Current techniques for management of inferior nasal turbinate hypertrophy: Review article

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Abstract:

Nasal blockage is one of the most common symptoms encountered in the field of rhinology. Inferior turbinate hypertrophy is one of the most common causes of nasal obstruction that may be observed in allergic rhinitis, vasomotor rhinitis, chronic hypertrophic rhinitis, or a compensatory response to an evident septal deviation. Although such condition is not life threatening, but it has a negative influence on the quality of life of the patients concerned. The inferior turbinate has an important role in the physiology of the nose and the defense of the lungs through temperature regulation and humidification of the inspired air as well as filtration of the foreign particles by the mucociliary clearance system. Surgical reduction of the inferior turbinate is required for inferior turbinate hypertrophy that is refractory to the medical treatment. Inferior turbinate surgery is intended to maximize the nasal airflow through reduction of the erectile submucosal tissue and / or the bony turbinate, while concurrently preserving the turbinate mucosa in order to preserve the humidification and warming of the inspired air. Although multiple surgeries have been described for the management of inferior turbinate hypertrophy, but there is lack of consensus on the ideal methods. Therefore, there is a need for a comprehensive review of the surgical techniques to better define each procedure and improve understanding of the principle and mechanism involved.

Keywords: Inferior turbinate hypertrophy, Management techniques.

1. Introduction:

Chronic nasal obstruction is caused by either nasal or septal deformities as well as mucosal disease associated with turbinate hypertrophy. Most inferior turbinate enlargement is generally due to mucosal hypertrophy. Cellular hyperplasia, tissue edema, and vascular congestion are the main contributors to inferior turbinate hypertrophy, but bony enlargement can also be a contributing factor **(1, 2)**. The most common non-infectious causes of mucosal swelling of the inferior turbinate are perennial allergic rhinitis, vasomotor rhinitis, compensatory hypertrophy resulting from a long-standing septal deviation, hormonal rhinitis, and drug induced rhinitis due to use of decongestant medications (rhinitis medicamentosa) and contraceptive pills **(3, 4, 5).**

As well, condensation rhinitis is well known to snow skiers. It is due to the reaction of the nasal mucous membrane to the colder outside environment. Rhinitis of disuse occurs in patients who no longer use their noses for the airflow (the patients who have undergone laryngectomy) as the pathophysiology is rebound inflammation due to a lack of feedback from the normal nasal airflow **(6, 7).**

1.1. Allergic Rhinitis:

It is characterized by one or more symptoms including sneezing, itching, nasal congestion, and rhinorrhea. The causative agents include pollens, molds, dust mites, and animal dander. Perennial allergic rhinitis is defined as occurring during approximately 9 months of the year. Seasonal allergic rhinitis is fairly easy to identify because of the rapid and reproducible onset and offset of symptoms in association with pollen exposure, while perennial allergic rhinitis is often more difficult to detect because of the overlap with sinusitis, respiratory infections, and vasomotor rhinitis. The key for the diagnosis of allergic rhinitis is the awareness of its signs and symptoms and IgE antibody tests to detect the specific allergens **(8).**

1.2. Non-Allergic Rhinitis:

It is characterized by sporadic or persistent perennial nasal symptoms which are triggered by environmental conditions such as strong smells, cold air, changes in temperature, humidity, strong emotions, ingesting alcoholic beverages, and changes in hormone levels. These triggers do not involve IgE cross-linking or histamine release. It is almost indistinguishable from allergic rhinitis. However, nasal and palatal itching, sneezing, and conjunctival irritation are less prominent. The most clinically prevalent form of non-allergic rhinitis is vasomotor or idiopathic rhinitis. **(9).**

1.3. Rhinitis medicamentosa:

It refers to non-allergic inflammation of the nasal mucosa which is caused by the abuse of nasal decongestant. It is characterized by nasal congestion based on long-term use of nasal decongestant without rhinorrhoea or sneezing. The histological changes of rhinitis medicamentosa are loss of nasal mucosa cilia, squamous epithelium metaplasia, edema of the epithelium cells, hyperplasia of goblet cells, increased expression of epidermal growth factor receptor, and infiltration of inflammatory cells. Patients with rhinitis medicamentosa should immediately stop using nasal decongestant and use instead nasal glucocorticoid spray for the recovery of the nasal mucosa **(10).**

1.4. Vasomotor Rhinitis:

It is non-specific paroxysmal sneezing and rhinorrhea. It is basically due to autonomic dysfunction. It can be induced by a variety of emotional or endocrine factors and physical agents such as cold, heat, or local irritant. In these cases, these stimuli do not provoke antibody reaction and the allergic history and skin reactions are generally negative or entirely non-specific. However, borderline cases exist and are often difficult to separate from the allergic type **(11, 12).**

2. Evaluation of the inferior nasal turbinate hypertrophy:

An objective validated classification system for categorizing inferior turbinate size is lacking. **Friedman et al. (13)** categorized inferior turbinate as grade 1 to 3, whereas grade 1 was mild enlargement with no obvious obstruction, grade 3 was complete occlusion of the nasal cavity, and grade 2 was in between. **Leitzen et al. (14)** rated inferior turbinate hypertrophy as normal, mild, moderate, or severe (0, 1, 2, and 3 respectively). CT scan study by **Uzun et al. (15)** categorized inferior turbinate as being lamellar (type 1), bone with compact (type 2), combined (type 3), and bullous (type 4). **Camacho et al. (16)** have used the 25% inferior turbinate classification system (grade 1–4) as **A: grade 1** (0%–25% of total airway space), **B: grade 2** (26%–50% of total airway space), **C: grade 3** (51%–75% of total airway space), and **D: grade 4** (76%–100% of total airway space).

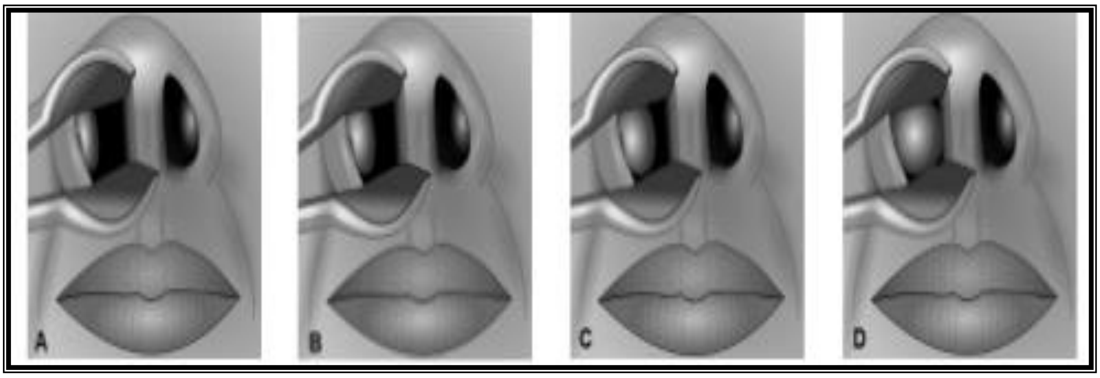

Figure 1: Inferior turbinate classification system **(16)**

3. Indications for inferior turbinate reduction surgery:

Nasal obstruction occurs as a result of submucosal or mucosal hypertrophy associated with increased vascularity of the inferior turbinate. Medical treatment of inferior turbinate hypertrophy consists of topical intranasal corticosteroid sprays, oral antihistamines, and topical decongestants. Generally, when conservative management for 3 months fails to resolve nasal obstruction as a result of inferior turbinate hypertrophy, surgical treatment is indicated **(17).**

4. Surgical Considerations:

Surgical management can target both the bony and the mucosal components of inferior turbinate hypertrophy. Based on the preservation of the medial mucosa of the inferior turbinate, there are two types of surgical techniques, the mucosal-sparing and non-mucosal-sparing. The procedures for inferior turbinate reduction include turbinectomy (total, partial), turbinoplasty (submucous resection, microdebrider), out-fracture, thermal techniques (electrocautery, radiofrequency ablation, cryotherapy), and laser **(18, 19).**

4.1. Conventional turbinectomy:

Full thickness turbinate resection is the most aggressive technique available for the treatment of an inferior turbinate hypertrophy. Turbinate resection procedures range from limited resection of the anterior aspect of the turbinate to total turbinate resection **(20).**

Many techniques leave a portion of the anterior head for nasal humidification and the posterior aspect to decrease the risk of bleeding. Although inferior turbinectomy results in significant relief of nasal obstruction, but it is associated with more complications such as pain, nasal crusting, synechiae, and bleeding. Moreover, atrophic rhinitis and empty nose syndrome have been recognized as late sequalae of this procedure, especially following total turbinectomy **(21).**

4.2. Turbinoplasty:

There are two types of turbinoplasty, intra-turbinoplasty and extra-turbinoplasty. Intra-turbinoplasty is a technique involving tunneling inside the turbinate, which only removes the submucosal erectile tissue, while leaving behind the bulky inferior turbinate bone. Therefore, this procedure is meant to address inferior turbinate hypertrophy contributed by the soft erectile tissue. Extra-turbinoplasty is a modification of an inferior turbinoplasty that combines conservative sparing of the nasal mucosa together with the removal of the obstructing soft tissue and part of the bulky inferior turbinate bone. Multiple techniques exist. An intra-turbinoplasty can be performed by microdebrider, coblation, and radiofrequency, whereas extra-turbinoplasty can be performed by micro-instruments, coblation, and microdebrider. Inferior turbinoplasty has the advantage over the other turbinate procedures by preserving sufficient mucosa, while removing adequate obstructed tissue to improve the airway significantly **(21, 22).**

Powered instrumentation (microdebrider) can be used to remove hypertrophic submucosal soft tissue and bone. A common technique involves using No. 15 blade to make an incision in the anterior head of the inferior turbinate and then a powered instrument, a small microdebrider, is introduced. The mucosa is preserved, which plays the key role in the warming and humidification of air through the nasal passages as well as the ciliary function and mucociliary clearance remain in a good condition. It has been shown to produce prompt and durable symptom relief and postoperative complications are rare **(23, 24).**

Medial flap turbinoplasty has been described as a way to reduce the turbinate size with preservation of mucosa. The medial mucosal flap is elevated and left intact, while the turbinate bone and lateral mucosa are resected. The branches of the inferior turbinate artery must be cauterized during this procedure. Good long-term results have been described with this technique, although more studies are needed **(25)**.

4.3. Inferior turbinate out-fracture:

Inferior turbinate out-fracture is commonly used during nasal surgeries with minimal side effects. However, it generally has not shown lasting symptomatic improvement, as in many studies, the turbinate either re-medializes or continues to hypertrophy. Therefore, turbinate out-fracture is generally used in combination with an additional technique to improve the nasal airflow such as turbinate reduction or septoplasty **(26).**

4.4. Thermal soft tissue reduction techniques:

The inferior turbinate soft tissue part could be reduced using different thermal techniques. The most common techniques are bipolar electrocautery and radiofrequency ablation. The principle of these techniques based on creation of thermal injury leading to ultimately fibrosis and reduction in the size of the turbinate **(27).**

Electrocautery:

The standard technique consisted of coagulating in two parallel lines from posterior to anterior into the medial wall of the inferior turbinate. The heat coagulates the tissues causing necrosis, which is followed by fibrosis and shrinkage of the turbinate. High-frequency surface diathermy was introduced. This technique was applied to destroy the tissues over a wide area or to achieve linear coagulation. Bleeding was rare and temporary complaints of crust formation were developed **(28).**

Surface electrocautery is a destructive procedure as it causes mucosal atrophy, metaplasia, loss of cilia, and impairment of mucociliary transport. Permanent crusting and synechiae between the septum and turbinate may occur. Therefore, it lacks the nasal function preservation. Although it is known to have these undesirable effects, it is still one of the most practiced methods **(27).**

Intraturbinal Coagulation:

As surface electrocautery does produce considerable damage to the mucosa, intraturbinal thermocoagulation was introduced. The effect of submucous diathermy is achieved by coagulation of the venous sinusoids within the turbinate, leading to submucosal fibrosis

(29). However, the amount of deep tissue reduction is difficult to dosage and its effect is often limited or temporary. The most common complications are delayed haemorrhage, prolonged nasal discharge, and crusting **(30).** In spite of these disadvantages, submucous diathermy is still the treatment of choice for many ENT physicians, as it is easy to perform and causes relatively few complications **(31).**

Radiofrequency Ablation:

Radiofrequency energy has been used for many years to ablate tissue in a variety of medical fields. Either monopolar or bipolar radiofrequency can be used. Turbinate reduction could be done by inserting special probe submucosally allowing delivery of radiofrequency energy in monopolar fashion or with a bipolar instrument that delivers the energy through a conductive fluid medium **(32).** Coblation is a unique method of delivering radiofrequency energy to the soft tissue for applications in otolaryngology. By using radiofrequency in a bipolar mode with a conductive solution such as saline, it energizes the ions in the saline to form a small plasma field **(33).** Radiofrequency ablation allows more focused reduction of the deeper components of the inferior turbinate due to limited dissipation of the heat. Waves disperse enough energy to break the molecular bonds of tissues at relatively low temperatures (below 90°c), thereby limiting damage to the adjacent tissues **(24).**

Radiofrequency ablation has been reported to significantly alleviate all symptoms (e.g., nasal obstruction, rhinorrhea, sneezing, and nasal itching) in patients with allergic rhinitis. Moreover, these effects were reported to persist up to five years after treatment, indicating a good long-term efficacy. Radiofrequency ablation can be performed in-office under local anesthesia, is safe with low morbidity, no nasal packing is required, has little risk of mucosa destruction, thus preserving the mucociliary function, and it may be performed selectively in the pediatric population. Radiofrequency ablation may result in mild postoperative pain that typically resolves spontaneously and nasal obstruction secondary to crusting and mucosal swelling that often resolves after 2 to 3 weeks **(34).**

4.5. Laser inferior turbinate reduction:

Laser turbinate reduction was popularized in the 1990s. Various lasers have been used for turbinate reduction such as CO2, diode, Ho: YAG (Holmium: yttrium aluminum garnet), Nd: YAG (Neodymium: yttrium aluminum garnet), argon, and KTP (Potassium Titanyl Phosphate). Laser turbinate reduction has been described with many different techniques such as contact, non-contact, or interstitial. Lasers have been described in the operating room and in the outpatient clinic setting with topical anesthesia. The properties differ between laser types based on their application of contact or non-contact mode, pulsed or continuous wave emission, emitted wavelength, and output power. The varying lasers have different tissue penetration and field effects. In comparison between laser types, there were no statistically significant differences in the outcome with approximately half of patients reporting subjective improvement at 1 year **(35, 36).**

4.6. Cryosurgery:

It was introduced by Ozenberger in 1970 **(37)**. Turbinate is frozen under local anesthesia with a cryo-probe that uses nitrous oxide or liquid nitrogen as a cooling agent. The necrosis produced by freezing was found to be different from that produced by cautery. It was assumed that new respiratory epithelium would replace the frozen tissue. Apart from transient headache, there are no postoperative sequelae. After one month, there was a marked reduction in the glandular acini and the cilia appeared normal. It can be more effective in allergic rhinitis than in non-allergic turbinate hypertrophy, as it is especially effective in controlling rhinorrhea. However, the amount of volume reduction is hard to predict. Therefore, it is gradually abandoned as a technique for turbinate reduction **(38).**

5. Complications of inferior turbinate surgery:

Major complications of inferior turbinate surgery are rare. Bleeding and crusting are the most frequently described complications. These complications have been reported more frequently with more aggressive techniques that include greater resection of the turbinate or surgery in the more posterior aspect of the turbinate. Bone necrosis, synechiae, anosmia, and atrophic rhinitis have been described, but are rare and generally associated with more aggressive procedures **(36).**

Empty nose syndrome is a rare complication associated with turbinate surgery, in which the patients have subjective nasal obstruction despite of a significant space for the airflow in the nasal cavity. It is associated with reduced inferior turbinate volume. It is almost exclusively seen in patients who have had turbinate surgery and is classically described as a complication of complete resection of the inferior turbinate **(39)**.

Inferior turbinate out-fracture alone seems to be ineffective. Total resection of the inferior turbinate should not be performed for nasal obstruction due to a small but a real risk of empty nose syndrome. Radiofrequency ablation, laser reduction, and limited resection are the most commonly described techniques. However, more long-term studies are needed to determine long-term efficacy and to distinguish any clinically significant differences in the outcome between the techniques **(36).**

6. Conclusion:

The main goals of surgical reduction of inferior turbinate hypertrophy are the relief of nasal obstruction and avoiding complications such as bleeding, crusting, and excessive pain. It is indicated when nasal blockage is refractory to medical treatment. Although there is lack of consensus on the ideal method, techniques such as turbinoplasty and radiofrequency ablation appear to have the advantage. A judicious and cautious approach to turbinate reduction is required to prevent complications. The technique to perform mainly depends on the clinical practice, surgical skills, and experience of the surgeon.

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