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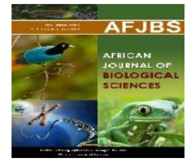

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Management of Inferior Turbinate Hypertrophy

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Abstract: Cellular hyperplasia, tissue edema, and vascular congestion are the main contributors to hypertrophied inferior turbinate, but bony enlargement can also be a contributing factor. Bilateral turbinate enlargement is caused by nasal inflammation as a result of allergic (the most common) and non-allergic rhinitis, other environmental triggers, such as dust and tobacco, medical causes, rhinitis medicamentosa, vasomotor rhinitis and hormones. Also any medications a patient takes that stimulates the parasympathetic nervous system can also affect the turbinate mucosa and cause congestion. Female hormones, specifically progesterone, may have a similar effect; therefore, congestion can frequently be experienced during the premenstrual phase of the menstrual cycle and the third trimester of pregnancy. Some female hormone replacement therapy and oral contraceptives that have a higher concentration of progesterone may have similar effects. Condensation rhinitis is well known to snow skiers and is due to the reaction of the nasal membranes to the colder outside environment. Rhinitis of disuse occurs in patients who no longer use their noses for airflow (eg, patients who have undergone laryngectomy) the pathophysiology is rebound inflammation due to a lack of feedback from the normal nasal airflow. The most efficient drugs available for reducing congestion of the turbinate mucosa are nasal decongestants. Topical sprays, oxymetazoline and phenylephrine, α-agonists are extremely powerful, and prolonged use can cause rebound congestion. Use of oral decongestants help to resolve the problem, pseudoephedrine and phenylephrine are two common formulae of oral decongestants. However, their side effects are elevation of blood pressure in hypertensive patients and urinary retention in patients with benign prostatic hypertrophy also, prolonged use of oral decongestants may lead to tolerance and ineffectiveness. Many different techniques are now available when medical treatment fails to control inferior turbinate hypertrophy such as turbinectomy (total, partial), turbinoplasty [out fracture, sub-mucous resection (SMR), microdebrider], lasers (carbon dioxide, neodymium: yttrium-aluminum-garnet, potassium titanyl phosphate, diode, argon plasma), thermal techniques [electrocautery bipolar technique, cryotherapy, radiofrequency ablation (RFA)].

Keywords: *Management, Inferior Turbinate Hypertrophy*

1. Introduction

Cellular hyperplasia, tissue edema, and vascular congestion are the main contributors to hypertrophied inferior turbinate, but bony enlargement can also be a contributing factor. Bilateral turbinate enlargement is caused by nasal inflammation as a result of allergic (the most common) and non-allergic rhinitis, other environmental triggers, such as dust and tobacco, medical causes, rhinitis medicamentosa, vasomotor rhinitis and hormones **(1).**

Also any medications a patient takes that stimulates the parasympathetic nervous system can also affect the turbinate mucosa and cause congestion. Female hormones, specifically progesterone, may have a similar effect; therefore, congestion can frequently be experienced during the premenstrual phase of the menstrual cycle and the third trimester of pregnancy. Some female hormone replacement therapy and oral contraceptives that have a higher concentration of progesterone may have similar effects. Condensation rhinitis is well known to snow skiers and is due to the reaction of the nasal membranes to the colder outside environment. Rhinitis of disuse occurs in patients who no longer use their noses for airflow (eg, patients who have undergone laryngectomy) the pathophysiology is rebound inflammation due to a lack of feedback from the normal nasal airflow **(2)**.

1- Allergic rhinitis (AR):

It is a complex disorder. It is characterized by one or more symptoms including sneezing, itching, nasal congestion, and rhinorrhea. Many causative agents have been linked to AR including pollens, molds, dust mites and animal dander. Seasonal allergic rhinitis (SAR) is fairly easy to identify because of the rapid and reproducible onset and offset of symptoms in association with pollen exposure. Perennial AR is often more difficult to detect than SAR because of the overlap with sinusitis, respiratory infections, and vasomotor rhinitis. The key to diagnosis of AR is awareness of signs and symptoms. IgE antibody tests to detect specific allergens are the standard method used today **(3).**

2- Non-allergic rhinitis (NAR):

Non-allergic rhinitis is at times almost indistinguishable from allergic rhinitis (AR), although typically nasal and palatal itch, sneezing, and conjunctival irritation are less prominent. The most clinically prevalent form of NAR is vasomotor or idiopathic rhinitis, characterized by sporadic or persistent perennial nasal symptoms that 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 immunoglobulin E cross-linking or histamine release **(4)**.

3- Rhinitis medicamentosa (RM):

Refers to non-allergic inflammation in the nasal mucosa which is caused by the abuse of nasal decongestant and it often occurs in patients with allergic/non-allergic rhinitis along with nasal congestion. RM is characterized by nasal congestion, without rhinorrhea or sneezing. The signs of RM include nasal swelling, thickening, loss of elasticity and loss of sensitivity to the decongestant **(5)**.

Management of inferior turbinate hypertrophy

All patients must be subjected to the following:

1- Preoperative evaluation:

Full history taking, complete clinical examination, nasal endoscopic examination and coronal paranasal diagnostic computed tomography scan for all patients.

2- Symptoms evaluation:

A standard visual analogue scale (VAS) ranging from 0 (no symptoms) to 10 (most severe) was used to assess three subjective nasal obstruction. Patient's overall postoperative satisfaction was also graded on a VAS ranging from 0 (complete satisfaction) to 10 (complete dissatisfaction).

3- Preoperative laboratory investigations:

Complete blood picture, prothrombin time, artial thromboplastin time, bleeding time, hepatitis C virus and hepatitis B virus.

4- Full counseling of all patients for surgery and informed consents were obtained.
(6)

Evaluation of nasal physiology:

1] Rhinomanometry: attempts to quantify nasal airflow and total nasal area during exclusive nasal breathing. Differential pressure measurements are obtained by placing a nasal catheter into the nasopharynx. Nasal resistance measurement assesses all resistive components of the nasal airway from the anterior nares to the nasopharynx and is sensitive to small changes in airway caliber. This technique has been validated and is most useful for documenting changes in nasal patency caused by pharmaceutics or surgical interventions. It is moderately invasive, slow to perform, and requires patient assistance to complete **(2)**.

2] Acoustic rhinometry: is a newer technique for evaluating the cross-sectional area of the nose and the volume of the nasal cavity by analysis of incident and reflected sound during a brief cessation of nasal breathing. This technique also has been validated and is also useful for documenting changes in nasal patency caused by pharmaceutics or surgical interventions. It is minimally invasive, quick to perform, and requires little patient cooperation **(2)**.

Rhinomanometry and acoustic rhinometry can be used clinically to evaluate nasal patency in a number of situations. Either test may be used for a general evaluation of nasal airflow and to compare premorbid conditions with changes that may occur after medical or surgical therapy. Additionally, these tests can compare nasal passages for medical or surgical planning **(2).**

3- Saccharin test:

Inside nasal cavity assessment methods involving the most commonly the saccharin transit time test and radioisotope investigations saccharin test is a widely, simple, inexpensive used method for evaluation the mucociliary transport time (MCTT) **(7).**

Anionic resin has been added to saccharin solve this problem. 5 mg of particulate saccharin is put on the inferior turbinate about 1 cm posterior to the nostril and the transport time from the placement of the particle till the subject reports the taste is being measured. Transit time of 10–15 min is regarded as normal by many studies but, time greater than 20 min is generally considered abnormal **(8).**

The collaboration of the subject is particularly important in this test as the individual reports the sweet taste of the saccharin. Sniffing, sneezing, and the nose blowing should be avoided through the test. It's best not to perform the test in the patients with severe rhinorrhea **(7).**

To give visual control, a (methylene or indigo blue) color is frequently added to saccharin test. Detection of the dye in oropharynx when the subject senses the taste provides a way of confirmation. If the subject does not report any sweet sensation after 30 min, another saccharin particle should be put on the tongue to expose any abnormality in taste function. The main disadvantage of the saccharin test is the reliance on the individual's subjective sense of taste **(9).**

4- Methylene blue test:

The methylene blue test used to evaluate the efficiency of the mucociliary clearance mechanism and detecting the time objectively to be compared with postoperative test. A volume of 0.5 ml of methylene blue dye was instilled into the antrum of the nose taking care not to soil the nasal mucosa. They waited 10–15 min and then they looked endoscopically for movement of the dye along the nasal mucosa toward the nasopharynx. They deduced the following three conclusions from this test normal movement of the dye indicated by movement of the dye as blue streaks along the walls of the nasal cavity toward the nasopharynx in patients with a normally functioning nasal mucosa. Delayed movement of the dye: the movement could be observed within minutes of instilling the dye as a few pockets but not quite reaching the nasopharynx, in patients with defective mucociliary clearance. No movement of the dye at all could be seen in patients with any mucociliary clearance **(10).**

Medical treatment:

The most efficient drugs available for reducing congestion of the turbinate mucosa are nasal decongestants. Topical sprays, oxymetazoline and phenylephrine, α-agonists are extremely powerful, and prolonged use can cause rebound congestion. Use of oral decongestants help to resolve the problem, pseudoephedrine and phenylephrine are two common formulae of oral decongestants. However, their side effects are elevation of blood pressure in hypertensive patients and urinary retention in patients with benign prostatic hypertrophy also, prolonged use of oral decongestants may lead to tolerance and ineffectiveness **(11).**

Antihistamines:

Antihistamines are agents that affect the turbinate by blocking the effects of histamine at H1 receptor sites. Many antihistamines are available however these medications are only indicated in patients with allergic rhinitis. Used in conjunction with oral decongestants, antihistamines can relieve itching, congestion and drainage symptoms. Adverse effects are drug specific and range from sedation and memory effects to excessive dryness **(12).**

Intranasal steroid sprays:

Intranasal steroid sprays are useful for turbinate dysfunction. These medications are indicated for the management of allergic rhinitis but, like all steroids, also have nonspecific anti-inflammatory effects. Intranasal steroids are administered every day and require continued daily use for any significant benefits. Proper direction of the spray nozzle to the lateral nasal wall prevents the most common adverse effects of nasal dryness **(13).**

The leukotriene receptor antagonist:

The leukotriene receptor antagonist (montelukast) is also approved for use in cases of allergic rhinitis. Improvement in daytime symptom scores of nasal congestion, rhinorrhea, and sneezing were evident in clinical studies. No significant adverse effects were encountered **(14).**

Surgical management:

Many different techniques are now available when medical treatment fails to control inferior turbinate hypertrophy such as turbinectomy (total, partial), turbinoplasty [out fracture, sub-mucous resection (SMR), microdebrider], lasers (carbon dioxide, neodymium: yttrium-aluminum-garnet, potassium titanyl phosphate, diode, argon plasma), thermal techniques [electrocautery bipolar technique, cryotherapy, radiofrequency ablation (RFA)] **(15).**

A wider nasal cavity does not necessarily mean the nose functions better. The goal of surgical treatment should be to diminish complaints while preserving function and optimal volume reduction with preservation of function **(16).**

1- Turbinate Resection:

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 extensive total turbinate resections **(17).**

Fig (1): Full resection turbinate (18).

Also this procedure involves clamping the inferior turbinate at its base to achieve homeostasis, followed by the use of nasal scissors or endoscopic instruments for resection of the entire turbinate along its base. The most common complication of total inferior turbinectomy appears to be hemorrhage **(19).**

Inferior turbinectomy conferred significant relieve of nasal obstruction but was associated with more complications, such as, pain, nasal crusting, synechiae and bleeding. Atrophic rhinitis and empty nose syndrome were recognized as late sequalae of this procedure, especially following total turbinectomy **(20)**.

“Empty nose” patients suffer from chronic nasal crusting, dryness, and intermittent bleeding. The most distinctive symptom of ENS is “paradoxical obstruction”**-** in that the patient suffers from difficulty breathing despite a widely patent nasal airway. ENS patients describe their feeling of nasal obstruction as constant and continuous: feeling of suffocation, inability or significant difficulty to breathe through their nose, feeling that their nose is too open, sensation of excessive airflow, shortness of breath, difficulty to properly inflate the lungs, lack of nasal resistance, and/or undifferentiated breathing difficulties **(21).**

2- Turbinoplasty:

Turbinoplasty includes three techniques: out-fractured, SMR, and microdebrider.

- **Out fracture:**

Out-fracture of the inferior turbinate may be performed with other turbinate reduction techniques. It involves lateral displacement of the inferior turbinate by an initial in-fracture, moving it medially from its attachment at the lateral nasal wall. The basis of doing this procedure is to create additional space when inferior turbinate is lateralized Its efficacy is variable, resulting in much criticism over its role. As there is a tendency for the turbinate to return to its original position, it is not recommended as a single procedure, but it may be used to supplement the other techniques **(21)**.

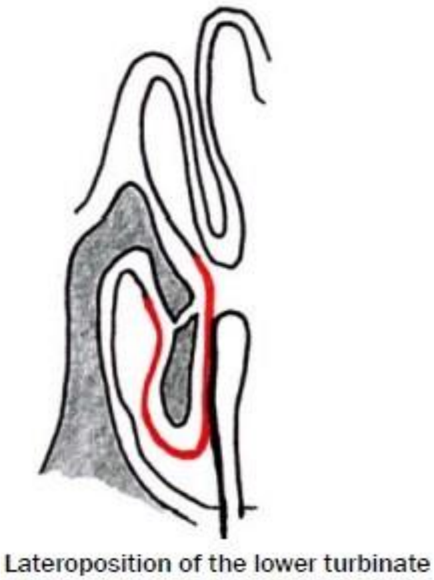

Fig (2): turbinate out fracture thickness (18).

Sub-mucous resection (Conventional Turbinoplasty):

This surgery is designed to remove the nonfunctional obstructive part of the turbinate while preserving the functional medial mucosa, which plays the key role in the warming and humidification of air through the nasal passages. Performed endoscopically, inferior turbinoplasty has the advantage over the other turbinate procedures by preserving sufficient mucosa, while removing adequate obstructed tissue to improve the airway significantly. The other term used for this technique is "submucosal resection", as a reference to its submucosal dissection procedure. There are two types of turbinoplasty: intra-turbinoplasty and extra-turbinoplasty **(22)**.

An intra-turbinoplasty is a technique involving tunneling inside the turbinate, which only removes the submucosal erectile tissue, leaving behind the bulky inferior turbinate bone. This procedure is meant to address inferior turbinate hypertrophy contributed by the soft erectile tissue. When both soft erectile tissue and turbinate bone are removed, it is designated as an extra-turbinoplasty. The 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. An intra-turbinoplasty may be performed by microdebrider, coblation and radiofrequency, whereas extra-turbinoplasty may be performed by micro instruments, coblation, and microdebrider. An extra-turbinoplasty utilizing the medial mucosa as a medial flap to cover the raw edges of resected lateral mucosa and soft erectile tissue is initially started as a non-endoscopic procedure. One of the observations by in his series was that over 30% of his patients failed to obtain relief from postnasal discharge and rhinorrhea at one year and more postoperatively. This was attributed to an excessive mucosal preservation, as without an endoscope to guide the resection; the volume of reduction was imprecise **(20)**.

This technique involved making an incision at the anterior inferior turbinate using cold instruments such as sickle knife or micro scissor. The incision was extended downwards and along the inferior surface of inferior turbinate to its posterior end. Using micro-instruments (micro-scissor and/or cutting forceps), the whole lateral aspect of the inferior turbinate mucosa and soft tissue were removed in an anterior to posterior direction. The turbinate bone was dissected off the soft tissue using a freer dissector or micro-scissor to separate it from the medial mucosa of the inferior turbinate, and forceps was used to remove it the resected posterior end of the inferior turbinate was cauterized to prevent postoperative bleeding. Following the removal of bone and lateral mucosa, the medial mucosa was rotated laterally to cover the remaining exposed area of the lateral part of the inferior turbinate (**23)**.

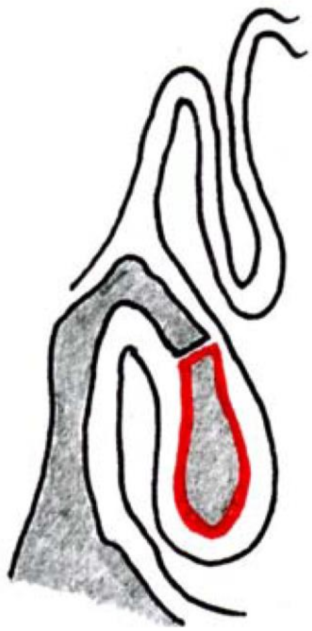

Fig (3): Submucosal resection

As the overlying mucosa is preserved, good mucociliary function is maintained, postoperative complications are rare, and effective symptom relief is achieved **(24)**.

- **Microdebrider-assisted turbinoplasty**:

Powered instrumentation (microdebrider) for submucosal turbinate resection has recently gained a significant amount of attention. The microdebrider is an electrico powered, handheld shaver that operates under suction. The procedure, could be performed under local anesthesia with an endoscope for visualization, it begins with an anterior incision in the inferior turbinate. Next, a submucosal pocket is dissected medial to the bony turbinate and the microdebrider is then inserted into this pocket, where it can be used to remove hypertrophic submucosal soft tissue and bone **(25)**.

Since the superficial mucosa is preserved, mucociliary function remains in good condition and postoperative complications, including bleeding, crusting and synechiae, are rare. Furthermore, this technique also has been shown to produce prompt and durable symptom relief **(26)**.

3-Thermal soft tissue techniques reduction:

Inferior turbinate soft tissue part could be reduced using different thermal techniques, the most common techniques is bipolar electro cautery, and radiofrequency ablation. The idea of these techniques based on creation of thermal injury leading to ultimately fibrosis and reduction in the size of the turbinate **(27)**.

- **Laser Therapy:**

The lasers commonly used for inferior turbinate reduction are diode and CO2 lasers. Other type of lasers such as Neodymium-doped: yttrium aluminum garnet (Nd-YAG), Holmium: YAG, potassium titanyl phosphate (KTP), and argon plasma lasers have been reported. Laser-assisted turbinate surgery causes sub-mucosal scarring with obliteration of the venous sinusoids; thus, it could shrink turbinate tissue with subsequent relief nasal obstruction **(28)**.

Lasers produce a beam of coherent light that is absorbed by the tissues; the extent of absorption and depth of tissue ablation depends on its wavelength. Its diameter depends on the spot size of the laser beam. Pulsed laser treatment is mostly used instead of a continuous laser beam as the later causes damage in a wider area. A

number of dots or small craters are produced in the mucosa at a distance of 1-2mm. The laser energy can be delivered directly or through an optical fiber **(29)**.
Laser treatment can be considered a useful, cost effective, time saving procedure which can frequently be performed in our patients under local anaesthesia, with short operation time, good results and minor side effects. Also, Laser surgery has the advantages of limited tissue trauma and reduced bleeding **(28)**.
Complications include mild postoperative pain that typically resolves spontaneously and nasal obstruction secondary to crusting and mucosal swelling that often resolves after 2 to 3 weeks **(30).**

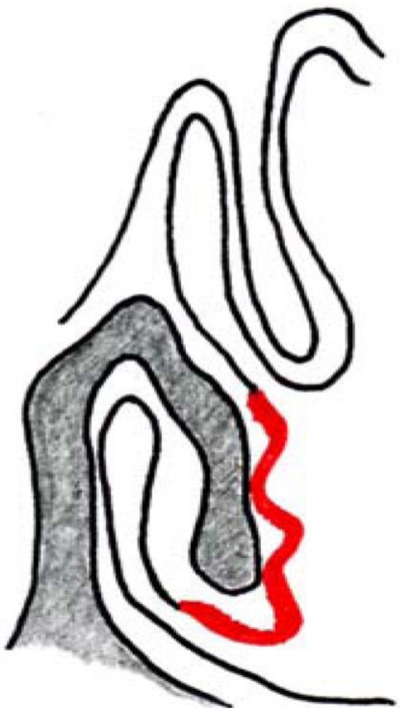

Fig (4): Laser surgery of the inferior turbinate (31)

- **Electrocautery:**

The Electrocautery method was first used a galvanic current. The standard technique consisted of coagulating from posterior to anterior two parallel lines into the medial wall of the turbinate. The heat coagulates the tissues, causing necrosis, which is followed by fibrosis and shrinkage of the turbinate. Bleeding was rare, temporary complaints of crust formation were developed. Over the years, various types of galvano caustic instruments have been developed. Later, high-frequency surface diathermy was introduced. This technique was applied to destroy the tissues over a wide area or to achieve linear coagulation. The procedure is could be used in cases of mucosal and sub mucosal swelling especially after testing the ability of the mucosa to decongest with topical vasoconstriction application **(32)**.
Surface electrocautery is obviously a destructive procedure. It causes mucosal atrophy, metaplasia, loss of cilia, and impairment of mucociliary transport. Permanent crusting and synechiae between the septum and turbinate may occur. Although it is known to have these undesirable effects it is still one of the most practiced methods. Coblation ('controlled ablation') was a quite recently introduced method of high frequency bipolar diathermy. As the effect is achieved at low temperatures, damage to the neighbouring tissue is said to be minimal **(32)**.
Other disadvantages of electrocautery include the lack of nasal function preservation and poor long-term outcomes when compared with other surgical techniques **(27).**

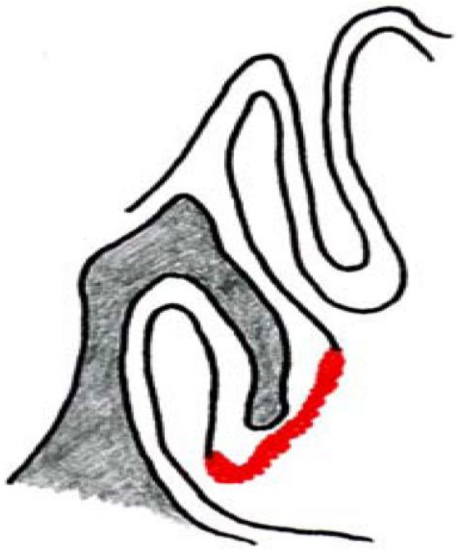

Fig (5): Electrocoagulation of the inferior turbinate (31)

- **Intraturbinal coagulation:**

Because surface electrocautery does produce considerable damage to the mucosa, intraturbinal thermocoagulation was introduced. It was buried that a gold needle in the turbinate and then ran a galvanic current through it for several seconds. It was described that a similar submucosal technique. Later, high-frequency diathermy was introduced. It was reported that the use of a unipolar electrode to make a submucous linear burn. It was reported that for the first time reported on bipolar intraturbinal diathermy. Through an anterior puncture, the two parallel wires were buried in the length of the turbinate. Then 2-4 mm-deep parallel horizontal grooves were burned into the turbinate tissue in a postero-anterior direction. After World War II, It was again reported that on submucous diathermy. Like Hurd, they both used a bipolar electrode to ensure an accurate prediction of the current. Simpson and Grooves advocated using a unipolar electrode, as a single wire would be easier to position. The effect of submucous diathermy is achieved by coagulation of the venous sinusoids within the turbinate, leading to submucosal fibrosis **(33)**.

The method has several drawbacks. First of all, the amount of deep tissue reduction is difficult to dosage. Secondly, its effect is often limited or temporary, so that the procedure has to be repeated. The most common complications are delayed haemorrhage, prolonged nasal discharge and crusting. In spite of these disadvantages, submucous diathermy is still is the treatment of choice for many ENT doctors, simply because it is easy to perform and causes relatively few complications **(34)**.

- **Radiofrequency ablation (RFA):**

Radiofrequency energy has been used for many years to ablate tissue in a variety of medical fields. Start of investigation of the efficacy of radiofrequency tissue ablation with thermo couples electrode in treatment of obstructed sleep disordered breathing. 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 **(35)**.

It 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 adjacent tissues **(26)**.

RFA 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 **(36)**.

The main advantages of RFA that it can be performed in-office under local anesthesia, safety low morbidity, no nasal packing required, has little risk of mucosa destruction, thus preserving the mucociliary function and it may be performed selectively in a pediatric population. While the Complications include mild postoperative pain that typically resolves spontaneously and nasal obstruction secondary to crusting and mucosal swelling that often resolves after 2 to 3 weeks **(30)**.

- **Cryosurgery** :

It was introduced by Ozenberger in 1970. Turbinate is frozen under local anaesthesia 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 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. The amount of volume reduction is hard to predict. So it is gradually abandoned as a technique for turbinate reduction **(37)**.

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