REVIEW ARTICLE

Surgical reduction of hypertrophied inferior turbinate: a review and critical analysis of different techniques

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Abstract:
Purposes: Multiple new and old surgical techniques are available for treatment of hypertrophied inferior turbinate. Current study is an up-date which reviews and evaluates merits and demerits of all these procedures in the light of publications.
Summary: One of most common causes of chronic nasal obstruction is hypertrophied inferior turbinates. More than a century had passed in attempting and trying to indentify the gold standard of treatment of this problem. Electric Cautery, LASER, Chemocautery, Cryotherapy and Lateral fracture; all techniques damage the mucosal lining which has a few unacceptable consequences. Sub Mucosal Diathermy fulfills the requirement of restoration of nasal patency as well as reduction in size of turbinates with out disturbing the mucocilliary function of nose. Radiofrequency and power assisted turbinoplasty are equally effective. Well designed evidence based prospective comparative valid studies are required to decide the best technique.

Keywords: hypertrophied inferior turbinate,

Introduction:
Nasal obstruction is major problem for the patients and surgeons. One of the major causes of chronic nasal obstruction is hypertrophy of inferior turbinates[1, 2, 3]. Its proper management is still debatable. In allergic rhinitis and vasomotor rhinitis, hypertrophied turbinates are generally treated by steroids, antihistamines and decongestant drugs. Failure of pharmacotherapy will route to surgical options of reduction in volume of turbinate. Several techniques are available for this purpose but almost all of them cause complications like bleeding, atrophic rhinitis, dryness of nose and synachae [4, 5, 6, 7]. The gold standard of treatment of hypertrophied inferior turbinate is still missing. Advantages and disadvantages of different techniques are still debatable. This article reviews and evaluates eleven techniques, new and old, a few of them abandoned and a few reintroduced again in last 130 years.

Physiology of inferior turbinates:

Inferior turbinate is almost 7.5 centimeter long shelf like projection at the lateral wall of nose. This independent bone is covered by parenchyma, submucosa, mucosa and pseudo stratified ciliated columnar epithelium containing numerous goblet cells. Submucosa contains large number of secretary cells mainly serous glands. Mucous membrane has sinusoids located in between the capillaries and venules. Approximately 50% resistance of inspiratory air flow is provided by inferior turbinate at the level of valve of nose. If it increases, intra thoracic pressure will increase and ultimately increase in negative intrathoracic pressure will lead to decrease venous flow toward heart and lungs[7]. Inferior turbinates play an important role in control of air way, olfaction, humidity and temperature regulation and resonance.

Evaluating criteria:
Evaluating criteria of reduction methods should be uniform for every method of reduction in size of hypertrophied inferior turbinate. Its basics principle is restoration of nasal patency at the end of surgery. Over reduction may produce

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wide cavity but functional improvement is some thing else. The second important point is the minimal damage to mucoucillia with preservation of function. Complications caused by the reduction technique should also be considered a parameter. In the light of above mentioned criteria, analysis and evaluating is written in chronological order. The methods are under discussion are listed in Table 1.

Thermal coagultiont-electrocautry:

In 1845 Heider from Vienna and Crusel from St. Peterburg introduced this method of treatment of hypertrophied inferior turbinate. Its popularity increased after reports of Middeidorpff (1854). After introduction of cocaine as local anesthetic agent, acceptability of this treatment was increased. In 1880 electrocautery was used commonly. Nasal reflex neurosis was noted and reported[8]. In 1890, electrocautery was criticized at World Congress in Berlin. For the purposes of superficial electrocautery Galvanic current was used[9]. Coagulation from posterior to anterior in two parallel furrows was standard method. In 1922 high frequency diathermy was introduced[10]. Neres had been inserting a gold wire in the turbinate and applied galvanic current[11]. Surface electrocautery causes damage to mucoucillia, mucosa and parenchyma. Atrophic rhinitis, crust formation, synachae, bleeding and impairment of mucoucilliary function were common complaications[12]. In spite of number of complications and destructive procedure, sub mucosal diathermy method is still used not only in Otorhinolaryngology but also in other disciplines of medical practice but sometimes may cause loss of inferior turbinate due to necrosis[13]. Monopolar diathermy replaced the galvanic current electrocautery[14]. It was the start of intraturbinal electrocautery, of which present form is Sub Mucosal Diathermy. Initially tow parallel wires were inserted into turbinates 2-4 millimeter deep and current was applied in posterio to anterior direction[15]. A few decades ago, application of single wire at two places became popular because it was easy to perform.

New development in surface electrocautery is Coblation (Controlled Ablation) in which high frequency Bipolar diathermy is used. Bipolar is easy to control. Advantages of new methods are less bleeding, less damage to surrounding tissues, low temperature and controlled coagulation[16]. To view the sites of specific areas of gross hypertrophy of inferior turbinates, and Endoscopes are used along with the Bipolar Electrofulguration.

Chemical Cautery/ Chemocautery/ Chemo coagulation:

In this controversial technique, saturated Trichlor acetic acid is applied topically at hypertrophid inferior turbinate[17]. It was started in last decade of 19th century. Many surgeons were advocating it but microscopic studies revealed necrosis of mucosa[18]. It was successfully used for volumetric reduction of inferior turbinates but at the cost of burning sensation, excessive slough formation, crust, bleeding, atrophic rhinitis and synachae. Gradually it lost its popularity but from last few yeas again surgeons have started its therapeutic use[17]. Muhammmd javed aslam et al. used 20 % silver nitrate solution for topical use instead of Trichlor acetic acid and advocated its use because of cheap, effective and applicable under local anesthesia[19]. There is no historical report of use of silver nitrate for reduction in size of inferior turbinates; however it was under use as apart of ointment for burn patients[19]. Improvement in symptoms varies from 70-90% [20-23].

Turbinectomy

Surgical trimming of inferior turbinates is one of the commonly method used by surgeons[24]. Jarvis first time described this procedure in 1882[25]. Jones and Holmes were in favor of total turbinectomy[26, 27]. Still surgeons are using this procedure[28]; although its opposition was started from the start of this method[29]. Hypertrophy is because of swelling of sub mucosa; not because of enlargement of bone[30]. Curved turbinate scissors were used for turbinectomy. One blade was inserted below the inferior turbinate and other on the top after fracture of inferior turbinate. Bone along with soft tissue was removd[31]. Disadvantages of this irreversible technique were multiple including dryness, crust, bleeding,

synachae, pain, headache, foul smell and atrophic rhinitis [31-38]. Total or partial Turbinectomy reduces the volume of inferior turbinate but it does not preserve the function of nose. Moreover because of number of complications; this technique can not be recommended[2]. Endoscopic reduction of inferior turbinate is helpful to reduce the complications. The major role of endoscopic surgery is the precise and delicate removal of pathology with minimum trauma, bleeding crust and scar formation[39].

Lateralization/lateropexia

Killian was the pioneer of lateralization of inferior turbinate in 1904. The purpose was to avoid the complications of turbinectomy. The turbinate was out fractured and displaced laterally into maxillary sinus with the help of kallian's nasal speculum. It has tendency to resume its original position[40].

Lateropexia is the name of technique of displacement of fractured inferior turbinate into maxillary sinus after removal of part of lateral nasal wall[41]. Lateralization of inferior turbinate gives better results along with sub mucous resection[42], radiofrequency[43], sub mucosal diathermy and sub mucosal bone resection[44].

Sub mucosal resection of turbinate:

To avoid the complications of turbinectomy, alternate technique of sub mucosal removal of turbinate/ bone was adopted. Freer and other surgeons did experiments. Results of technique were not convincing. Later on, sub mucosal resection along with lateral displacement was introduced named tulbinoplasty[42]. Freer has modified this procedure in 1911. Sub mucosal bone resection along with lateral displacement was considered better[44].

Vidian neurectomy:

It was introduced by Golding Wood to control the hyper secretion and stuffiness of nose by cutting the vidian nerve through transnasal approach[45]. This method was abondonded with in next few years.

Cryosurgery:

1n 1970, Ozenberger introduced the method of cryosurgery in which nitrous oxide or other cooling agents were applied on turbinate under local anesthesia[46]. Turbinate was frozen in to an ice ball. Then after thaw, the necrotic sloughed turbinate was shed after micro thrombus formation followed by ischemia. It was not precise in control. Surgeons started to use this technique[47, 48] but benefits to patients were not long term. Short term contact of nitrogen and tissue at -70^0C causes denaturation of cells. Cryoprobe is of applied on turbinate at 2-4 points for duration of 90-120 seconds[49]. It can be performed as an outpatient procedure with excellent acceptance in patients[50] and does not require electricity. So load shedding does not become a problem in treatment of patients. Effectiveness is directly proportional to duration of application, area of therapy, and repeating the session. Chassone noted the success rate 83%[51]. Combination of cryosurgery and septoplasty gives excellent results. Haight et al noted that cryosurgery was effective in those patients where response to steroid was well[52]. Complications like bleeding were comparatively less. Over all it was safe and effective procedure but long term results were not sustained [53, 54]. However results were improved with repeated application[55]. A marked improvement was not possible immediately. Subjective improvement was taking a month or more. This technique was gradually abondonded. It was not precise and result oriented on long term basis[56].

Patial resction – crushing – trimming:

Partial resection of inferior turbinate means resection of a part of it; may be anterior part, posterior part and crushing, horizontal or diagonal resection. This technique replaced the total turbinectomy. In 1930 crushing method with blunt instrument was started by Kresner[4]. Posterior resection was introduced by Proetz[57] in 1953 and anterior resection by Goode[40], Pollock[58] and other surgeon. Maximum nasal obstruction was at anterior end of inferior turbinate, so its reduction was more effective and fruitful[59].

Horizontal resection was advocated by Cour-

tiss and Goldwyne[60] while diagonal resection by Spector[61]in which more than half turbinate had to be removed preserving functionally important head of turbinate.

Horizontal resection improves the air flow but deteriorate with passage of time[62, 63]. Scab and crust were not uncommon and foul odor was consequence of dead necrotic tissue[64, 65]. Bleeding was also common in this surgery[66].

Turbinoplasty:

It was not possible to save the mucosal lining of inferior turbinate almost in all types of surgical reduction in size of inferior turbinate. Considering the complications of mucosal damage, surgeons started to use an L-Shape flap of mucosal lining of inferior turbinate[67, 68]. Originally Freer in 1911, described this procedure[69]. The term Turbinoplasty was introduced in 80s by Marby[70]. Parenchyma and part of bone is removed after elevation of flap with incision at lateral inferior margin. In another technique 'partial inferior turbinoplasty', two incisions are used which join in centre of inferior turbinate and wedge shape piece of parenchyma is removed[71]. Removal of parenchyma with preservation of function is best in intraturbinal turbinoplasty in which bleeding and crust formation is minimum[44]. Introduction of endoscopic technique of nasal surgery offered better visualization of operative field[72]. Recent and latest advancement in this field is microdebrider[73, 74] assisted and radiofrequency assisted turbinoplasty[75-77]. Microdebrier assisted turbinoplasty is more effective in relieving the nasal obstruction as compare **with radiofreqency assisted turbinoplasty78.**

Laser surgery:

Laser technology was used in 1977 by Lenz who applied Argon laser to reduce the inferior turbinate[79-80]. CO_2 [81, 86], Neodymium-YAG laser[84], Potassium-Titanyl Phosphate (KTP) laser[87, 88], Diode laser[89, 90], and the Holmium-YAG laser [91, 92, 93] was introduced in next few years. CO_2 laser became rapidly popular among all these available lasers[84, 85, 93, 94]. Laser produces a beam of coherent light in which all the waves are of same wave length and travel in same direction and in same phase, upwards or downwards. Depth of tissue penetration depends upon wave length. In CO_2 temperature rises up to 500 degree Centigrade. When it reaches at 60 degree, all proteins in cell coagulate and when it reaches at100^0, water present in cells will evaporate and remained tissue will be burnt in to charcoal. Mode of application may be continuous or pulse. Pulse mode is more acceptable because of less tissue damage and less affected tissue area. Its power ranges from 0 to 30 W. More power means more tissue damage. Low power does not produce coagulation. High power may cause severe destruction. CO_2 laser seal all small vessels and nerves, so bleeding and pain is minimum with laser. CO_2 laser energy is delivered directly as compared to others which are delivered through optical fiber (KTP, Nd-YAG, Diode, Ho -YAG). The main negative point of carbon dioxide laser is that optical fiber can not be used. It can not reach at posterior end of inferior turbinates. To overcome this problem swiftlase apparatus was introduced[95]. Later on nasal probe UniPulse delivery system associated with nasal endoscope was introduced which provide better access to posterior end of inferior turbinate, fine precise ablation and minimum char[96].

Laser surgery reduces the volume but functional preservation of is controversial. Epithelial regeneration is limited but seromucinous glands and cavernous blood spaces decrease permanently [85, 94]. Endoscopic carbon dioxide laser turbinoplasty with special endonasal delivery system improves the results as compared with conventional CO_2 laser which can be operated under local anesthesia as a day care procedur[96]. Nazik and Nafie has recommended Nd–YAG turbinoplasty as an alternative method as compared with functional endoscopic turbinoplasty and conventional partial turbinectomy[97].

Argon laser is an ion laser of which wavelength is 0.42-0.52 micrometer. Penetration depth is 1-28 mm. In between argon laser applicator and tissue a hot arc of up to 3000^0C forms and produces thermo coagulation. It occurs with out contact of tissue. The distance of 2-10 mm is maintained between tissue and applicator.

Diode laser is less expensive to acquire and handling of instrument is also easy. Nd: YAG laser is so-called solid state laser. Laser light applicator requires flexible light cable. Contact and non-contact type may be selected.

Powered instruments:

Powered instruments were introduced in 70s as Shavers/ Microdebrider[98]. Microdebrider can be used on surface as well as for intraturbinal reduction with or with out endoscope. Powered endoscopic turbinoplasty is safe, simple, effective and minimal invasive technique[99]. Intraturbinal resection with Microdebrider is fast, effective, well tolerated and of low morbidity[100]. The damage of mucosal lining at surface is comparatively less in intraturbinal reduction with Microdebrider. Preservation of function is better in Microdebrider assisted than conventional/ endoscopic methods.

Radiofrequency:

This technique was introduced in 90s. Principal of this method is high frequency current application in tissue. Damage to bone is avoided. Probe is placed in centre of parenchyma at sufficient distance away from surface to prevent the damage of mucous membrane[101]. Temperature inside the tissue is controlled close to 75 degree Centigrade. Operation can be performed under local anesthesia. An applicator needle with thermo element is introduced in tissue which measures the temperature[16]. It is comparatively more effective and better in terms of functional preservation[102, 103]. This surgical procedure is safe and effective with minimal discomfort to patient and does not alter nasal mucosa[104].

Conclusion:

It is unfair to draw a firm conclusion and decision about best technique and method until and unless a prospective, comparative study in not being conducted. There are advantages and disadvantages in every technique. There is need of well designed prospective comparative study for evidence involving data collection, statistical analysis and long term monitoring[105].

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