anchors the adenoid's fibrous framework. The latter comprises a network of collagen type III (reticular) fibers that support lymphoid parenchyma comparable to that of the palatine tonsil (**8**).

The adenoid and tonsils are primarily B-cell organs. B-cell lymphocytes account for 50–65% of all adenoid and tonsillar lymphocytes. T-cell lymphocytes make up about 40% of adenoid and tonsillar lymphocytes, while mature plasma cells account for 3% **(9).**

There is abundant evidence that the adenoid and tonsils play a role in secretory immunity induction and regulation. They have a system of channels covered by specialized endothelium that can mediate antigen uptake like Payer's patches of the epithelium in the intestine **(9).**

Both adenoid and tonsils are well-positioned to mediate immune protection of the upper aerodigestive tract when exposed to airborne antigens. Both organs, particularly the tonsils, are specifically intended to carry foreign material directly from the outside to the lymphoid cells. At the same time, the lymph nodes rely on antigenic delivery via afferent lymphatics. The crypts are coated by stratified squamous epithelium, which is ideally adapted for capturing foreign material and transferring it to the lymphoid follicles **(10).**

The adenoid and tonsils are classified as secondary lymphatic organs. Weak antigenic signals are eliminated by intratonsillar defense systems. The proliferation of antigen-sensitive B lymphocytes in the germinal centers only happens in response to the presentation of subsequent greater antigenic concentrations. Antigen concentrations that are too low cause lymphocytes to differentiate into plasma cells, whereas those that are too high cause B-cell proliferation. The adenoid and tonsils are immunologically active between the ages of 4 and 10 years. Tonsil involution occurs after puberty, whereas adenoid involution begins at the age of 8 years. This involution causes a decrease in the number of B cells while increasing the ratio of T to B cells (**11**).

Adenoidectomy

Adenoidectomy is a surgical technique used to remove the adenoid. Adenoidectomy can be done alone or frequently combined with other surgical operations (tympanostomy tube installation, tonsillectomy, etc.). Tonsillectomy was typically done with adenoidectomy over most of the 20th century. The criteria for adenoidectomy remain somewhat controversial even after over 50 years of research. Adenoidectomy is most commonly done on younger patients (**12**).

Indications: (**13**)

- The adenoid enlargement causes nasal airway obstruction, which can result in obstructive breathing, obstructive sleep apnea symptoms, and chronic mouth breathing that could result in palatal and dental abnormalities.
- Recurrent or persistent otitis media in children aged 3-4 years and older.
- Recurrent and/or chronic sinusitis.

Contraindications : (14)

- Infection: Tonsillectomy and adenoidectomy should not be performed in children with active local infection. A three-week gap following an episode of acute infection is usually sufficient for general recovery and lowering the risk of surgical bleeding.

- Anemia, bleeding disorders such as hemophilia, and other disorders of hemostasis are the hematologic contraindications to tonsil and adenoid surgery. Surgery should not be undertaken if the hemoglobin concentration is less than 10 g/dL or if the hematocrit value is less than 30 percent. So, preoperative evaluation and precautions must be taken as blood transfusion and coagulation factors replacement to overcome major complications such as severe and uncontrollable bleeding with hypovolemic shock.

- Children are at risk of developing velopharyngeal insufficiency (VPI). This risk can be related to a short palate, submucous cleft palate, true cleft palate, muscle weakness, or hypotonia related to a neurological condition, velocardiofacial syndrome, or Kabuki syndrome. Partial adenoidectomy and postoperative muscle speech therapy after adenoidectomy are two possible treatments for these issues.

- Atlanto-axial joint laxity is observed in 10% of children with Down syndrome. Surgery in the neutral position or following stabilization by neurosurgery may make it possible to perform the surgery without injury to the patient.

Adenoidectomy techniques

Cold surgical techniques:

- ***Adenoid curettage :***

It is the most common and effective technique for adenoidectomy which involves the use of an adenoid curette. The long curved handle of the adenoid curette is perpendicular to a sharp edge. After positioning this sharp-edged blade in the nasopharynx, removing the adenoid is done by gentle curettage against the vomer and posterior pharyngeal wall. After removing the adenoid tissue, hemostasis is secured by using adrenaline or xylometazoline packing for 10 minutes or by electro-cauterization using bipolar diathermy or suction monopolar. Different curette sizes are offered based on the patient's age and to accommodate different nasopharyngeal diameters **(15).**

A

B

Figure 1 (A, B): Different adenoid curette sizes, with the curette blade on the inside superior surface (**16).**

- ***Magill forceps:***

Using curettes or adenoid punches was found to result in incomplete tissue removal leaving remnants. These remnants are typically located deep inside the choanae and encroach on or into the posterior nasal cavity or above torus tubaris. Magill forceps is a curved instrument used to remove these remnants as it can reach, grip, and punch it **(17).**

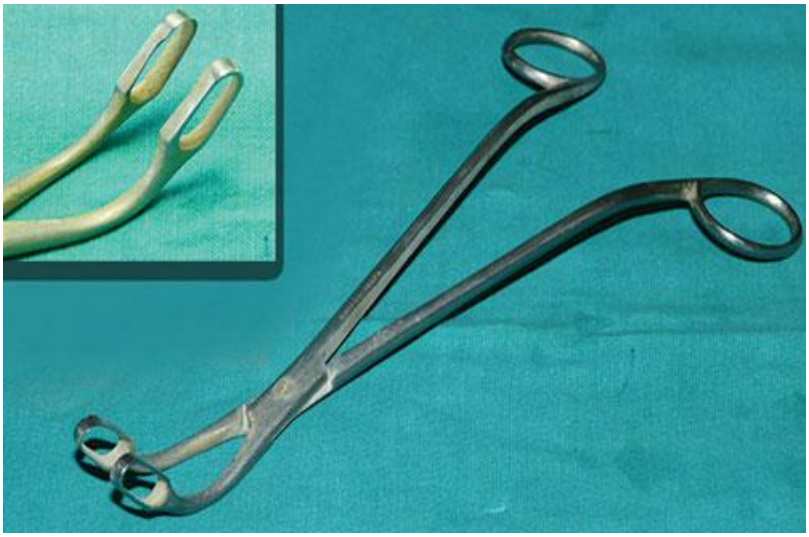

Figure 2: Magill adenoid forceps **(17)**

- **Electro-cautery with a suction bovie:**

It involves shrinking or removing the adenoid by electro-cautery using a suction bovie. The bovie has a hollow center for sucking in blood or secretions and a metal contact rim for coagulation. This device has two settings: coagulation and coagulation and cutting. The pure coagulation setting takes a long time as the process can be slowed down by the chard adenoid tissue's tendency to impede and obstruct the suction and so it requires repeated cleaning. Ablation of the adenoid tissue seems to be accomplished more quickly with the coagulation/cutting approach. However, when the cutting method is used, there is a higher transfer of energy to the surrounding tissues, which may result in more damage to the nearby tissue or more neck stiffness after the treatment **(18)**

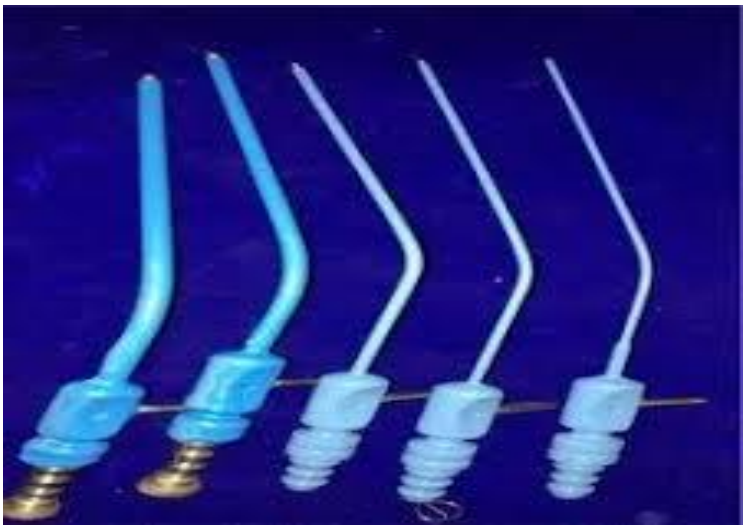

Figure 3: Different sizes of suction cautery instruments **(18)**

- **Microdebrider:**

The microdebrider is considered one of the most important innovations that have been brought into the field of rhinology. It is a cylindrical instrument that has a hollow tube with an inner and outer portion. At the end of the tube, both the inner and outer portions of the tube have a blade that cuts tissue as the blades move back and forth. The catheter has continuous suction applied to the device so that cut tissue is captured and removed from the surgical area. The faster the blades move, the smaller the pieces **(19).**

By its oscillating mode at a rate of up to 2400 rpm with saline irrigation, the oscillating blade of the microdebrider is inserted through the nose or oropharynx by its curved blade to reach the nasopharynx, where it removes the adenoid tissue in a side-to-side motion. A 2.7-mm or 4-mm 0-degree trans-nasal or 70-degree trans-oral endoscopy is used to visualize the process. Keeping the blade visible at all times is crucial. This approach is thought to be quicker with less blood loss. To halt the bleeding from the adenoid bed's rough surface, suction mono-polar or bipolar electro-cautery is employed **(20).**

The microdebrider has the advantage of providing easier access to difficult surgical locations (like in the paranasal sinuses), allowing 360-degree rotation which allows for a more accurate approach to the tissue needing to be removed. Blades also can be adjusted with the microdebrider. Straight-edged blades are more precise and less traumatic, while serrated blades provide a better grip for the surgeon. These blades can have the speed changed to allow for tighter precision of cutting and less time consumption **(21).**

However, there is bleeding during the actual removal and the overall blood loss recorded has been comparable to the typical curette use. Therefore, it has been suggested that the microdebrider can be used to remove adenoid tissue that is challenging to access using conventional methods. Another factor to be taken into account is the increased expense of the microdebrider setup and tip (**22**).

Figure 4: A: Serrated end of the microdebrider blade, **B:** Different types of microdebrider blades **(19)**

- **Coblation:**

Coblation is one of the most recent and promising methods that has been introduced to the field of medicine. It was developed in the 1990s and is commonly used in ENT procedures like tonsillectomy, adenoid removal, and turbinate reduction due to benefits like bloodless dissection, precision, and reduced pain **(23).**

The term coblation is derived from controlled ablation. It is the process of removing volumetric tissue without heat using molecular dissociation. This function resembles an excimer laser in most aspects. This technique operates on the idea that a charged layer of particles known as plasma is released when an electric current is run through a conducting fluid. With enough energy, these charged particles can disrupt the molecular connections inside the cells by accelerating through tissue. This results in the breakdown of cells and molecule by molecule reducing tissue volume **(24).**

The coblation system consists of a radiofrequency generator, foot pedal system, irrigation system, and coblation wand. The coblation wand has two electrodes, a base electrode and an active electrode, separated by ceramic. By applying low temperature (60-70°C) and through the saline medium, the produced current moves between these electrodes. This saline is broken down into ions, which create active plasma, which gives the wand's tip an orange glow. The generated plasma has a thickness of 100–200 µm (**25**).

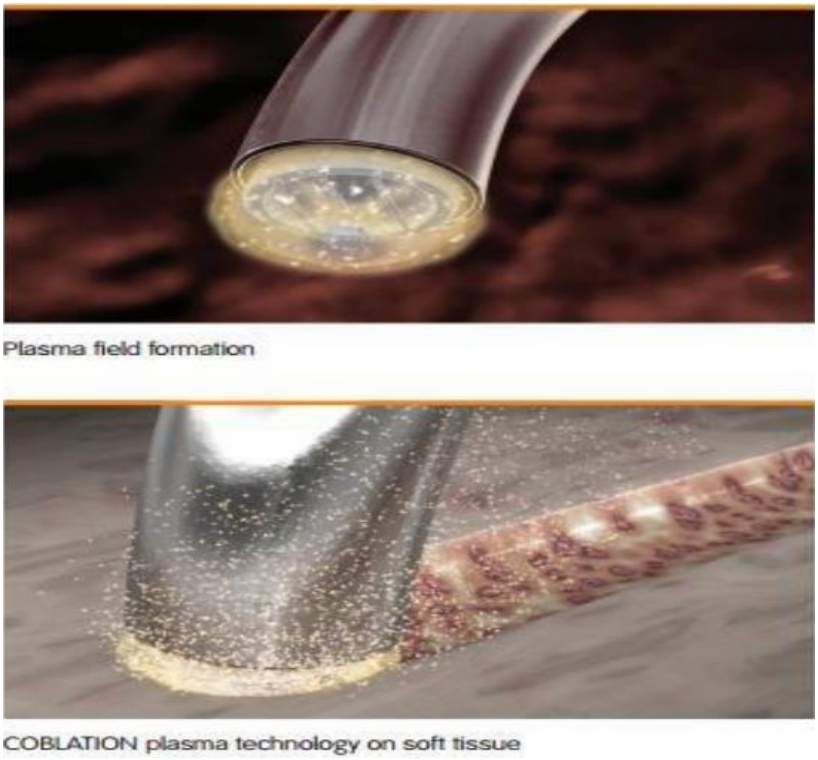

Figure 5: Plasma generation in coblator **(24)**

The modes of operation include ablation for tissue removal and coagulation for hemostasis. The effect of plasma on tissue is purely chemical and not thermal. Plasma generates OH and H ions. These make plasma destructive. OH radical causes protein disintegration. When tissue turns brown after surgery, it is not heat-induced charring, but tissue oxidation. The effectiveness of ablation is increased by applying coblation sporadically along with generous irrigation of cold saline **(24)**.

The advantages of coblation are very limited depth of penetration, minimal collateral tissue damage, localized effect, controlled volumetric tissue removal, surface temperatures of 40-70 C, and by-products/gases that form are different from those of the conventional devices (**21**).

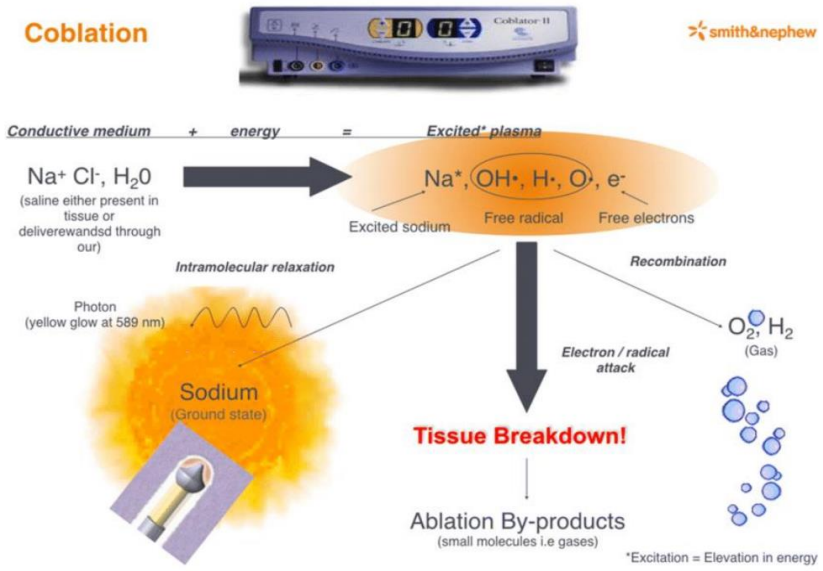

Figure 6: Coblation physics and how plasma medium is formed **(26)**

Complications of adenoidectomy

Complications following adenoidectomy are rare.

1. **Bleeding:**

In 0.4% of cases, the initial consequence is acute bleeding from the site. Vasoconstrictive medications, such as oxymetazoline, can be used to manage certain moderate epistasis. Four out of every 1000 patients experience bleeding severe enough to require a trip back to the operating room. Adenoidectomy does not result in significantly delayed bleeding, which is seen in about 2% of tonsillectomy patients **(27).**

2. Recurrence :

It is considered one of the most important and controversial complications of adenoidectomy. The adenoid may regrow after adenoidectomy and their regrowth can lead to treatment failure. However, several studies demonstrated that the adenoid rarely regrows, and rarely does regrowth cause recurrent obstructive symptoms. Their regrowth rate varies and is estimated to be from 1.3% to 26% according to the literature. The rate of the regrowth and the reason why the adenoid regrows is controversial and related to several factors, most importantly the approach and technique used and the complete visibility of the field **(23).**

3. **Velopharyngeal insufficiency (VPI):**

Incomplete closure of the palate to the posterior and lateral nasopharyngeal wall, where the adenoid had previously been placed, results in VPI, which is seen in 0.03–0.06% of instances. More than half of the individuals having an adenoidectomy get VPI, which is often gone in 2-4 weeks. One in 1500–3000 adenoidectomies result in persistent VPI. Children with documented palatal abnormalities or those with overall lower muscular tone are more likely to experience persistent VPI. For patients at high risk of VPI, some suggest partial adenoidectomy, leaving the inferior section of the adenoid pad intact. Depending on the severity of the VPI, speech therapy may be the initial treatment for up to a year, whereas surgery is required in 50% of persistent cases (**28**).

4. **Torticollis**

Individuals who have had their adenoid removed from the posterior wall of the nasopharynx over the spine and superior constrictor muscle may experience stiff necks, neck spasms, and in rare cases, torticollis. Torticollis is an uncommon condition. Anti-inflammatory drugs, a neck brace, and warm compresses could be useful in reducing discomfort and spasms **(29).**

5. **Nasopharyngeal stenosis**

The infrequent condition known as nasopharyngeal stenosis is characterized by circumferential pharyngeal contracture in the Waldeyer ring area. Because the combined treatment creates a bigger and more circumferential area of the denuded pharyngeal surface with greater potential for scar contracture, this contracture is more likely with tonsillectomy and adenoidectomy than with adenoidectomy alone. Usually, nasal blockage or hypo-nasal speech is the clinical manifestation. Repair is risky and typically involves rotating flaps of undamaged mucosa in the pharynx or palate region **(29).**

6. **Atlanto-axial subluxation from infection: (Grisel syndrome)**

An extremely unusual event that might result in laxity of the anterior transverse ligament between the axis and atlas and vertebral body decalcification is infection or inflammation in the nasopharynx after adenoidectomy. A week or two following surgery, spontaneous subluxation is seen and is linked to torticollis and discomfort. Cervical spine stabilization and consultation with a neurosurgeon are part of the treatment **(30).**

7. **Eustachian tube injury:**

Eustachian tube injury can occur, but this is an infrequent complication (**28**).

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