

Inferior turbinate hypertrophy: Review and graduated approach to surgical management

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ABSTRACT

Background: Surgical techniques for managing inferior turbinate hypertrophy (ITH) vary widely and have evolved substantially in the past four decades as new technologies have emerged.

Methods: Literature review.

Results: Inferior turbinate (IT) procedures can be categorized as: simple turbinate outfracture; turbinoplasty techniques such as extramucosal destruction, and submucosal tissue removal; and extramural turbinate resection (partial or complete). Each of these approaches has advantages and drawbacks. Considerations for technique selection include clinical setting (in-office versus operating room), cost of the devices used, efficacy of the procedure to relieve nasal obstruction, and minimizing postoperative complications such as nuisance bleeding, adhesion formation, and crusting.

Conclusion: There are a variety of contemporary surgical techniques used for IT reduction. This article highlights the available literature and gaps in current knowledge. A graduated approach to the management of ITH will be presented.

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Nasal airway obstruction is a common patient complaint seen in a variety of clinical subspecialties. Surgical management of inferior turbinate hypertrophy (ITH) comprises a multitude of commonly used and effective means to relieve obstruction.¹ Typically, these procedures are performed after failed medical therapy. A successful outcome from surgery performed for ITH is predicated on an accurate diagnosis with contributions from other common factors in nasal airway obstruction specifically ruled out.

EVALUATION OF NASAL AIRWAY OBSTRUCTION

A patient's history plays an invaluable role in assessing their nasal breathing function. After determining the side of obstruction, its severity, frequency, duration, and exacerbating factors, an examination of the nasal and ITs both before and after topical decongestion is conducted. Nasal endoscopy with examination of the entire sinonasal tract will rule out other obstructive lesions including septal deviations, mucosal inflammation, purulence, or polyps. Evaluation of the nasopharynx for the presence of obstructing adenoid tissue, a "mulberry tip" (polypoid changes of the tail of the IT) or in rare cases neoplasms is required. Infrequently, further evaluation with imaging (CT or MRI) might be considered as dictated by physical exam findings or specific clinical concerns. Objective means of evaluating the nasal airway such as acoustic rhinometry, rhinomanometry, and other similar techniques are not used routinely.^{2–6}

SURGICAL MANAGEMENT

Although the medical management of turbinate hypertrophy is aimed primarily at mucosal reduction, surgical management can target both the bony and the mucosal components. Numerous techniques and variations have been developed and fine-tuned over the

past 100 years. IT surgery can be performed in an office setting or may be done in the operating room depending on the technique and whether or not concomitant procedures are performed. Considerations for technique selection include cost; efficacy; desire for general anesthesia; and minimizing postoperative complications such as nuisance bleeding, adhesion formation, and crusting.

The techniques have changed in frequency of use over the past 40 years, notably coincident with emergent technologies. At the outset, partial or total turbinectomy represented the technique of choice during the 1970s and 1980s. A recent study by Batra *et al.*¹ in 2009 determined that during these decades, 67 and 52% of patients underwent turbinectomy for turbinate hypertrophy; whereas the technique was only used in 24 and 14% for studies in 1990s and 2000s, respectively.^{7–12} As newer techniques evolved the popularity for partial and total turbinectomy waned significantly. The more recent history of turbinate surgery includes periods of popularity for cryotherapy,^{13–16} thermal techniques (including needle tip cautery and radiofrequency ablation),^{17–21} and lasers.^{22–27} The peak periods of use of these technologies followed their introduction into the otolaryngology space.¹ Contemporary literature has focused on the use of the microdebrider used submucosally to reduce turbinate volume,^{28–33} and the application of the ultrasonic aspirator has also recently been described for turbinate surgery.^{34,35} These various techniques are analyzed in this article.

TURBINATE OUTFRACTURE

Lateral repositioning of the IT *via* out-fracturing has been used for many years with data suggesting that modest improvement in nasal airway can be achieved.^{36,37} Variations are limited in this rather straightforward technique but include the use of different instrumentation including the Goldman/Boise elevator and Freer elevator. An obvious limitation of this technique is that the turbinate size is not actually removed and no tissue is removed. Buyuklu *et al.*³⁶ used CT to evaluate the turbinate position before and at 9 months after the outfracture procedure and the distance from turbinate bone to the lateral nasal wall was measured. They found a statistically significant degree of lateralization, however, longer outcomes were not measured.

EXTRAMURAL RESECTION

Total IT resection has been used for many years as a valid technique that has shown success in improving nasal airway obstruction.^{38,39} This is the most aggressive turbinate procedure and results in the maximal amount of tissue removal (both bone and soft tissue are

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taken). Although the objective criteria for a widely patent airway are certainly obtained *via* this method, Kern⁴⁰ showed, in a landmark study, that some patients remain symptomatically obstructed because of a phenomenon known as “empty nose syndrome” in which the patient has an objectively patent nasal airway but has a sensation of obstruction.^{40–42} Other complications of this procedure include hemorrhage, nasal crusting, and synechiae formation.⁴³ Total IT resection has largely fallen out of favor because it has been shown to have a higher complication rate than other techniques.

Partial turbinectomy, which typically includes resection of the anteromedial 1/3 of the IT, has also been in use for many years. Considering that the arterial blood supply enters the turbinate posteriorly, this technique was developed even before the empty nose syndrome was recognized, because it avoided the vascular pedicle and the bleeding that became associated with total turbinate resection. Partial turbinectomy has a lower risk of hemorrhage when compared with total IT resection, and when bleeding is encountered, it is more easily controlled with the anterior exposure.^{44–46} This technique does have similar complications of crusting and synechiae formation as total turbinectomy, however. Partial turbinectomy has considerable variation in technique. After infiltration with a local vasoconstrictive agent, various methods of removing both bone and mucosa have been implemented. These include clamping the targeted tissue with curved or straight clamps before sharply removing the tissue with scissors or a blade. This is followed by cauterization of the mucosal edges. Studies on outcomes for partial turbinectomy vary. Fanous⁴⁴ reported good to excellent improvement in nasal airway at follow-up between 6 months and 4 years whereas Wight^{45,46} reported an objective success, but not a subjective relief in obstruction at 2 months.

EXTRAMUCOSAL DESTRUCTION

IT reduction has been performed most commonly with the carbon dioxide (CO₂) and neodymium:yttrium-aluminum garnet (Nd:YAG) lasers; however, there have been reports with the holmium:yttrium-aluminum garnet (Ho:YAG), potassium titanyl phosphate, diode, and argon plasma as well. When they became adapted for medical use, lasers saw a surge in popularity, including for turbinate procedures. Lasers are used to perform a precise excision and/or ablation of hypertrophic turbinate tissue. The risk of hemorrhage is less with this technique; however, there remains a risk of crusting and atrophy.⁴⁷ Elwany^{13,48} found synechiae formation to be the main complications and advised avoiding vaporization of the medial surface of the IT beyond its anterior third.⁴⁸ A study in 2007 by Sroka *et al.*⁴⁹ compared the Ho:YAG with diode lasers and both techniques resulted in statistically significant improvement in nasal airflow at 6 months and 3 years, postoperatively, and overall they concluded that the Ho:YAG laser had better long-term nasal patency.

Along with the use of lasers, cryosurgery also enjoyed a short period of popularity. Cryotherapy exerts its effects by the intracellular formation of ice crystals and subsequent cell membrane destruction. The critical temperature is –12°C. Thrombosis of small vessels and subsequent ischemia increase the tissue destruction and the effectiveness of cryotherapy.¹⁵ Procedures such as these that disrupted the surface mucosa became less popular because surgeons noted significantly more crusting and pain with these surface-destroying techniques. Although lasers and cryosurgery gained favor in the 1990s and early 2000s, they are less frequently used now.

SUBMUCOSAL LESION FORMATION AND TISSUE REMOVAL

With the popularity of lasers waning, surgeons began experimenting with techniques that preserved the turbinate’s mucosa but still created volume reduction through initiating fibrosis through submucosal lesion formation or actual tissue removal. Currently, many of the most well-accepted surgical techniques for IT reduction fall into the category of submucous resection (SMR) and turbinoplasty. Nu-

merous procedural variations and nuances exist between individual surgeons and techniques. Turbinoplasty and SMR involve the remodeling of the IT with removal of submucosal tissue with or without bone removal. This is performed without removal of the external mucosal layer to reduce the chances of synechiae formation or loss of receptors located on the turbinate’s mucosal surface.⁵⁰

RADIOFREQUENCY

Needle tip Bovie as well as spatulated Bovie cautery have both been used to shrink the submucosal tissue of the IT. An initial cut using either the Bovie itself or a separate stab incision with a scalpel can be made followed by several passes along the medial surface of the IT extending posteriorly. This technique produces high tissue temperatures and can cause significant surrounding tissue injury and thermal damage of the overlying mucosa leading to crusting and synechiae. This is a simple and quick technique that can be performed in the office or operating room setting.

Radiofrequency ablation (RFA) using the Coblator (Arthrocare, Austin, TX) is a more recent technique that can be performed in a similar method as electrocautery. This technique uses radiofrequency heating to induce submucosal tissue destruction and fibrosis.⁵¹ The alternating current of the electrode, however, induces ionic agitation at the cellular level with consequent vaporization of some of the tissue and a thermal lesion is created. This procedure is also well tolerated under local anesthesia in the office setting. Compared with traditional electrocautery, which heats tissues to temperatures of 400–600° C, RFA maintains temperatures between 60 and 90°C with significantly less heat dissipation.³⁵ Cavaliere *et al.*⁵² compared the bipolar Coblator and the monopolar somnoplasty, in a randomized, prospective study with 75 patients in each group. They concluded that both technologies provided similar long-term results to 20 months. Although most studies are observational and/or have short follow-up, the literature overall suggests that RFA is well tolerated and provides favorable outcomes in improving the nasal airway.^{53–56}

MICRODEBRIDER

The microdebrider made its foray into rhinology into the early 1990s and is heralded as a significant advance in endoscopic sinus surgery.^{57,58} As it became widely accepted as a useful tool for sinus surgery that was capable of continuously suctioning blood from the field and permitting expeditious tissue removal in a mucosal-sparing manner, smaller iterations of blades were developed for IT surgery. The technique most commonly advocated is a submucosal resection of tissue using this instrument. After a stab incision is made at the anterior head of the IT a submucosal pocket is developed adjacent to the bone. The microdebrider can then be used facing laterally to perform soft tissue and bony resection. Complications are infrequent. Perforation of the overlying flap or poor approximation of the incision can result in bleeding, synechiae, and crusting.²⁹

More recently, advances in bipolar microdebrider technology have added another aspect to the functionality of the microdebrider.⁵⁹ Use of the bipolar-equipped microdebrider (PK Diego, Gyrus ACMI-ENT Division, Bartlett, TN; Fig. 1) for SMR of ITs has several potential advantages. In addition to removing tissue, the cautery feature can be used to cauterize the field that promotes fibrosis as well as providing hemostasis. As the instrument is removed from within the turbinate body, a small amount of cautery can also be used to cauterize the stab incision site to further minimize any nuisance bleeding that may occur postoperatively.

ULTRASONIC ASPIRATOR

The ultrasonic bone aspirator is the newest technique used in IT surgery. Originally used for soft tissue cavitation, surgical aspirators use ultrasonic waves to emulsify bone with concurrent irrigation and microsuction of the bone particles. The use of this emerging technol-

Figure 1. The bipolar-equipped PK Diego microdebrider (Gyrus ACMI-ENT Division, Bartlett, TN) permits both tissue shaving and bleeding control through cautery. The inferior turbinate (IT) blade is shown (inset). (Courtesy of Gyrus ACMI-ENT Division, Bartlett, TN).

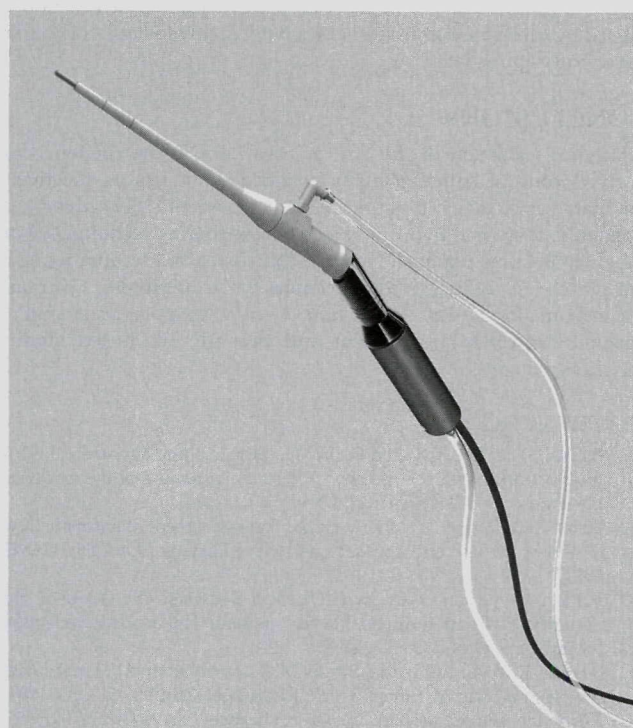
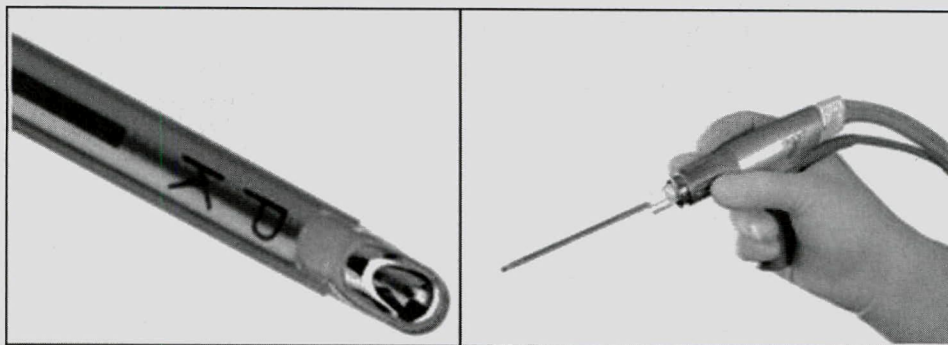


Figure 2. Handpiece of the Sonopet ultrasonic aspirator (Stryker Corp., Kalamazoo, MI). Irrigation and distal suction are supplied to the tip of the instrument. A variety of tips are available. (Courtesy of Stryker Corp., Kalamazoo, MI).

ogy was first described in the otolaryngologic literature for endoscopic dacryocystorhinostomy by Antidse and colleagues,⁶⁰ who highlighted the advantage of improved bone removal in confined spaces. The key feature of this instrument is tissue selectivity. It vibrates, rather than spinning like a drill burr or microdebrider blade, which results in effective bone removal while being relatively atraumatic to the surrounding soft tissue. The lack of a spinning burr also reduces the risk of skipping or chatter associated with a drill, providing more control (Fig. 2). For IT surgery, the tip of the aspirator can be introduced through a small stab incision and the turbinate bone can be resected in a precise, graded manner, with minimal thermal or mechanical injury to the overlying soft tissue envelope. The technique was first described by Greywood³⁴ in 2010 and he reported improvement in nasal obstruction that varied with concurrently performed procedures. He also reported no complications. Gindros³⁵ compared ultrasonic aspiration to electrocautery and RFA and found both subjective and objective improvement in all cases. The best results were obtained, first, with ultrasonic aspiration and, second, with RFA. However, the results did not vary significantly between any of the

groups. Ultrasonic turbinate reduction appears to be an effective and safe alternative. More experience is needed with this technique.

COMPARATIVE EFFICACY

The literature suggests that IT surgery, regardless of the technique, is effective at improving nasal obstruction due to turbinate hypertrophy not responsive to medical therapy. In the more recent literature, the mucosal sparing techniques including submucous microdebrider-assisted and RFA techniques have been most studied. A randomized clinical trial by Passali⁵⁸ in 2003 compared the following six techniques: turbinectomy, laser cautery, electrocautery, cryotherapy, submucosal resection, and submucosal resection with lateral displacement. Nasal resistance was measured in 382 patients by anterior active rhinomanometry and nasal volume by acoustic rhinometry. Significant improvement was noted initially in all groups ($p < 0.001$); however, the duration of improvement varied. Patients with electrocautery or cryotherapy had progressive worsening of nasal resistance and the patients who underwent laser cautery had reduced nasal volumes over the 6-year follow-up. Only the patients with submucosal resection achieved normal parameters for mucociliary transport time and secretory IgA concentration. The submucosal resection patients also experienced better quality of life scores and when combined with outfracture, had the best results.

Kizilkaya *et al.*⁶¹ showed that both RFA and microdebrider submucosal resection resulted in significant improvement in visual analog scale score and acoustic rhinometry at 3 and 6 months. They also measured ciliary beat frequency and saccharin transit times. There were no statistically significant differences between the groups. Garzaro *et al.*⁶² compared the outcomes of nasal physiology after radiofrequency turbinate reduction and partial turbinectomy. Both groups had good clinical outcomes with improved nasal function. However, there was a reduction in the number of normal cilia and a significantly more prolonged mucociliary transport time in the partial turbinectomy group, suggesting that RFA is a superior method to preserve nasal physiology.

GRADUATED APPROACH TO MANAGEMENT

If all of the techniques described for managing ITH have established effectiveness, how does one decide which technique to use in any given patient? Should the same technique be used in every patient, every time? Interestingly, the literature has not addressed this very practical issue in any meaningful way. The authors feel that, to some extent, the decision between which technique to select for IT surgery should be individualized to the clinical situation. A few guiding principles may be useful to keep in mind when deciding on which technique to use. Evidence and trends in the literature suggest that

1. All techniques have been shown to offer benefit and improve nasal obstruction.

Table 1 Graduated approach to ITH management

Severity of ITH	Technique
Mild	Outfracture RFA (cautery/coablation)
Moderate to severe	SMR (microdebrider/other)
Massive/underlying disease	Extramural resection (partial)
Posterior tip hypertrophy	Extramural resection (microdebrider)

Key: ensure accurate diagnosis and target pathology.

May combine techniques, especially outfracture.

ITH = inferior turbinate hypertrophy; RFA = radiofrequency ablation;

SMR = submucous resection.

2. Surface sparing techniques appear to have advantages of less crusting, fewer adhesions, and possibly less pain.
3. Actually removing turbinate tissue submucosally appears to have lasting advantages over less aggressive techniques of lesion creation, etc.
4. Extramural turbinate resection removes the maximal amount of tissue but is also associated with the highest morbidity of all techniques.
5. Multiple techniques (especially outfracture) may be combined to maximize effectiveness.

Using these general principles, the authors have tried to use a rationale and graduated approach to the surgical management of ITH. As shown in Table 1, the technique selected is based on an accurate diagnosis of the pathology to be targeted and an assessment is made regarding the "degree of turbinate hypertrophy." For example, in a situation of mild turbinate hypertrophy with a large adenoid pad or severe septal deviation, a less aggressive technique of submucosal lesion creation might be chosen. In the large majority of moderate to severe turbinate hypertrophy where it is deemed that the turbinates play a more central role in the obstruction, the authors prefer the more aggressive approach of submucosal turbinate reduction using a microdebrider, with or without bipolar cautery. Finally, given the associated morbidity of extramural resection techniques, partial (extramural) turbinate resection should be reserved for massive turbinate hypertrophy, notably in cases that may involve underlying conditions such as granulomatous disorders, etc. Posterior turbinate tip hypertrophy is also best managed with extramural resection, frequently through the use of a microdebrider.

This graduated approach to ITH management can be used to frame the decision of which technique to use in a given clinical situation. It should be noted, however, that these are simply the opinions of the authors and, although supported by trends in the literature, the application of a variety of the other techniques is equally valid. The choice of procedure selected is ultimately the surgeon's preference.

IT SURGERY FOR NONOBSTRUCTIVE SYMPTOMS

In addition to nasal airway obstruction, IT surgery has been implicated as a management option for patients that suffer from rhinitis that is refractory to medication or for patients that are trying to reduce medication usage.⁶³⁻⁶⁶ There have been increasing studies in the literature exploring advantages of IT surgery on nonobstructive symptoms of rhinitis with several studies showing improvements in nasal drainage and even allergic symptoms of itching and sneezing. The basis for recommending surgery is that the IT offers a large mucosal surface through which the host interacts with the environment; some argue that reducing this area could alter this immune/allergic interaction. In addition, turbinate surgery could possibly disrupt the normal flow of neural influences mediating nasal functions such as drainage, sneezing, and congestion by directly disrupting neuronal

pathways in the submucosa. At present, operating on the IT for nonobstructive symptoms related to rhinitis is not a widely accepted indication.

LIMITATIONS TO EFFECTIVE MANAGEMENT

Some caveats to the effective surgical management of the hypertrophic turbinate include the role of confounding sources of obstruction such as a deviated septum or septal swell body,⁶⁷ the poorly understood homeostatic mechanisms of the nose, and a lack of correlation between objective degrees of nasal obstruction and subjective symptoms. It is also worth highlighting the glaring fact that there is no objective clinical definition of "turbinate hypertrophy" and because imaging is rarely done in the evaluation of the isolated complaint of nasal obstruction, the extent to which the obstruction is caused by turbinate soft tissue versus bony involvement is, of course, never truly appreciated.

CONCLUSIONS

Surgical reduction of the ITs for nasal airway obstruction is an evolving concept. Although many available techniques are effective, a graduated approach to the surgical management of ITH is advocated. Currently, there is a trend toward mucosal sparing techniques with submucous tissue removal. Newer technologies and techniques offer the promise of reducing complications while improving outcomes and maximizing patient satisfaction. As new technologies emerge, a demand for careful assessment and properly conducted studies should be sought.

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