DISSERTATION ON

A COMPARATIVE STUDY FOR THE ANALYSIS OF OUTCOME IN CASES OF INFERIOR TURBINATE HYPERTROPHY BY VARIOUS METHODS OF TURBINOPLASTY.

Dissertation Submitted To

THE TAMILNADU Dr. M.G.R MEDICAL UNIVERSITY,

In partial fulfillment of the

rules and regulations, for the award of the

M.S. DEGREE IN OTORHINOLARYNGOLOGY

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THANJAVUR – 613004

THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY

CHENNAI – 600032

APRIL - 2017

CERTIFICATE

This is to certify that dissertation entitled **A COMPARATIVE STUDY FOR THE ANALYSIS OF OUTCOME IN CASES OF INFERIOR TURBINATE HYPERTROPHY BY VARIOUS METHODS OF TURBINOPLASTY** is the bonafide record of work done by **DR.N.JAGADEESH**, for Degree of Master of Surgery (Otorhinolaryngology) to Tamilnadu Dr. M.G.R Medical University,Chennai is the result of original research work undertaken by her in the department of **ENT And Head and Neck surgery** Thanjavur Medical College, Thanjavur during his Post Graduate Course from 2014 – 2017 . This is submitted as partial fulfillment for the requirement of M.S. Degree Examinations – Branch IV (Otorhinolaryngology) to be held in April 2017.

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A COMPARATIVE STUDY FOR THE ANALYSIS OF OUTCOME IN CASES OF INFERIOR TURBINATE HYPERTROPHY BY VARIOUS METHODS OF TURBINOPLASTY

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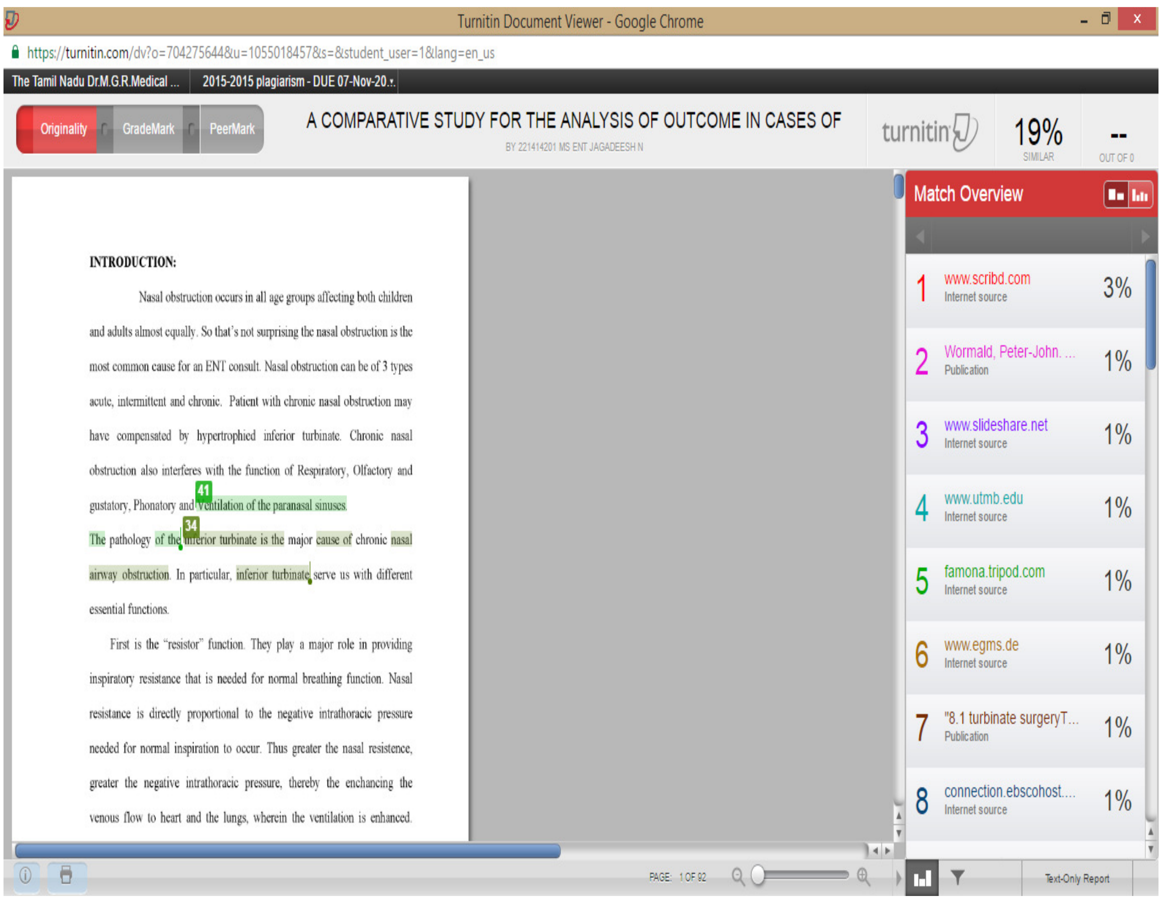
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INTRODUCTION:
Nasal obstruction occurs in all age groups affecting both children and adults almost equally. So that's not surprising the nasal obstruction is the most common cause for an ENT consult. Nasal obstruction can be of 3 types acute, intermittent and chronic. Patient with chronic nasal obstruction may have compensated by hypertrophied inferior turbinate. Chronic nasal obstruction also interferes with the function of Respiratory, Olfactory and gustatory, Phonatory and ventilation of the paranasal sinuses.
The pathology of the inferior turbinate is the major cause of chronic nasal airway obstruction. In particular, inferior turbinate serve us with different essential functions.
First is the "resistor" function. They play a major role in providing inspiratory resistance that is needed for normal breathing function. Nasal resistance is directly proportional to the negative intrathoracic pressure needed for normal inspiration to occur. Thus greater the nasal resistence, greater the negative intrathoracic pressure, thereby the enchancing the venous flow to heart and the lungs, wherein the ventilation is enhanced.
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DECLARATION

I , **DR.N.JAGADEESH**,, solemnly declare that dissertation titled **A COMPARATIVE STUDY FOR THE ANALYSIS OF OUTCOME IN CASES OF INFERIOR TURBINATE HYPERTROPHY BY VARIOUS METHODS OF TURBINOPLASTY** a clinical study submitted by me is a result of original work carried out by myself under the guidance of Prof. G.Gandhi, M.S.,D.L.O., Head of the Department, Otorhinolaryngology, Head and Neck surgery Thanjavur Medical College, Thanjavur

I further declare that the result of research has not been submitted previously by myself or other persons in any conferences or journals.

Place: Thanjavur **Dr. N.JAGADEESH**

Date:

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CONTENTS

INTRODUCTION

Nasal obstruction occurs in all age groups affecting both children and adults almost equally. So that's not surprising the nasal obstruction is the most common cause for an ENT consult. Nasal obstruction can be of 3 types acute, intermittent and chronic. Patient with chronic nasal obstruction may have compensated by hypertrophied inferior turbinate. Chronic nasal obstruction also interferes with the function of Respiratory, Olfactory and gustatory, Phonatory and Ventilation of the paranasal sinuses.

The pathology of the inferior turbinate is the major cause of chronic nasal airway obstruction. In particular, inferior turbinate serve us with different essential functions.

First is the "resistor" function. They play a major role in providing inspiratory resistance that is needed for normal breathing function. Nasal resistance is directly proportional to the negative intrathoracic pressure needed for normal inspiration to occur. Thus greater the nasal resistence, greater the negative intrathoracic pressure, thereby the enchancing the venous flow to heart and the lungs, wherein the ventilation is enhanced. Second is the "Diffusor" function where inspiratory lamellar flow is converted into turbulent flow.

Increase in turbulence in the outer layers of the air helps to enhance the humidification, cleansing and warming up of the air over the large, richly vascular surface area of the turbinate. Last is the nasal defence system where normally functioning turbinate mucosa, submucosa and parenchyma contributes to cellular and humoral defence mechanism and mucocilliary clearance.

AIMS AND OBJECTIVES

To study and compare the outcome of turbinoplasty of inferior turbinate by using Conventional submucosal resection of turbinate, Microdebrider assisted submucosal resection, Cryosurgery.

To compare the success rate of the surgical procedure of turbinoplasty in relation to improvement in the nasal obstruction.

To compare complication of these surgical procedures in relation to bleeding, crusting, synechiae formation.

REVIEW OF LITERATURE

History of the Procedure:

- **TURBINOPLASTY**

In the 1980s, the term 'turbinoplasty' was introduced (Mabry, 1982, 1984). It covers various methods of intraturbinal surgical reduction of the inferior turbinate with preservation of the mucosa. Recently, several authors have elaborated and propagated methods of intraturbinal reduction of the inferior turbinate (Gray, 1965; Lenders and Pirsig, 1990; Grymer et al., 1993; King and Mabry, 1993; Illum, 1997; and Marks, 1997; Huizing, 1998). After medialization of the turbinate, an L-shaped incision is made at its lateral-inferior margin. A mucosal flap is elevated and part of the turbinate bone and parenchyma is resected, as required.The mucosal flap is then repositioned and fixated. When the resection of bone and parenchyma is restricted to the anterior part of the turbinate, we speak of an 'anterior turbinoplasty'. This technique is applied in patients with inspiratory breathing obstruction due to hyperplasia of the turbinate head.

Another technique is 'partial inferior turbinoplasty'. In this method two separate incisions are made that join in the centre of the concha. A wedge-shaped piece of the turbinate is then removed and the margins of the resulting defect are brought together (Schmelzer et al., 1999). Intraturbinal turbinoplasty allows reduction of the turbinate while all mucosal functions are preserved, as was recently demonstrated by Passali et al. (1999) in their comparative study. A second advantage is its very low incidence of postoperative bleeding and crusting. From the standpoint of 'optimal volume reduction with preservation of function', intraturbinal turbinoplasty is the method of choice in treating turbinate hypertrophy. It is a tissue-reducing procedure and can be tailored according to the pathology without compromising the mucosal function [2],[13],[14],[15].

- Turbinoplasty surgeries were introduced 1982, following which many different methods of turbinoplasty are being done. Powered instruments for the turbinoplasty were being first used during 1994, and radiofrequency by 1998 and argon plasma surgery in 2002. All these turbinoplasty procedures are being done even now [1].

INFERIOR TURBINOPLASTY:

The term "inferior turbinoplasty" goes back originally to Freer, who first published this procedure in 1911[7]. All further publications"gave consideration" to original procedure only with little modifications [8],[9],[10],[11],[12].

The inferior, anterior turbinoplasty is a procedure which restores the mucosa of nasal cavity and also serves to reduce the volume of flowarea in the inferior turbinate. The section zone can be extended posteriorly depending on the case.

CONVENTIONAL SUBMUCOSAL RESECTION:

- The complications of turbinectomy induced several surgeons to look for more conservative surgical methods to reduce the size of the inferior turbinate. Submucous resection of the turbinate bone was the first surgical alternative to be introduced (Low, 1906; Linhart, 1908; Würdemann, 1908; Zarniko, 1910).
- Wurdemann declared himself to be "adverse in nearly every case to a complete excision of the inferior turbinal bodies" and wanted "to prevent disastrous results". A more delicate variant of this new principle was described by Freer in 1911: "a relatively small vertical

incision is made to submucously uplift the covering of the turbinate with a sharp elevator, completing the denudation with a sharp raspatory in this way allowing longitudinal resection of the lower turbinate" . Despite its convincing this technique gained only limited popularity (Strandberg, 1924; Odeneal, 1930; Harris, 1936). In 1951, Howard House revived the method. Good results were later reported by Loibl and Pfretzschner (1972) and Tolsdorff (1981), who combined the method with lateral displacement. Mabry (1982, 1984) further refined the technique and introduced the term 'turbinoplasty'[6]. Following his patients he found the turbinates to be normal in size and function one year postoperatively. In the study by Passali et al. (1999), submucous bone resection combined with lateral displacement was considered the best method in terms of results and preservation of function [5].

- This is true when the results showed only 2% secondary bleeding and less than 1% crust formation [4]. Pollock and Rohlich proved submucosal turbinectomy as the preferred method due to the best longterm results with virtually no complications[3]. Mori et al. said submucosal resection facilitates easy nasal breathing, as well as relieves symptoms of allergic rhinitis.

- A cohort study showed, improved nasal airway when 45 patients of allergic rhinitis are examined and followed up for 5 years. Postoperative anti allergic drugs were not needed for more than 50% of those patients. This success is explained by sectioning of nerve of sphenopalatine foramen which triggers the allergic response in the mucosa.

POWERED INSTRUMENTS:

Recently, powered instruments like 'shavers' have come into use in turbinate surgery (Setcliff and Parsons, 1994). These instruments are used on the turbinate surface as well as intraturbinally, often in combination with the endoscope. It has been claimed that they permit precise removal of soft tissue. Some surgeons resect parts from the lateral and inferior borders of the turbinate, while others use the shaver intraturbinally (Friedman et al., 1999; Van Delden et al., 1999). The technique is said to be fast, effective, and well tolerated and to have a low morbidity (Davis and Nishioka, 1996). The use of powered instruments appears to be a matter of personal preference. It depends not so much on the instrument that is used. Rather, it is the surgical concept that counts in reducing the size of a turbinate.

CRYOSURGERY:

When liquid nitrogen contacts cells at -70 degree celsius, it causes intracellular proteins to undergo denaturation. Also there occurs electrolyte displacement intracellularly. As endothelial cells react in a similar way, microthromboses form in the vessels which cause a disturbance of perfusion with consecutive tissue ischemia [16].

Ozenberger, one of the early advocates of this method, discovered that through the destruction of parasympathetic nerves due to allergic rhinitis, cold like occurrance, in particular can be treated favourably [17].[18],[19]. Allergic rhinitis does seem to profit more than vasomotor rhinitis. Thus patient selection is very important than the selection of the surgery type itself. Bumstead,proved 92% success in 50 cases after a period of two years[20]. Chiossone proved 83% and Hartley proved 50%[21],[22]. The results on a short term basis are satisfactory, yet the successful surgical result is not obtained after a year. Rakover, as well as Rosen, proved 35% satisfaction rate using 50 cases on regular followup[23]. The surgical repetition was hence needed [24]. Cryotherapy is not recommended when methods like turbinoplasty is available to the patient.

Chen YL, Tan CT, Huang HM,during the year Jan 2002 to Dec 2006, conducted a study of 160 patients with hypertrophied inferior turbinate and perennial allergic rhinitis to analyse the effectiveness microdebrider assisted turbinoplasty with lateralization of inferior turbinate(MAITL) with submucosal resection of the turbinate (SR). The study was concluded in favour for inferior turbinoplasty with lateralization, assisted with Microdebrider, which was found to relieve nasal obstruction. Moreover the study also found to relieve decreasing total nasal resistance and saccharin transit times, in the patients for more than 3 years in patients with perennial allergic rhinitis, who had severe nasal obstruction preoperatively [25].

In a study conducted by Lee CF, Chen TA, (Nov 2001 to Dec 2002), in 29 patients with chronic hypertrophic rhinitis treated with powered endoscopic inferior turbinoplasty, and followed up for an average of 15.3 months after surgery. Overall improvement in nasal obstruction was 91%. Average nasal airflow was increased, secondary atrophic rhinitis and permanent synechiae had not been observed. They concluded that Power endoscopic turbintoplasty is a safe and effective method for treatment sinosurgery and appears to provide a surgical choice of a minimally invasive technique of chronic hypertrophic rhinitis, specially handy in adjunct to endoscopic septoplasty[26].

Yañez C and Mora N, conducted a prospective cohort study on 350 patients (From June 1994 to October 1996). The study was aimed at to evulate the efficacy and long-term outcomes of the submucous stroma debriding technique (SSD) in patients with nonallergic chronic inferior turbinate hypertrophy. On follow-up, long-term improvement were documented by anterior rhinometry, nasal endoscopic evulation and mucociliary transit time. They concluded that the long-lasting effects and ciliated epithelium sparing was fulfilled by SSD method [27].

A prospective study done byHuang TW, Cheng PW, on 50 patients between May 2004 to July 2004 with perennial allergic rhinitis who had substantial mucosal hypertrophied inferior turbinates. All patients underwent endoscopic microdebrider -assisted inferior turbinoplasty with follow-up 1 year after surgery. Observations showed that endoscopic microdebrider-assisted inferior turbinoplasty is effective for decreasing nasal resistance. It also showed improvement in the quality of life in patients with perennial allergic rhinitis who have substantial nasal congestion[28].

Friedman M, Tanyeri H, Lin J, Landsberg R, Caldarelli D, studied 120 patients with nasal obstruction due to enlarged turbinates who underwent submucous inferior turbinate resection using microdebrider.

They noted that microdebrider allows precise and incremental tissue removal, preserving the mucosa, therby preventing complications associated with inferior turbinate surgery. They concluded that microdebrider submucous resection of inferior turbinates is a safe method for achieving turbinate size reduction [29].

EMBRYOLOGY OF THE NOSE:

The structures of the nose develop from three different embryonic tissues i.e, the ectoderm, the neural crest, and the mesoderm.

During the fourth week of gestation, the development of the nose is commenced, by caudal migration of the neural crest cells towards the midface - the developmental precursors of the nose - neural crest cells. Five different and identifiable primordial tissues surrounding the stomodeum. The five structures are

1. Frontonasal prominence,
2. Right and left maxillary prominences,
3. Rightr and left mandibular prominences.

Initially, two epithelial thickenings called “Nasal placodes” appear on the head. Each placode is bounded by a medial nasal prominence medially and a lateral nasal prominence laterally. The placodes deepens by virtue of overgrowth of the mesenchyme of these prominences and form the “olfactory pits”. As the pits deepen to form the nasal sacs, the maxillary processes grow medially and meet the lateral nasal processes on each side, thus demarcating the primitive nasal cavity.

The two medial nasal folds merge and form the "frontonasal process". Its upper and anterior end forms the primitive nasal septum. The free lower surface forms the primitive palate. A "bucconasal memberane" seperates the primitive nasal cavity from the primitive oral cavity which later ruptures and forms the primitive choanae one on each side of the midline.

Later, the secondary palate grows and the choanae move to a more posterior location at the junction of the nasal cavity and oropharynx, thus forming the "definitive choanae". (***Stammberger, 1991***)***, (Szolar et al., 1994; Von Alyea, 1941).***

EMBRYOLOGY OF TURBINATE:

A serial of elevations appear on the lateral wall of nose from sixth fetal week which ultimately form the turbinate. The most inferior or maxilloturbinal forms the inferior turbinate. The middle, superior and supreme turbinate result from the reduction of ethmoturbinal complex. (***Stammberger,1991***).

THE LATERAL NASAL WALL: (FIG 1)

The lateral nasal wall is formed by eight separate bones, each of which has processes that articulate intricately with each other. There are four large bones and four small bones.

Large bones are

1. The maxilla,
2. The ethmoid,
3. The frontal,
4. The sphenoid.

Small bones are

1. The inferior turbinate,
2. The lacrimal bone,
3. The palatine bone,
4. The nasal bone.

Of these the frontal, ethmoid and sphenoid are single unpaired bones in the midline of the skull. The others are paired ones. Hence,although there are two sphenoid, two frontal and two ethmoid sinuses, there is only a single sphenoid, frontal and ethmoid bone.

THE MAXILLA:

The maxilla forms the base or the framework on which the lateral nasal wall is built. The lateral nasal wall ia formed by medial surface of the maxilla. The maxillary sinus opening is small and not easily seen. This is because the large opening in the maxillary bone is closed off by processes of different bones, which narrow the opening. These processes are

a. The descending process of the lacrimal bone anteriorly
b. The uncinate process of the ethmoid bone anterinferiorly
c. The maxillary process of the inferior turbinate inferiorly.
d. The perpendicular plate of the palatine bone posteriorly.

Certain areas are covered by only a double layer of mucosa of the nasal cavity and the maxillary sinus. These are the anterior and posterior fontanelles. Occasionally,these double layer of the mucosa may be dehiscent to produce accessory ostia. The normal maxillary ostium is hidden deep behind the intermediate portion of the uncinate process.

Anterior to the maxillary hiatus, the maxillary bone is drawn in to a process, which extends superiorly. Since the upper border of this process articulates with frontal bone and the anterior border articulates with the nasal bone, this process is called the frontonasal process of maxilla. The medial surface of this process shows two crests. The upper one is the ethmoidal crest. The most anterior part of the middle turbinate is attached to this ethmoidal crest. The lower crest is called the conchal crest and gives attachment to the inferior turbinate. The smooth area below the conchal crest forms the part of the inferior meatus [41],[42].

THE INFERIOR TURBINATE:

The inferior turbinate is a separate scroll-like bone. Unlike the middle and superior turbinates, it runs a fairly straight course from anterior to posterior. It is approximately 60mm length in anterior to posterior direction. It forms an important component of the nasal valve. It is derived from the maxilloturbinal ridge. Its inferior margin is free and overhangs the inferior meatus. Its superior margin is attaced to the maxilla anteriorly and the palatine bone posteriorly. Approximately 1cm behind its anterior end, superior margin shows a peak or apex. The nasolacrimal duct opens in to the inferior meatus at this peak [43],[45].

PROCESSES OF INFERIOR TURBINATE (FIG 2)

The inferior turbinate has three processes.

1. Lacrimal process
2. Ethmoidal process
3. Maxillary process

LACRIMAL PROCESS

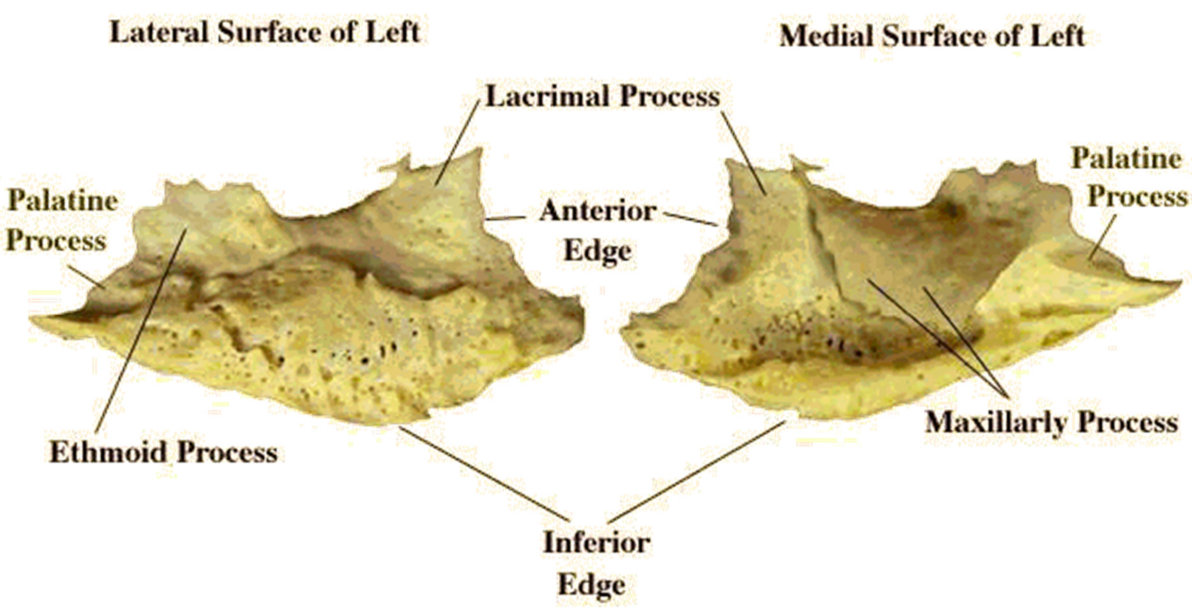
It is present anteriorly from its superior margin. The lacrimal process articulates with the descending process of lacrimal bone and thus assists in forming the canal for the nasolacrimal duct.

ETHMOID PROCESS

This is little behind the lacrimal process arising from near the superior margin. It articulates with the uncinate process of the ethmoid bone. Thus to recapitulate, the uncinate process is attached to the lacrimal bone at its anterior end and to the inferior turbinate posteriorly.

Fig 1: LATERAL WALL OF NOSE

Fig 2: INFERIOR TURBINATE BONY OUTVIEW



MAXILLARY PROCESS

The maxillary process arises from the superior border but it curves laterally to attach to the maxilla. It closes off part of the maxillary hiatus and forms part of the lateral wall of the inferior meatus.

NASAL VALVE

There are two nasal valve areas.

a. External nasal valve
b. Internal nasal valve

EXTERNAL NASAL VALVE

Boundaries

- Lower lateral cartilages
- Soft tissue alae
- Membranous septum
- Sill of the nostril.

INTERNAL NASAL VALVE

Boundaries are

- Septum
- Upper lateral cartilages
- Anterior end of inferior turbinate.

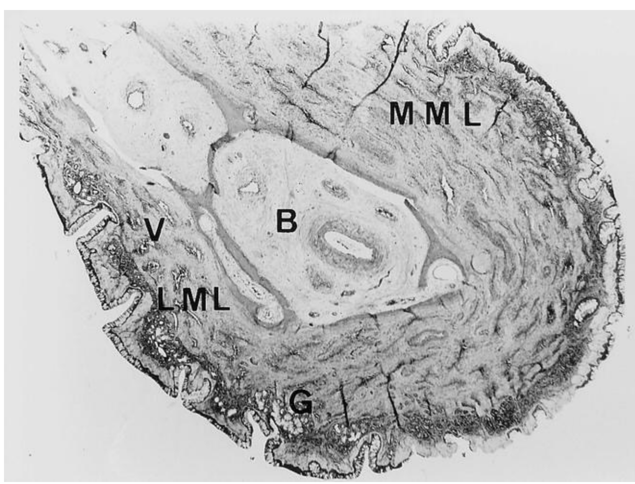
It is approximately 1.3cm from the external nares. It accounts for 50% of airway resistence. Inferior turbinate can affect this area greately[32],[33].

HISTOLOGY(FIG 3)

The inferior turbinate has three layers.

- Medial thin mucosa
- Bone
- Lateral thick mucosa

FIG 3: HISTOLOGY OF TURBINATE MUCOSA



MML - Medial thin mucosa

B - Bone

LML - Lateral thick mucosa

NASAL MUCOSA

The mucosa is lined by pseudostratified columnar ciliated respiratory epithelium. The mucosa contains complex array of arteries, veins, and venous sinusoids. The goblet cells are present densely all over the inferior turbinate. The goblet cells produce salts, glycoproteins, polysaccharides, lysozymes.

Nerve supply of nasal cavity

a. Olfactory nerves.

Olfactory nerves are the nerves involved in carrying smell sensation. The region supplied by olfactory nerve includes olfactory region of nose. These nerves pass through the cribriform plate in the form of 12 - 20 nerves and complete their course into the olfactory bulb of the frontal lobe.

b. Nerves of common sensation

They are

i. **Anterior ethmoidal nerve**
ii. **Sphenopalatine ganglion and its tributaries**
iii. **Infraorbital nerve and its tributaries**

Lateral side and medial side of the vestibule of the nose is supplied by the Infra orbital nerve and its tributaries. Sphenopalatine foramen located at ganglion which supplies the posterior thirds of the nasal cavity. Antero-superior portion of the nasal cavity is supplied by the Anterior ethmoidal nerve.

c. Autonomic nerves

Nasal secretion is under the control of parasympathetic nervous system. They supply the nasal glands. They are the branches of greater petrosal nerve, and they pass as vidian nerve through the canal of Pterygoid and finally reach the sphenopalatine ganglion before supplying the glands of nasal cavity and vessels to produce vasodilation. Incontrast, sympathetic nerve fibres do not relay in the sphenopalatine ganglion. They originate from upper two cervical ganglions of the spinal cord of the thoracic segments and travel through the superior cervical ganglion before entering the deep branch of petrosal nerve, which joins with the parasympathetic fibres of the greater petrosal nerve to finally supply the nasal cavity by forming nerve of the pterygoid canal. they are involved in vasoconstriction. Thus Vidian neurectomy serves by reducing secretions from nasal cavity in cases of excess rhinorrhea and allergic rhinitis. [45],[46][47][48]

LATERAL NASAL WALL AND ITS BLOOD SUPPLY (FIG 4)

Internal carotid artery and its supply

1. Anterior ethmoidal artery
2. Posterior ethmoidal artery

Both are ophthalmic artery branches.

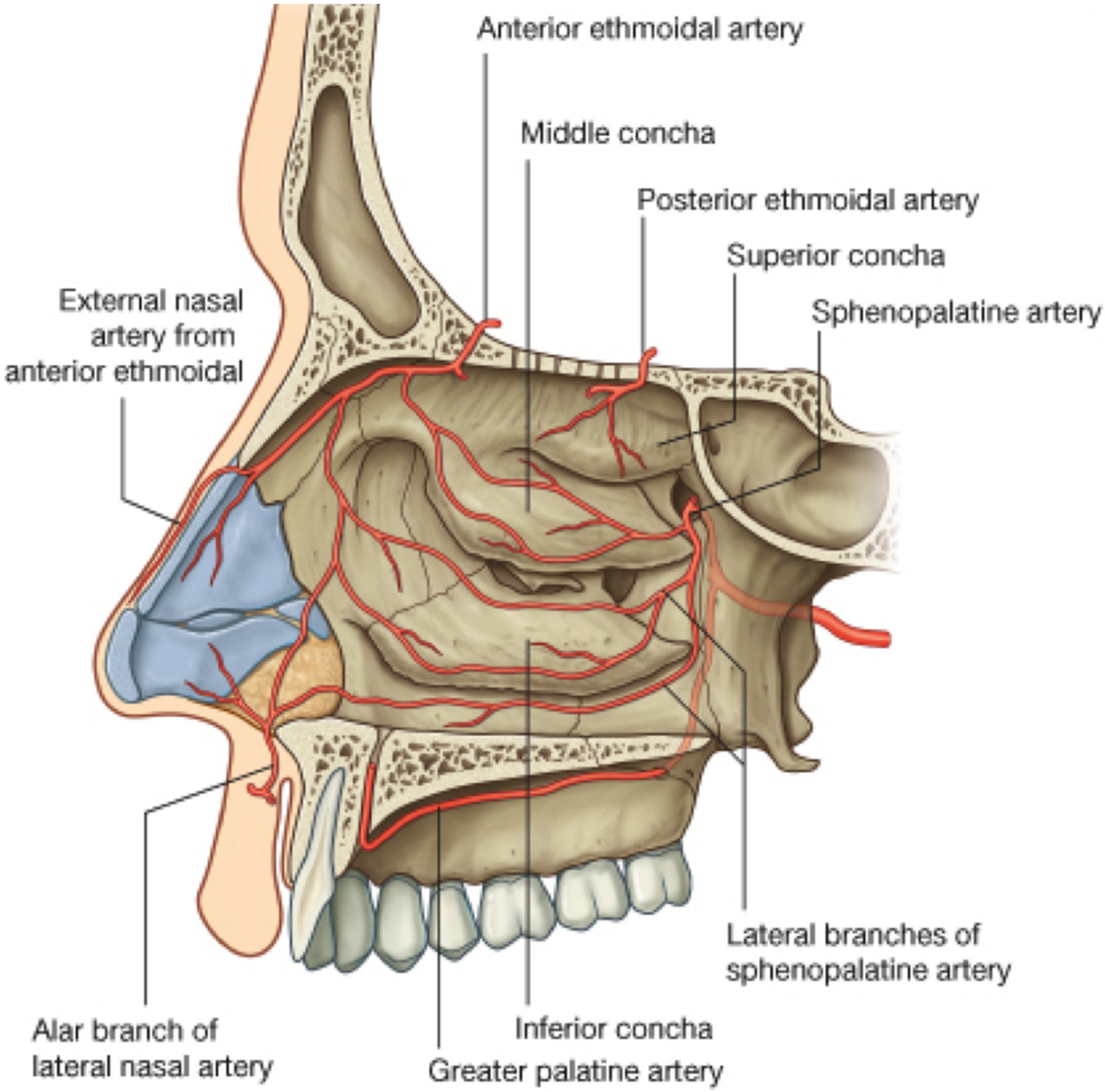
External carotid artery and its supply

1. Sphenopalatine artery branches to form Posterior lateral nasal artery,
2. Maxillary artery branches to form Greater palatine artery,
3. Nasal branch of anterior superior dental artery which is formed from the infra orbital branch of the Maxillary artery,
4. Branches of facial artery to vestibule of nose.

LYMPHATIC DRAINAGE

Anterior and external nose is drained in to the submandibular group of lymphatic nodes, while the upper jugular nodes drain the rest of the nasal cavity. Lymphatics of the upper part of nasal cavity communicate with subarachnoid space along the olfactory nerves.

Fig 4: LATERAL WALL OF NOSE – BLOOD SUPPLY



PHYSIOLOGY OF THE NOSE

Nasal cavity remains the common entry pathway both to the olfactory epithelium as well as to the upper respiratory tract[34] .

Functions of the nose related to turbinates

a. Airway
b. Filtration – most particles greater than 30 micrometer
c. Heating – to 31 – 37 degrees
d. Humidification – to 95%

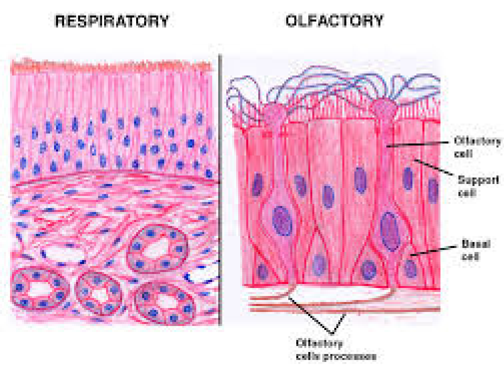
RESPIRATORY MUCOSA (Fig 5)

The pseudostratified respiratory mucosa consists of ciliated, intermediate, basal, and goblet cells. They rest on a well-defined basement membrane supported by a relatively deep, loose lamina propria containing small blood vessels, venous plexuses, ducts of mucous and serous glands, sensory nerves, and blood cells (primarily lymphocytes). The venules and the capillaries located in the lamina propria are thin walled with fenestrated endothelial lining.

The tall (15 to 20 microns) ciliated columnar epithelium is the predominant cell and extends from the basement membrane to the luminal surface, where cilia along with fine hair like microvilli are seen. The microvilli are branching structures and appear shorter than the cilia. The microfilaments form the basic structure of the microvilli. The function of the microvilli is unknown, but they are found to be involved in the physiology of providing increased cell surface area. The ciliated cell cytoplasm exhibit complex digitation with near by cell membranes, presumably to permit intercellular exchange. Complex intercellular spaces are located to accommodate edema and cells of immune system for providing immune response.

The columnar cells and goblet cells are thought to be derived from the basal cells of the epithelium which rests on the basement membrane. The progenitor for the ciliated cell appear to be a non ciliated cell. Goblet cells and columnar cells are situated over the basement membrane with the microvilli projecting over the luminal side. Both the cells have basally located nucleus and apical mucin vacuoles towards the luminal surface. They are bound to near by cells through interdigitation of the cell membrane.[35].

Fig 5 Respiratory And Olfactory Mucosa



AIRWAY

The passage for the air in and out of the is tightly regulated. The name are located in a such a way that the air is directed in upward direction. Air undergoes 80 to 90 degree turn posteriorly as the nasal vault is reached to take an almost horizontal pathway till it hits the posterior wall of the nasopharynx. After reaching this point, a bend of 90 degree occurs. These bends are termed as “impaction points,” which serve to filter the impurities contained in the inhaled air. Immunological filtration occurs with the help of adenoids as the air hits the adenoids.“Sniffing” helps the air to reach the olfactory areas directly. The expiratory and inspiratory paths are generally the same[36].

STREAM OF AIR

The ostium internum, otherwise called the anterior nasal valves are located about 1.5 to 2 cm posterior to the external nasal cavity which provides a very critical cross section area of 20 to 40 mm^2 on each side, which forms the "narrowest part" of the upper respiratory tract, and provides about 50% of the total airway resistance. The air stream widens behind this narrow zone there by providing large surface area of the nasal mucosa for air to come in contact with it.

Evidence has accumulated that there is a 2 to 4hour period of alternating periods of nasal resistance happening cyclically from one nostril to other nostril. An increase in nasal resistance for a very long period can lead to cardiac complications like cor pulmonale, cardiomegaly, and pulmonary edema. The most common problem encountered with increased prolonged nasal resistance is mouth breathing, which leads to bypassing the air conditioning and cleansing physiological function of the nose [37].

AIR SPEED

The speed of the air is greatest at the anterior nasal valve, at a rate of 3.3 m/s with the flow rate of inspiratory air being at 200 mL/s as, against 1 mm/sec within the secondary bronchi . The air speed slows down after this valve is crossed thereby providing the mucosa with longer contact period between the incoming air and the lateral wall of nose. Air stream again narrows when it reaches the choana.

FILTERATION PROPERTY

The Aerodynamic equivalent diameter (AED), is defined as the diameter of a unit density sphere which has the same settling speed as the particle in question.

Particles of size which are approximately 5 micro meter AED or greater were found to be filtered to a maximum of 80 to 85% by the nose and nasopharynx. Particles of smaller size that are less than 5 microns tend to penetrate to lower respiratory tract. Virus-containing droplets are retained within the nasal cavity because they coalesce into larger diameters, frequently more than 5 to 6 micro meter.

CONDITIONING OF AIR

The mucosal blood vessels serve to heat or cool the air by effect of radiation while the act of Humidification occurs by the process of evaporation from the mucous surface. This mechanism maintaining the temperature and humidity of the inspired air helps to keep the temperature of the inspired air to the near normal body temperature while the relative humidity is maintained at 100%.

The blood vessels of the mucosa are arranged in two layers in almost parallel rows, a superficial layer and a deep layer. The epithelium of the mucosa is supplied by the superficial layer of capillaries while the deeper vessels send branches to basement membrane and they remain fenestrated serving in fluid exchange. The flow of blood is always from posterior towards anterior direction, opposite to the flow of inspired air and mucus thus forming a "counter current" mechanism that adds to the system efficiency.[36,37]

FUNCTIONS OF RESPIRATORY CILIA

In humans, the respiratory cilia are found to spread throughout the columnar epithelium except at the nasal vestibule, the posterior wall of oropharynx, part of the larynx and terminal ramifications of the bronchial tree. They are found in the Eustachian tube, much of the middle ear, and the paranasal sinuses. Cilia in a modified form also occur in the maculae and cristae in the inner ear and as retinal rods in the human eye.

ULTRASTRUCTURE OF CILIA

Human cilia is seen about 6 microns above the luminal surface with 0.3 micronwidth. Nasal cavity is found to have almost 100 cilia. These cilia are found to be attached to the base of the cell. Every one cilium is covered by the plasma membranic extension of the cell. Ultra structurally numerous longitudinally arranged microtubules are seen within the cilia known as axoneme. The microtubules arearranged in a cartwheel pattern in form of doublets or pairs with nine outer pairs at the periphery of the axoneme. A characteristic “9 plus 2” pattern is seen in the centre of the axoneme due to the arrangement of two microtubules.

Ciliary tip holds 3 to 7 , 25 to 35 nm sized claws that appears like a dense cap or crown. The microtubules extend downwards beneath the cell membrane and the axoneme of the cell to reach the apical part of the cell cytoplasm to join another microtubule to form a triplet. They converge into a cone-shaped form and acquire periodic striations. This structure, the rootlet, curves in the same direction where cilia beat.

These cross-striations present in the basal foot resembles the collagen fibers. Rest of the fine microtubules form complex connections with adjacent junctional complexes of the cell to form terminal web.

The micro tubular doublets each contain more centrally located subfiber, A, and a slightly more peripherally located subfiber, B.Regular arm like structures extend from subfiber A toward subfiber B. These arms are known as dyeing arms that are composed of ATP (adenosine triphosphate). 26Also there are arms extending from each subfiber A to B of the adjacent doublet. They are made of an elastic fibre called nexin. Radial spokes extend from subfiber A to the central pair of the doublet of the microtubule.

At the base of the cilium, the two central microtubules terminate, and the triplet is formed in the apical part of the cell by joining with a third microtubule which is called as subfiber C.[38],[39].

Ciliary Beat

The term the ciliary beat is defined as the to and/or motion of the cilia. The forward beat is the more powerful and effective stroke where the cilium is in full extension, and the claws at the tip penetrate the mucus membrane of the mucosa to propel the mucous forward.

The recovery stroke is less forceful and slower, and the shaft turns backward, on itself in such a way that it does not reach the mucus layer of the mucosa. Beating is metachronous and occurs 1,000 or more times per minute.

The ciliary movement is caused by the tubular sliding against each other there by creating a shear force that causes bending. The basis of the “nervous” connection in between adjacent cilia is unsolved. Perhaps the “touch” of an cilium with the adjacent cilium is enough, which initiates the coordinated, metachronous movement. This ciliary movement is initiated by the production of ATP within the cell. The “spokes” detaches and reattach es multiple times during the bending process. The axis of motion of the cilium, is defined by a line drawn perpendicular to a plane connecting the central pair of tubules.

In health, particles sitting on the mucous membrane are pushed by active ciliary movement at 3 to 255 mm per minute, with an average speed of about 6 mm per minute.

Apparent health exists, however, with different speeds.Speeds at some variance, from the average. Dryness of the mucosa damages ciliary activity. Other factors include, relative humidity and, pH of the fluids. Numerous structural abnormality, arising in the axonemal tubules was found.

PROCETION OF THE LOWER AIRWAY

This is achieved by the mucociliary mechanism. The nasal mucosa is rich in goblet cells and secretory glands that secret mucous which forms a blanket. This mucosal blanket hasa an outer visous layer and a inner serous layer. The inner serous layer is in contact with the ciliary ends which are constantly beating, resulting in a conveyor belt like propelling the mucosal blanket onwards to the nasopharynx.

Cilia are delicate filamentous structures, approximately 7micron long and 0.3 micron in thickness, consisting of a 9+2 arrangement of microtubules. There are approximately 200 cilia per cll on the nasal mucous memberane, interspersed by numerous microvilli. They beat with a rapid, forwardly directed “effective stroke” and a slow, backwardly directed “recovery stroke”. The effective stroke takes up $1/5^{th}$ of the ciliary cycle and is the propulsive phase.

In the nose, at a temperature of 30* C, cilia beat at 10-15 beats/sec.this leads to a streaming movement of the mucous layer at .25 to.75 cm/min. thus in about 30 minutes, the entire nasal mucous blanket is changed. This takes only 10 minutes in the paranasal sinuses.

The inhaled bacteria, viruses, dust particles and pollens are all entangled in the mucous blanket and propelled to pharynx to be swallowed. The mucociliary flow has a definite pattern which is genetically predetermined and always occurs along the neural path. In the sinuses, even if a surgical opening is made, the flow is along the natural ostia.

Ciliary movement is affected by drying, drugs like adrenaline, extremes of temperature, noxious fumes and smoking etc. conditions like Kartagener's syndrome where ciliary funcation is defective leads to impaired mucous drainage causing stagnation and infection.

MUCOUS LAYER

The bi-layered mucous blanket, produced maximum by the serous glands and the goblet glands, is a 12 to 15 microns thick, sticky, tenacious, adhesive sheet consisting of an upper, more tenacious mucus, riding on the tips of the ciliary shafts, and a deeper, thinner periciliary layer. The blanket functions as a lubricant, protects against desiccation, and traps particulate matter and soluble gases. It amounts to 1 to 2 L per day.

In health, the pH is slightly acid. Its approximate composition is

a. 2.5 to 3% glycoprotein,

b. 1 to 2% salts,

c. 95% water.

Immunoglobins constitutes 70% of the protein content of the mucous. Mucus is found all over the nasal cavity (except the vestibule), paranasal sinuses,middle ear, eustachian tube, and bronchial tree, and extending into the alveoli as surfactant. The beating of the cilia moves forward the mucus blanket, along with trapped or dissolved material, in a more or less continuous movement, towards the pharyngeal end of the oesophagus.

Encasing the shafts of the mucosal cilia, is a thicker, less viscid, and deeper periciliary layer, and above this, interfacing with the luminal surface, is the more viscid layer of mucus over the periciliary fluid,located below. The mucus over the luminal surface occur in the form of mucus flakes. Soluble and insoluble matter are caught in the mucus, and on the mucous flakes, and are transported posteriorly by the movement of the mucus blanket, to the upper end of the esophagus[38],[39],[40].

MUCOCILIARY TRANSPORT

The mucociliary transport system, as well as clearance system are two separate systems working hand in hand with one another. Its motive force, is dependent on the actively beating cilia, reaching the flakes of mucus, at the luminal surface and propelling the mucus flakes and surrounding mucus blanket posteriorly to the esophagus.

The mechanism by which the deeper periciliary, less viscid fluid, with its dissolved contaminants,together with viruses likely, also moves posteriorly. Although most bacteria entering nasal mucus blanket impedes the metachronous ciliary cycle, *Bordetella pertussis*,*Mycoplasma* *pneumoniae*, and *Pseudomonas aeruginosa*, among others, doso. Some respiratory viruses and bacteria, notably influenza virus, rhinovirus, adenovirus, herpes simplex virus, and respiratory syncytial virus, seem to impede mucociliary transport by the property of altering either the axonemal ultrastructure itself or the viscosity and the elastic properties of the mucous blanket[40].

VOCAL RESONANCE

The primary voice generated by the voice box is modulated and resonated by the nose and paranasal sinuses. The nose helps in the production of nasal consonants (m, n, ng) by allowing some air to escape through it. If too little air escapes, as in obstruction due to any reason , rhinolalia clausa results. If too much air escapes, s in velopharyngeal insufficiency, rhinolalia aperata results.

NASAL REFLEXES

Several reflexes are mediated by the nose. They are,

Nasogastric reflex

The reflex secretion of saliva and gastric juice in response to aroma of food.

Sneezing

It is protective reflex initiated by chemical, physical or termal stimuli to the nose. It is associated with facial movements, nasal secretion, lacrimation, vascular engorgement, a change in the respiratory rate along with the closure of the larynx.

Nasobronchial and Nasopulmonary reflexes

Increased airflow through one nostril is associated with ipsilateral bronchial muscle relation and increased ventilation in the ipsilateral lung.

NASAL CYCLE

A physiological cycle of spontaneous nasal congestion followed br decongestion alternating between the nasal cavities. Duration of the cycle varying from 4 to 12hrs. nasal cycle demonstrated in 80% of population.

Demonstrated by

a) Rhinomanometry

b) Thermography

Factors influencing nasal cycle

- Allergy
- Infection
- Exercise

- Hormones: pregnancy, puberty
- Fear
- Emotions
- Sexual activity
- Drugs
- Vagal over activity

Components in nasal resistence

1. Nasal vestibule
2. Nasal valve: Maximum resistance
3. Turbinate: Minimum resistance

- Major site is the anterior end of the inferior turbinates
- Sympathetic stimulus leads to the engorgement of venous erectile tissue.
- Parasympathetic stimulation leads to secretion.
- Total nasal resistance is 2-3 cm of water/L.
- Nasal resistance is inversely proportional to the age of the patient.
- Exercise decreases the nasal resistance.
- Increase in arterial carbon dioxide due to rebreathing leads to decrease in the nasal resistance.

The internal part of the nose receives arterial supply from the anterior and posterior ethmoidal arteries, the sphenopalatine arteries and the greater palatine arteries. The venous drainage is finally to the jugular veins in the neck. The minute arterioles do not drain directly to the capillary and venule but through the sinusoids. These sinusoids are surrounded by fine fibrils of smooth muscle, giving them power of vasoconstriction and vasodilation. When they fill up and distend, the tissue engorges as an erectile tissue. This property is more marked in inferior turbinate. Parasymapathic stimulation results in vasodilation, which engorges the sinusoids with blood and increased congestion and mucus production. Sympathetic stimulation results in vasoconstriction, which squeezes blood out of the nasal memberanes, thereby increasing nasal patency and decreasing mucus production.

Supine position increases nasal resistance

- Change in the jugular venous pressure
- Change in the sympathetic tone
- Cooling of the skin surface decreases the nasal blood flow.
- Chronic emotional disturbance leads to nasal congestion.

Nasal secretions

Nasal secretion comprises:

1. Water and ions
2. Glycoproteins

   Accounts for viscosity and elasticity

   a) Sialomucins
   b) Fucomucins
   c) Sulphomucins
3. Enzymes

   a) Lactoferrin
      - Binds to iron
      - Removes heavy metal ions preventing the growth of certain bacteria
   b) Lysozymes – antibacterial actions
   c) Anti proteases – alpha 1 antitrypsin
   d) Alpha 1 antichymotrypsin
   e) Alpha 2 macroglobulins

   Enzymes derived from the circulation and mucosa
4. Immunoglobulins: mainly IgA and IgE.
5. Cells

a) Surface epithelium

- Basophils
- Eosinophils
- Leucocytes

b) Glycoproteins from the mucoyus glands

c) Water from the serous glands

Mucus seen in two layers

1. Upper viscous layer
2. Lower watery layer

ASSESSMENT OF NASAL AIRWAY

RHINOMETRY

Rhinometry is a specific procedure that is used to measure the amount of air pressure and the rate of airflow in the nasal airway during respiration. From these measurements, nasal resistance to the airflow can be calculated.

Nasal resistence to air flow may be calculated from the following equation

R = P/V

R = resistence to air flow, in cmH_2O/litre/s Or $Pa/cm^3/s$

P = trans nasal pressure, in cm H_2O or Pa

V = nasal air flow, in litre/s or cm^3/s

Historical background

Paulswen did early work on nasal airway in 1882. But it was kayser who was perhaps the first to realize the role of aerodynamics in evaluation the flow of respiratory air through the nasal chamber.

Ogura et al supported the suggestion that a reflex mechanism allows chronically obstructed nose to affect the pulmonary function.

Objective and application of rhinometry: an important goal in rhinometry is the acquisition of more knowledge concerning nasal respiratory physiology, particularly in an attempt to substitute the validity of the concept of a relationship between nasal and pulmonary function.

Some applications of the rhinometry include

- Assessment of nasal physiology (nasal cycle)
- Evaluation of nasal respiratory insufficiency
- Measurement of velopharyngeal adequacy during speech
- Investigation of the patency of the maxillary sinus ostium

Methods of rhinometry

1. **Anterior rhinometry**

   Refers to the location of the measuring devices at the anterior end of the vestibule. In anterior rhinometry, one must be careful that nasal structures are not disturbed by the nozzles, least the results be inconsistent.

2. **Posterior rhinometry**

   Refers to the placement of the pressure transducers in the mouth to measure the transnasal pressure difference between the external nasal aperture and the nasopharynx. This technique use the mask flowmeter described by ferris et al for the measurement of nasal airflow and transnasal pressure.

   Dissadvantages – 25% of the patients are not able to relax.

3. **Combined rhinometry**

   Stoksted in 1951 connected a tube from the middle meatus toone limb of U manometer. The nares on the same side was closed and the subject breathed quietly from the other nostril. Then the electrodes of the manometer were connected to an electrocardiograph and nasopharyngeal pressure and the patency of the nasl passage was noted. Later, the U shaped tube liquid manometer was replaced with diaphragm type manometer.

4. **Active rhinometry**

   Refers to the situation in which the airflow through the nasal chambers is dependent on the patient's actively initiating his own respiratory efforts.

5. **Passive rhinometry**

   Here, a fixed airflow from an external positive pressure source is forced through the patient's nasal airway.

6. **Uninasal rhinometry**

   Refers to the situation in which one nasal chamber is being investigated.

7. **Binasal rhinometry**

   Both the nasal airways are evulated.

FACTORS CONTRIBUTING TO VARIABILITY IN OBJECTIVE AIRWAY TESTING IN GENERAL

Nasal cycle causes variability in unilateral resistance, but total nasal resistance remains relatively constant.

- Secretions can increase nasal resistance
- No change caused by nose blowing
- Exercise causes a reduction in resistance
- Hyperventilation increases nasal resistance
- Breathing CO2 decreases nasal resistance
- Nasal resistance is greatest when supine and least in the upright sitting position
- Nasal resistance is highest at night and in the early morning.
- Medications decongestant spray decreases nasal resistance
- No effect on the airway from saline nasal drops
- Aspirin causes a small increase in nasal resistance
- Antihistamine treatment may increase the nasal resistance in the unchallenged nose
- Smokers had significantly higher nasal resistance than nonsmokers.
- Nasal resistance increases with height in adults
- No correlation between nasal resistance and height in children
- Age: No change in nasal resistance with increasing age in adults
    - Decrease in nasal resistance with advancing age in adults
    - Nasal resistance increases with age in children.

In Acoustic rhinometry

1.Temperature: 1-mm shift in anatomic features for every 2.5˚C difference in temperature

2.Race : Minimal cross-sectional area was significantly lower in whites and Asians than in blacks; volumes smallest in Asians, largest in blacks.

3.Computer software may erroneously locate the minimal cross-sectional area at the outer end of the nosepiece, thus necessitating the establishment of a zero point.

IN RHINOMANOMETRY

1. Temperature: Cold air increases nasal resistance
2. Race Nasal: resistance is greater in whites than in blacks and intermediate in Asians.
3. Humidity: No change with changes in humid

COMMONEST TURBINATE DISORDERS

a. Allergic rhinitis
b. Acute rhinosinusitis
c. Chronic rhinosinusitis
d. Vasomotor rhinitis

e. Drug induced rhinitis

f. Atrophic rhinitis

g. Others – synechiae, polypoid changes.

Turbinate procedures

a. Resection techniques

b. Non resection techniques

Resection techniques

a. Partial turbinectomy

b. Inferior turbinoplasty

1.Sub total turbinectomy

2.Submucous resection

3. Powered turbinectomy

Non resection techniques

a. Out fracturing of inferior turbinate

b. Steroid injection

c. Chemical cautery

d. Cryotherapy

e. Electro cautery

    a. Surface electro cautery

    b. Submucosal electro cautery

f. Laser treatment

Advantage of resection techniques

a. Effect long lasting

b. Major improvements innasal airway and congestion

Disadvantage of resection techniques

a. More invasive

b. Take longer time to heal

c. Have the added risk of intra operative and postoperative Hemorrhage.

d. Increased risk of dryness

e. Increased risk of atrophic rhinitis.

Advantage of nonresection techniques

a. Less invasive

b. Faster to heal

c. Less likely to result in a dry nose and atrophic rhinitis

Disadvantage of nonresection techniques

a. Only small incremental improvement in nasal airway

b. In the long term it more likely to be associated with recurrent

    1. Rhinorrhea

    2. Congestion

    3. Obstruction secondary to mucosal regrowth and hypertrophy.

MATERIALS AND METHODS

SUBJECTS

All patients with nasal obstruction attending Government Thanjavur `medical college ENT department between January 2015 – July 2016.

PERIOD OF STUDY

January 2015 – July 2016.

DESIGN OF STUDY

Prospective study

INFORMED CONSENT

Obtained from all the patients

INCLUSION CRITERIA:

Adult patients with nasal obstruction and inferior turbinate hypertrophy not responding to medical treatment with or without septal deviation and with allergic or non allergic rhinitis.

1. All patients with nasal obstruction with hypertrophied inferior turbinate.
2. All patients of allergic and non-allergic rhinitis.
3. All patients in age group of 18 to 50 years.

EXCLUSION CRITERIA:

Nasal obstruction with inferior turbinate hypertrophy with

1. Patients with systemic diseases, coagulation disorders, chronic granulomatous disorders.
2. Age of the patients below 18 years and above 50 years.
3. Patients with sinonasal polyps, tumors.
4. A complete otolaryngological examination is to be done to rule out any associated pathologies and focus of infection which could influence the result of the turbinoplasty surgery.

Patients attending department of ENT at Thanjavur Medical College during the study period with features of nasal obstruction and inferior turbinate hypertrophy were treated with topical decongestants and anti histaminics for a period of six weeks. Those who did not improve with medical treatment were included in our study.

Subjective assessment of nasal obstruction was done by visual Analogue scoring before surgery and Graded into mild, moderate, and severe. They were also subjected to nasal endoscopy for objective assessment of inferior turbinate size and graded as I, II, III.

Patients included in this study underwent these procedures by random allocation.

- Conventional submucosal resection of turbinate.
- Micro debrider assisted submucosal resection.
- Cryotherapy .

The improvement in nasal obstruction following surgery was assessed after 1st, 3rd and 6th months by complete questionnaires and size of the inferior turbinate assessed by nasal endoscopy.

Grading of inferior turbinate size (Fig 6)

Grade I – Mild enlargement with no obvious nasal obstruction.

Grade II – The inferior turbinate occupies half of the nasal cavity with nasal obstruction.

Grade III – Complete occlusion of the nasal cavity.

Informed and written complaints were obtained in all patients who underwent these procedures.

Fig 6 :INFERIOR TURBINATE SIZE GRADING

Grade I

Grade II

Grade III

NASAL OBSTUCTION SYMPTOMS EVALUATION SCALE (NOSE)

BEFORE SURGERY/1MONTH AFTER SURGERY/3MONTHS/ 6MONTHS AFTER SURGERY

PROBLEM	NOT	MILD	MODERATE	SEVERE
NASAL CONGESTION	0	1	2	3
NASAL BLOCKAGE OR OBSTRUCTION	0	1	2	3
TROUBLE BREATHING THROUGH MY NOSE	0	1	2	3
TROUBLE SLEEPING	0	1	2	3
UNABLE TO GET ENOUGH AIR THROUGH MY NOSE DURING EXERCISE OR EXERTION	0	1	2	3

METHODOLOGY

Anaesthesia

The choice of anaesthetic technique will vary depending on the precise technique employed and the other procedures to be done in combination with the turbinate procedure. When only the turbinate procedure is to be performed, general anaesthesia is rarely necessary. Unless extenuation circumstances exist, a local anaesthesia with mild sedation is usually sufficient.

In most cases 4% lignocaine with adrenaline solution is used as a topical agent to decongest the nose and provide some anaesthesia of the turbinate mucosa. The solution is applied via cottonoids or cotton pledgets around the turbinate. Alternatives include oxymetazoline or phenylephrine in combination with lidocaine, or a topical decongestant alone.

Local anaesthesia is injected after the topical agent has taken effect. Most commonly 2% lignocaine with 1 : 1,00,000 epinephrine is used. Approximately 3 to 5 ml is injected for each turbinate, divided between the posterior end, anterior edge, and the medial mucosa.

Conventional Submucous Resection of the Inferior Turbinate (Fig 7)

With the patients in killians position, Submucous resection of inferior turbinate can be performed using a speculum and head light or nasal endoscopes. After the anaesthesia is applied, the incision is made along the inferior edge of the turbinate. The incision is best made with a no 11 blade. The incision is carried down to bone from anterior to, as far posterior as can be comfortably reached.

The mucosa is then elevated from both the medial and lateral surfaces of the turbinate bone using either a Cottle's septal elevator or an angled turbinate scissors. While retracting the mucosal flaps with the nasal speculum, the turbinate bone is resected. This can be accomplished either by cutting it with the turbinate scissors or using a luc forces to remove the bone piecemeal. The flaps are then cauterized along the raw surface to prevent hemorrhage and laid back together. If necessary a pack may be placed to stent the flaps during the initial stage of healing.

Postoperative care consists of serial removal of crust from the healing incision. This will often only be required on two or three occasions during the postoperative period. Adherent scabs should be left in place until they soften and separate naturally. The patient should be encouraged to use normal nasal saline drops frequently until healing is complete.

Topical nasal steroids, decongestants and antihistaminics are withheld until the effect of the procedure is known and the need for these medications is confirmed[59]. All the patients were followed up by DNE and NOSE score during the first,third and sixth month reviews.

Microdebrider assisted submucosal resection of the turbinate (Fig 8)

A spinal needle which was tightly attached to a 2 ml syringe is used to infiltrate along the posterior inferior border of inferior turbinate. The turbinate is fractured medially, allowing space for the endoscope and powered microdebrider to be placed. A 12 degree or straight blade is used in oscillate mode to remove the soft tissue from the lateral aspect of the vertical portion of the inferior turbinate

The debrider is then set in the forward rotating mode and the majority of the bone removed with the rotating blade. If the oscillate mode is used for bone removal this will often result in bone and portions of the medial surface of the turbinate being removed. If possible this should be avoided because this portion of the turbinate should be preserved so it can be rolled upon itself at the end of the procedure[61].

The residual bony fragments are dissected free with the malleable probe or double right angled ball probe. The inferior turbinate bone often thickens considerably as the dissection is continued anteriorly. Removal of this bone is critical, this is the narrowest region of the nose and the greatest degree of benefit can be achieved here.

After all the lateral mucosa and bone have been removed the remaining mucosa is rolled upon itself, covering the raw area. The freer's elevator is used to roll the mucosa and if necessary fracture the horizontal portion of the remaining inferior turbinate laterally. This reduce the size of the turbinate by 50%.

After the microdebrider assisted submucosal resection anterior nasal packings were done which was removed after 24 hrs of the procedure.

Patients started saline nasal spray usage following the day of the surgery. This is continued for one month postoperatively. After one day patients are allowed to very gently blow their nose after saline wash. Antibiotics are given for 5 days. Patients are reviewed after 2 weeks. All patients were reviewed every first, third and sixth month and analyzed by using DNE and NOSE score method.

Cryosurgery: (Fig 9)

After preparing the patient was performed by means of nasal packing by using xylometazoline nasal spary and 4% lignocaine local anaesthetic agent. Cryosurgery is performed by using nitrous oxide as low as -70°C. The contact time for the procedure was 90 -120 seconds at 2-4 points at each turbinate. Care was taken not to make and contact with mucosa over the septum or the lateral wall of nose. Nasal packing was not required in many of the patients. Patients were followed up during the first, third and sixth months. All patients were prescribed saline nasal drops and analyzed by DNE and NOSE score method.

Fig 7: Conventional submucosal resection

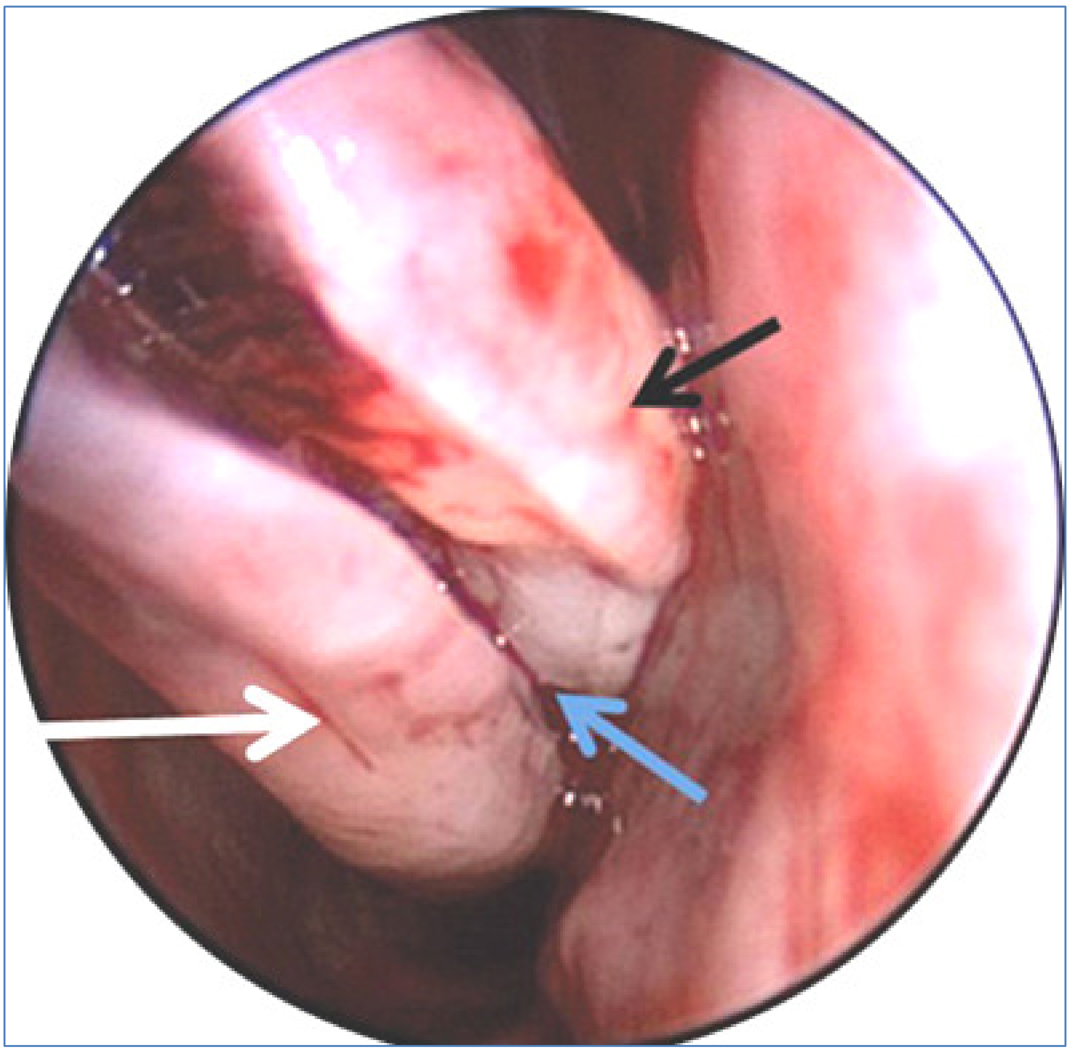


Fig 8: Microdebrider assisted turbinoplasty

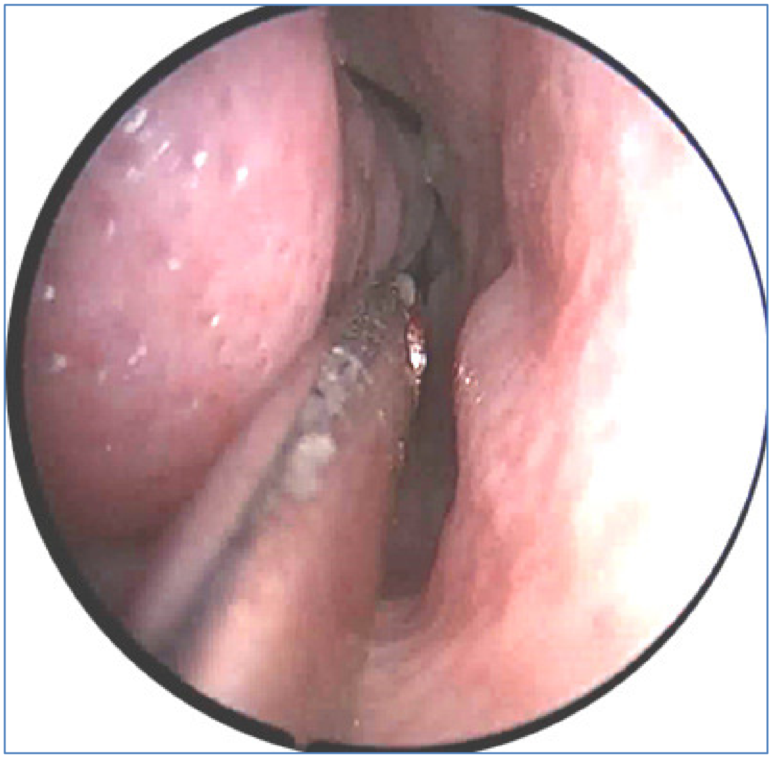
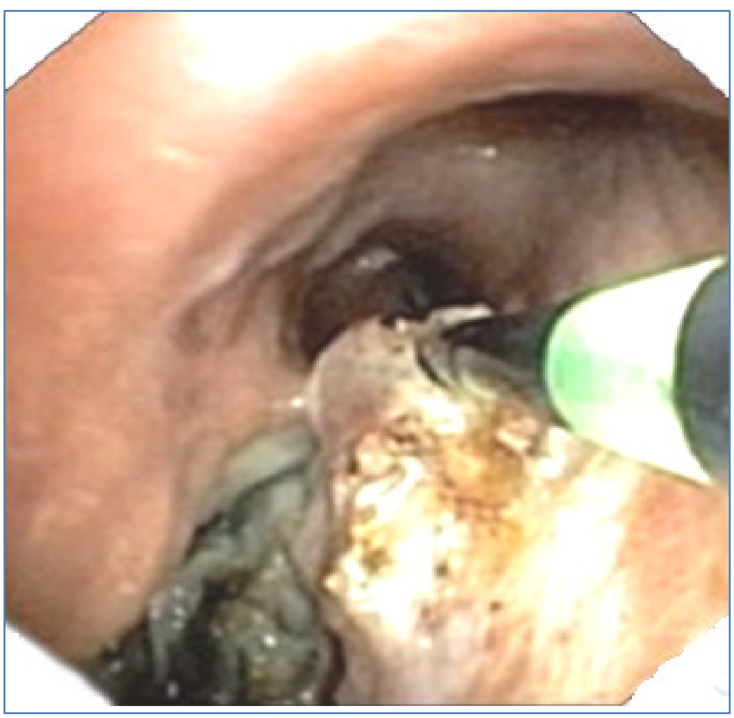


Fig 9: Cryosurgery



OBSERVATIONS AND RESULTS

The following data is obtained from the Patients attending department of ENT at thanjavur medical college during the period of study who had features of nasal obstruction with inferior turbinate hypertrophy who had undergone various turbinoplasty procedures.

SEX DISTRIBUTION (TABLE.1)

Our study has 36 males and 24 females. Their sex ratio was 1.5: 1. Most of the patients were between the age of 21- 40 yrs of age. Of the total cases that were operated, 60 % were males and the remaining 40 % were females. Among 60% males, 23.33% underwent cryosurgery, 18.3 % underwent conventional submucosal resection and 18.3% underwent Microdebrider assisted submucosal resection. Among 40% females, 15% underwent conventional resection, 15% underwent Microdebrider assisted surgery and 10% underwent Cryosurgery.

AGE DISTRIBUTION

In our study the age group of the patients were between 18- 50yrs.

The below table shows the distribution of the patients,

Table 1 :Sex distribution in turbinoplasty procedures

Procedure	Male		Female	
	n	Percentage %	n	Percentage%
Conventional	11	18.3	9	15
Microdebrider	11	18.3	9	15
Cryosurgery	14	23.33	6	10

Chart 1 :Sex distribution :

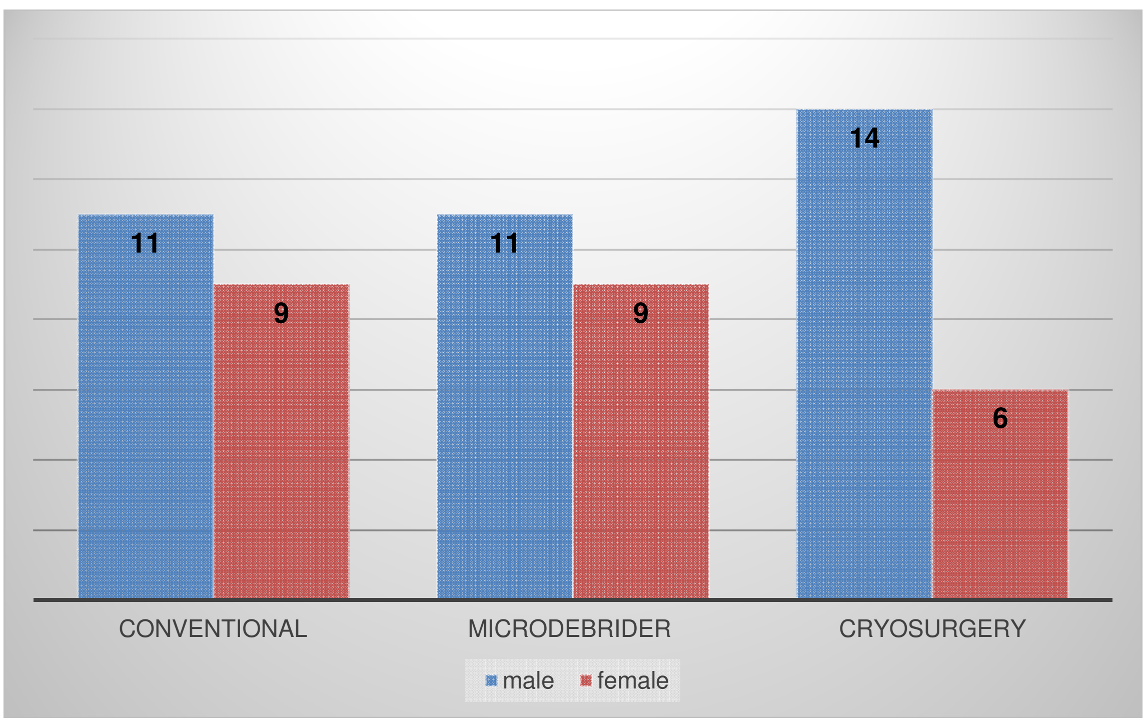


Table 2 :Age incidence in patients undergoing turbinoplasty procedures

Age	N	Sales
< 20 years	4	6.7
21 to 30 years	31	51.7
31 to 40 years	18	30
41 to 50 years	7	11.7

Chart 2: Percentage of age distribution

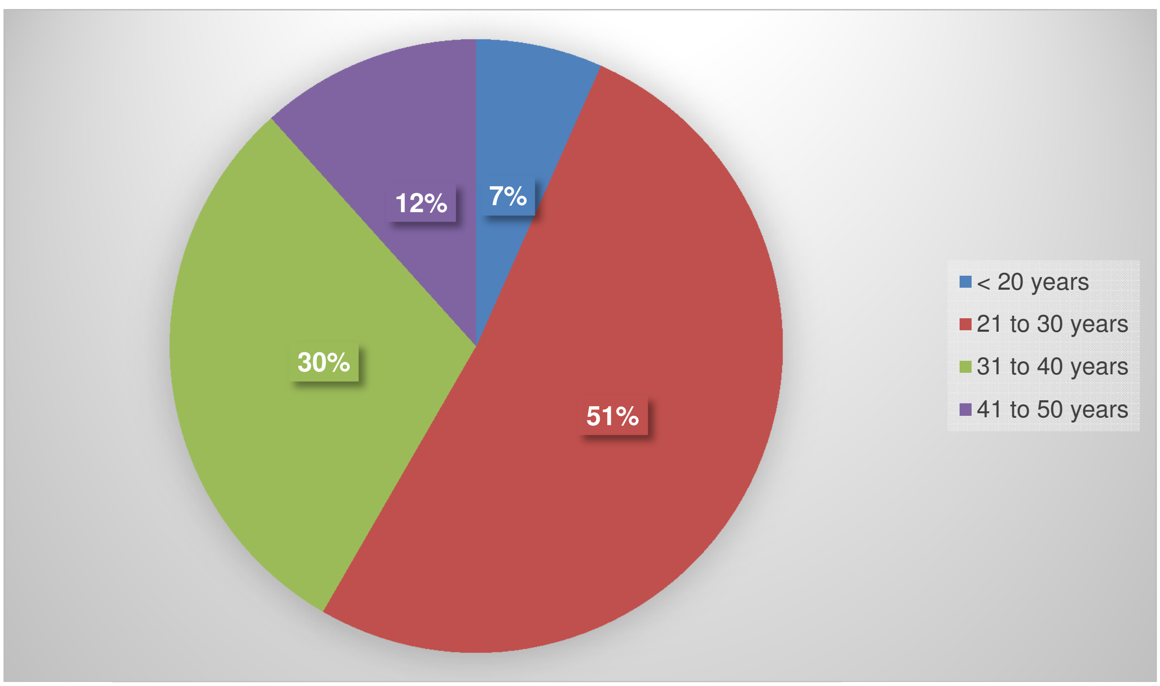


Table 3: Conventional Submucosal Resection

Preview & Review	DNE Grading		
	Grade I	Grade II	Grade III
Pre Operative	0	5	15
1st month Post Op	18	2	0
3rd month Post Op	15	4	1
6th month Post Op	11	7	2

Chart 3 :DNE Grading : Pre Operative&Post Operative

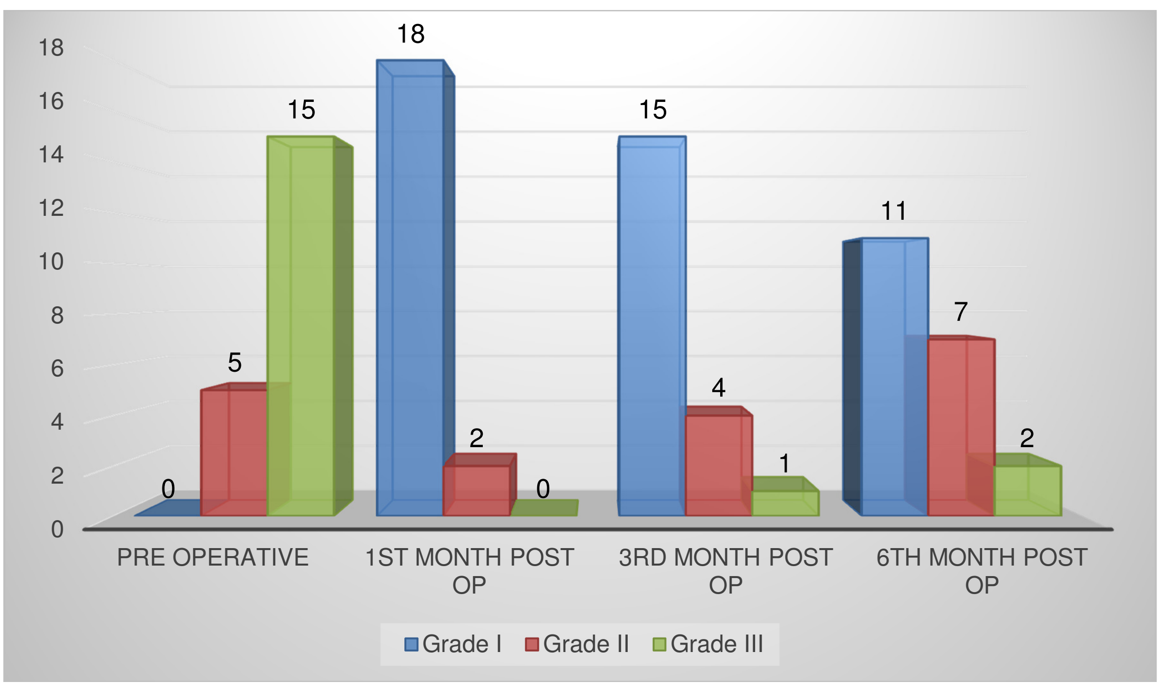
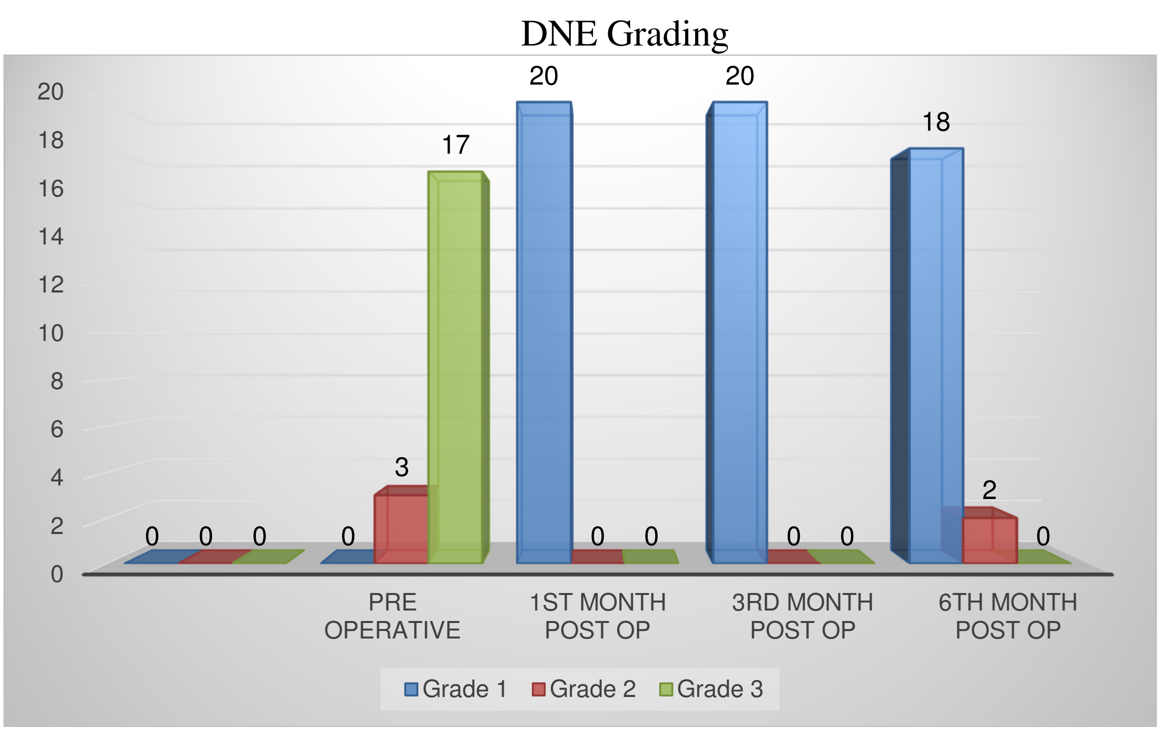


Table 4 :Microdebrider Assisted Submucosal Resection

Preview & Review	DNE Grading		
	Grade I	**Grade II**	**Grade III**
Pre Operative	0	3	17
Post OP 1st month	20	0	0
Post OP 3rd month	20	0	0
Post OP 6th month	18	2	0

Chart 4 :DNE Grading : Pre Operative&Post Operative



STATISTICAL ANALYSIS:

Totally 60 patients underwent three types of turbinoplasty procedures with 20 patients in each of the three groups. The male and female ratio were 1.5:1. All the patients were randomly separated into three groups. All the patients were analyzed pre operatively and reviewed post operatively by both DNE and NOSE score methods.

Pre operatively out of 60 patients 48 patients had grade III nasal obstruction and 12 patients had grade II nasal obstruction, which were 80% and 20% respectively.

Preoperative analysis of patients by NOSE score relieved that 45 patients had fairly bad obstruction problem and other 15 patients had moderate nasal obstruction problems, which forms about 75% and 25% respectively. None of the patients had any other complication in the preoperative period.

POST OPERATIVE ANALYSIS:

OBJECTIVE METHOD- DIAGNOSTIC NASAL ENDOSCOPY:

Post operatively only 5% (i.e 3 patients) of the patients had grade III nasal obstruction after 6 months of the post operative period. When compared with pre operative analysis, improvement of the nasal obstruction was found in 95% of the patients. Though 95% of the patients had improvement in nasal obstruction but only 67% of the patients were completely relieved of the nasal obstruction, whereas 28.3% of the patients had improvement from nasal obstruction but did not get completely relieved from it.

These results were in comparison of the literatures where in around 90% of the patients showed improvement in the nasal obstruction.

When analyzed by method by method, microdebrider assisted submucosal resection showed the highest improvement, during the 6 month follow-up. Conventional submucosal resection and cryosurgery method showed promising improvement in 1st month and 3rd month but results were not satisfying when followed up upto 6 months.

Conventional submucosal method showed the improvement of 90% improvement and by using Cryosurgery improvement rates were 95% during the 6 month review.

Microdebrider assisted submucosal resection showed 100% improvement at the end of 6 months post operatively.

When compared with conventional submucosal resection method, Microdebrider assisted turbinoplasty and Cryosurgery method, by using oneway ANOVA Microdebrider assisted method showed significant value $0.043<0.05$, $0.019<0.05$, during the 3rd and 6th method follow up period.

Table 5 :DNE Grading in patients undergoing Cryo Surgery

Preview & Review	DNE Grading		
	Grade I	**Grade II**	**Grade III**
Pre Operative	0	4	16
1st month Post Op	20	0	0
3rd month Post Op	18	2	0
6th month Post Op	12	7	1

Chart 5 :DNE Grading : Pre Operative&Post Operative Cryosurgery

-

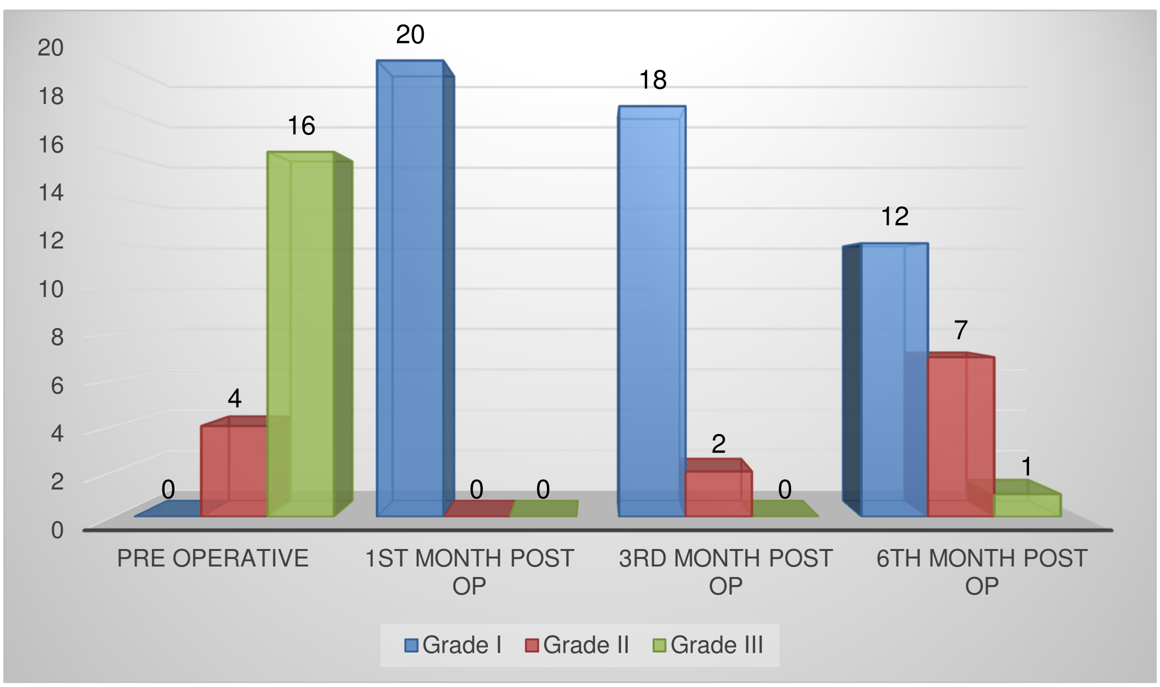


Table 6: NOSE score in PRE OP and Post OP Conventional Surgery

Conventional	Grade 0	Grade 1	Grade 2	Grade 3
Pre OP	0	0	6	14
Post OP 1st month	15	4	1	0
Post OP 3rd month	16	4	0	0
Post OP 6th month	11	6	2	1

Chart 6: NOSE Score in patients undergoing Conventional surgery

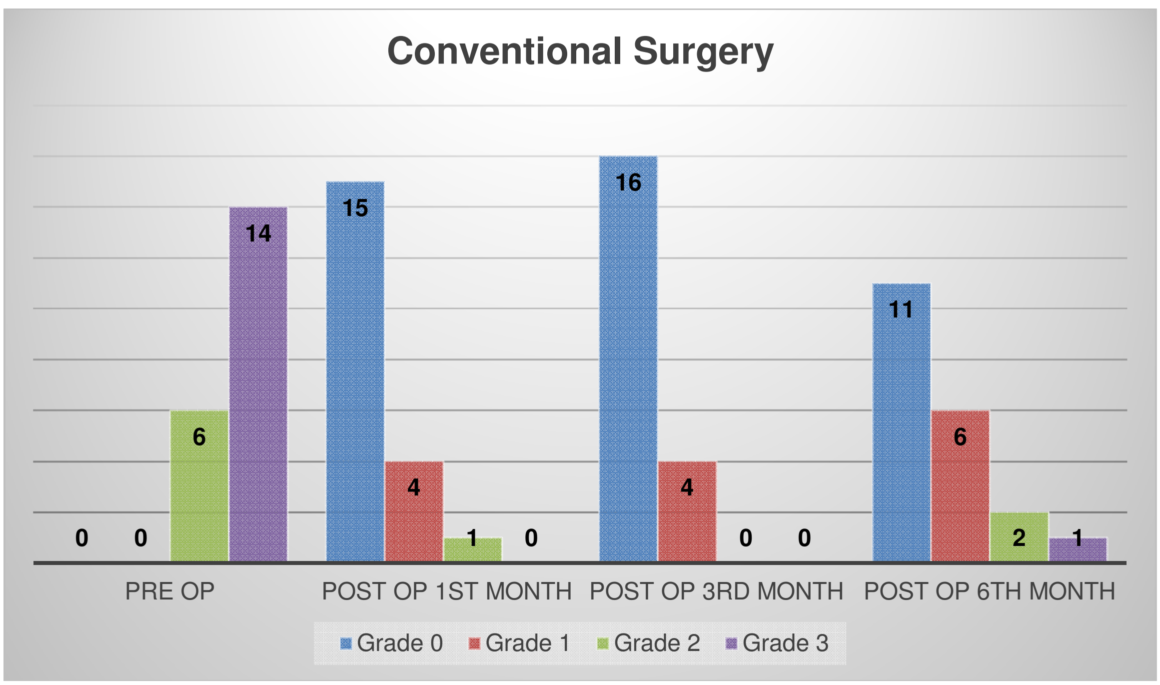
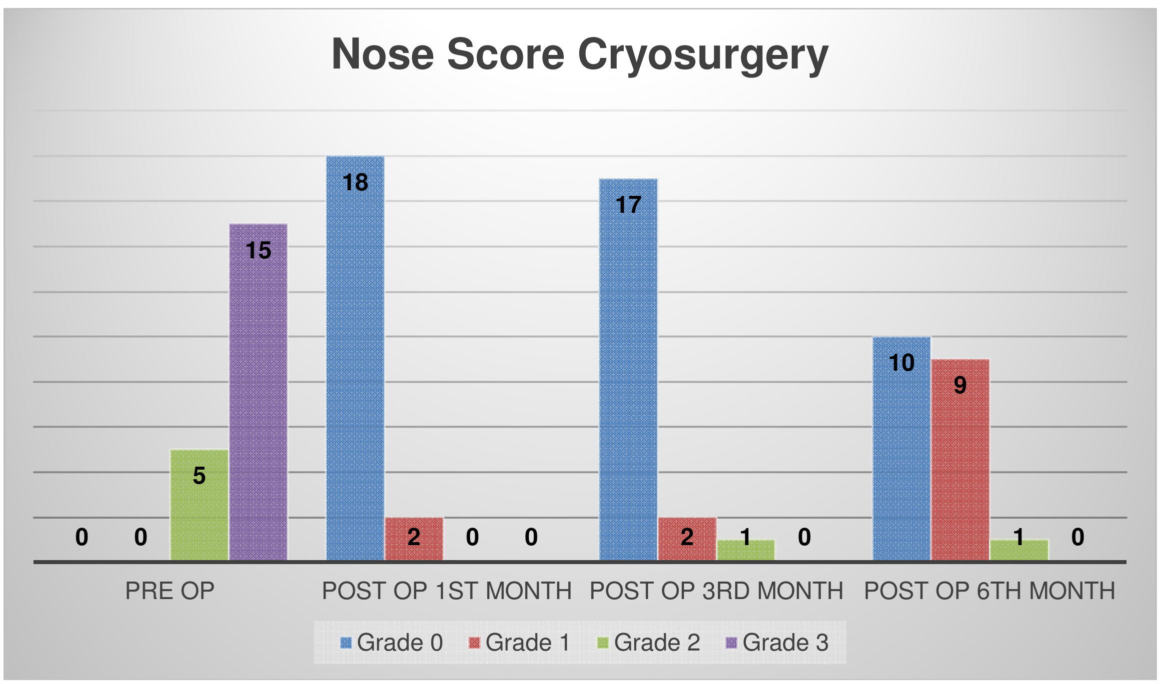


Table 7: : NOSE score in PRE OP and Post OP Cryosurgery patients

NOSE SCORE	Grade 0	Grade 1	Grade 2	Grade 3
Pre - OP	0	0	5	15
Post OP – 1st month	18	2	0	0
Post Op – 3rd month	17	2	1	0
Post OP – 6th month	10	9	1	0

Chart 7:NOSE score in PRE OP and Post OP Cryosurgery patients



NOSE SCORE ANALYSIS – SUBJECTIVE METHOD:

Analyzed pre operatively 75% of the patient had severe nasal obstruction problems and 25% had moderate nasal obstruction problem.

Postoperative comparison showed, patients had improved from nasal obstruction problems to the rates of 98.3%, 96.4%, and 91.7% during 1^{st} ,3^{rd} and 6^{th} months respectively.

Conventional method of submucosal resection showed improvement rates of 100%, 95%, and 95% respectively during 1^{st}, 3^{rd}, 6^{th} month follow-up. Though 95% of the patient had improvement only 85% of the patient had no nasal obstruction post operatively whereas other 15% of the patients complained of mild nasal obstruction during the follow up periods.

Microdebrider assisted method showed improvement of 100% during the 6 month postoperative reviews. Although 90% of the patients were completely relieved from the nasal obstruction, but 10% of the patients showed improvement from severe nasal obstruction to mild nasal obstruction.

Cryosurgery technique only 50 % of the cases showed complete relief from nasal obstruction at the 6th month follow up. Other 50% of the patients had improvement from severe to moderate, from moderate to mild . Although success rate amounts to 100%.

By using oneway ANOVA analysis significant value of 0.021< 0.05 were obtained in favour of Microdebrider assisted Submucosal type of turbinoplasty.

ANALYSIS OF THE COMPLICATIONS:

Our study showed different rates of different complications during the postoperative follow up of the patients, such as bleeding during and after the procedure, pain, dryness and crusting, synechiae and loss of smell. Here we have analyzed only bleeding, crusting and dryness and synechiae formation during the postoperative period.

Analysis of synechiae formation showed 13.3% of the patients had synechiae formation during the postoperative follow up. Among the 60, 8 patients had synechiae during postoperative DNE.

Conventional method of submucosal resection showed 25% of the synechiae formation among the 20 pateints operated by this method. Whereas Microdebrider assisted submucosal method had 10% of synechiae formation and lowest rate is achieved by cryosurgery which accounted for only 5% of the cases operated by this method.

Bleeding was documented in 7 patients out of all 60 patients operated with percentage of 11.7%. Microdebrider assisted method of submucosal resection was found to have a complication rate of 15% i.e 3 out of 20 patients operated by this method. Both Conventional method of submucosal resection and Cryosurgery showed a bleeding rate of 10%.

When compared the formation of the crust during the postoperative period Cryosurgery had a complication rate of 25%. Conventional method of submucosal resection showed 10% for the formation of crust and 15% for Microdebrider assisted method.

Table 8: : NOSE score in PRE OP and Post OP- Microdebrider surgery

Microdebrider	Grade 0	Grade 1	Grade 2	Grade 3
Pre OP	0	0	4	16
Post OP 1st month	20	0	0	0
Post OP 3rd month	18	2	0	0
Post OP 6th month	18	1	1	0

Chart 8: : NOSE score in PRE OP and Post OP Microdebrider surgery

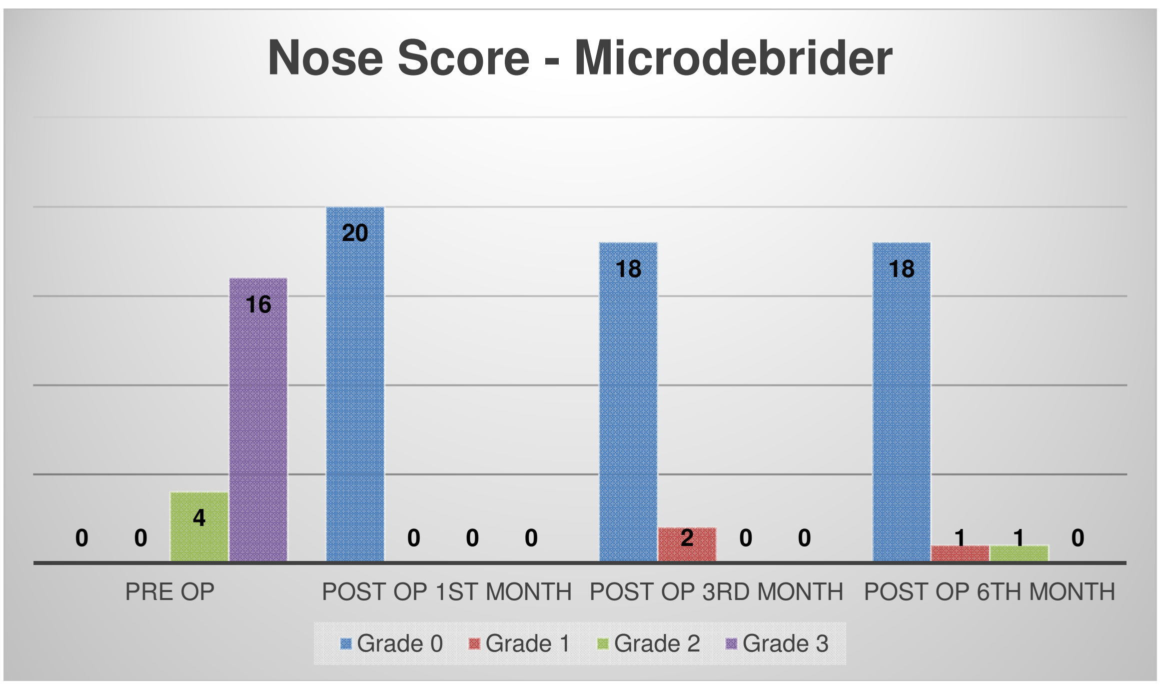


Table 9: Complications of different surgical procedures

Procedure	Synechiae	Bleeding	Crusting
Cryosrgery	1(5%)	2(10%)	5(25%)
Microdebrider	2(10%)	3(15%)	3(15%)
Conventionl	5(25%)	2(10%)	2(10%)

Chart 9(a) : Complications of different surgical procedures

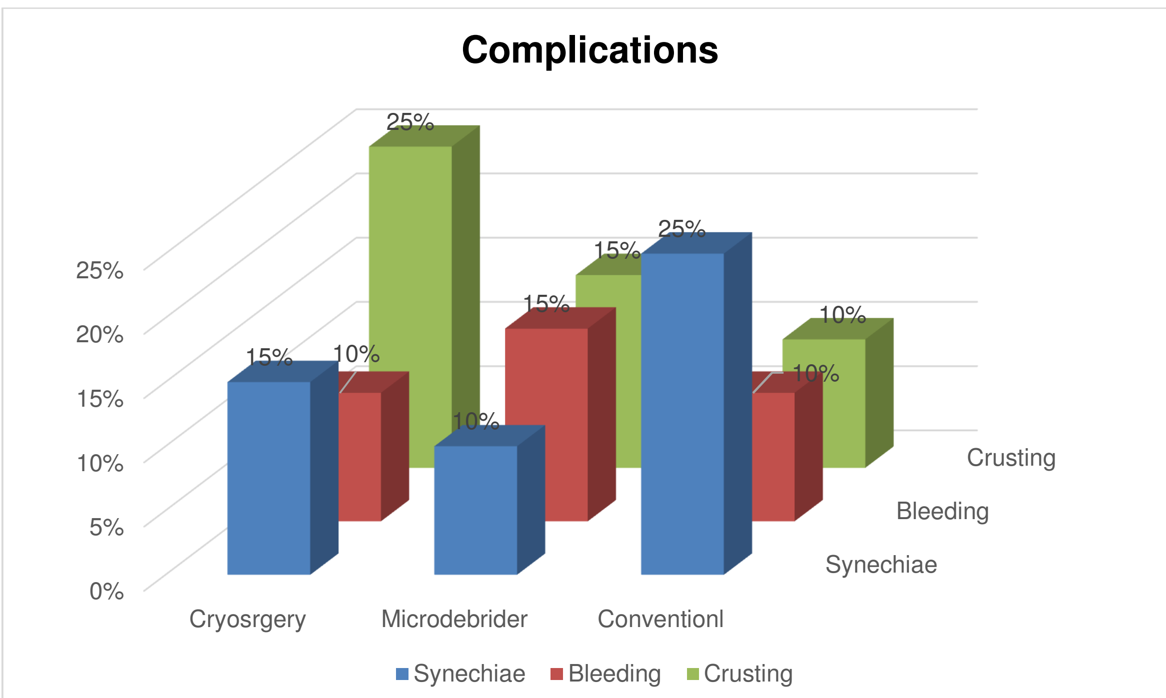
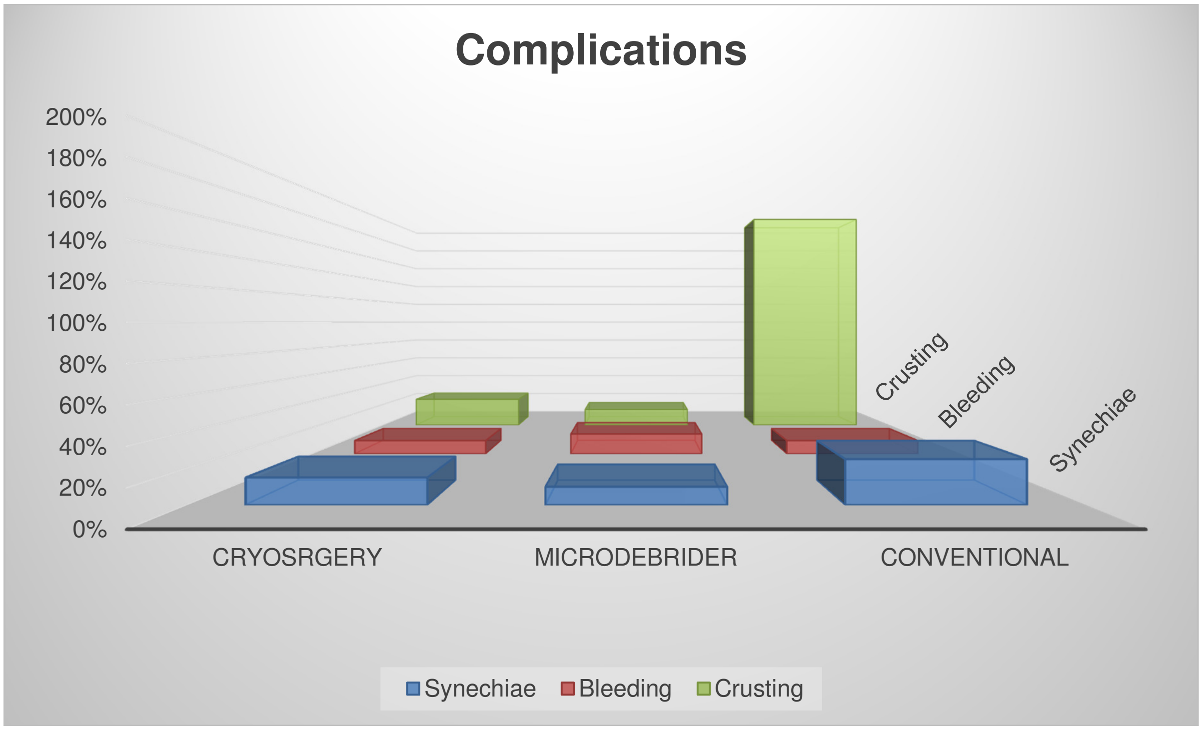


Chart 9(b) : Complications of different surgical procedures



DISCUSSION

Generally, the pathology of the inferior turbinate is treated with pharmotherapy using nasal decongestants, antihistaminics and steroids. However, in cases not responding to drugs, the surgical procedures are necessary. The choice of the surgical procedure depends on the nature of the pathology and the degree to which the maximum turbinate function can be preserved. Thus the surgical treatment aims at "preserving the turbinate function while diminishing the patients complaints and maintaining the optimal turbinate volume".

Turbinoplasty surgeries are done to relieve symptoms of nasal obstruction in patients with turbinate hypertrophy. Sixty patients with hypertrophied inferior turbinate and nasal obstruction had undergone surgeries like conventional submucous resection of turbinate, powered micro debrider assisted submucosal resection, cryosurgery by random allocation. Hence 20 patients underwent each procedure. They were analyzed subjectively and objectively by NOSE questionnaire and diagnostic nasal endoscopy respectively both in preoperative and postoperative state at 1^{st}, 3^{rd}, and 6^{th} months.

TURBINOPLASTY SURGERIES:

In our study out of 60 patients, 57 patients had improved nasal obstruction after turbinoplasty procedures. It is about 95% totally who had undergone turbinoplasty surgeries.

CONVENTIONAL SUB MUCOSAL RESECTION OF TURBINATE :

Out of 20 patients who underwent conventional method of turbinoplasty, 75% were found to have severe nasal obstruction and 25% had moderate nasal obstruction by objective method using Diagnostic nasal endoscopy, as against 70% of severe nasal obstruction and 30% of moderate nasal obstruction by subjective method using NOSE score when assessed pre-operatively.

POST OPERATIVE REVIEWS:

By DNE method:

During the first month review none of the patients showed severe nasal obstruction,where as during 3rd month one patient showed severe nasal obstruction and during 6th month in the same group two patients complaint of severe nasal obstruction.

When we made a analysis of the moderate nasal obstruction 2 patients showed in the first month and 4 patients showed moderate obstruction during the 3rd month and 8 patients were moderately obstructed in the 6th month review.

By NOSE score method:

During 1st the 5 patients complaints of nasal obstruction and they were followed only one complaint of severe nasal obstruction and 4 patients had some nasal obstruction during the 3rd month review. During the 6th month scores were one patient complained severe nasal obstruction and 2 patients complained of some nasal obstruction.

- Mori et al followed 45 patients who were submitted to submucous resection during 3 to 5 years after surgery. They observed that there was significant improvement of nasal obstruction: 82% responded well after three years and 79% after five years. In our study the only 10% of the patient showed grade III nasal obstruction during the 6th post operative month review. But moderate nasal were found in some 40% of the cases which were mainly due to the synechiae formation in the post operative period In our study post operative analysis was done after three months, so after sometime patients may recur.

- Pasaali and his colleague reported that the greatest relief from nasal obstruction was provided by submucosal resection method when compared with the other methods of turbinate surgery. It should also be however remembered, that the submucosal resection technique produces some mucosal damage to the inferior turbinate and requires excellent knowledge of the procedure.

- Gindros and his colleagues , in their study which compared the post operative bleeding in three different groups, and reported that significant difference in bleeding between the three groups postoperatively. The study reported as both microdebrider assisted group and radiofrequency group showed no bleeding post operatively. But bleeding was documented in five patients after conventional surgical turbinoplasty which represented 25% of this group. No significant difference in nasal crusting between the three groups (P > .05). The percentages of crusting are 0 %, 13 % and 25%for each group.

- In a study done by Chen YL and his colleague, which reported significant increase in formation of crust in the inferior turbinate (P<0.05) in the group operated by the conventional method.

Though in our study the difference between the groups was significant.

- Yañez and Mora had reported with a significant decrease in bleeding and crusting after use of microdebrider assisted turbinoplasty. Only 4 patients had crusting and only one patient had bleeding. This study was conducted in 338 patients.

- In our study we had Conventional method of submucosal resection showed improvement rates of 100%, 95%, and 95% respectively during 1st, 3rd, 6th month follow-up. Though 95% of the patient had improvement only 85% of the patient had no nasal obstruction post operatively whereas other 15% of the patients complained of some nasal obstruction problems during the follow up periods.

- Conventional method of submucosal resection showed 25% of the synechiae formation among the 20 pateints operated by this method, bleeding complications was 10% and crusting was also identified in 10% of the patients.

MICRODEBRIDER ASSISTED SUBMUCOSAL RESECTION OF TURBINATE:

Pre operatively 85% of the patient showed severe nasal obstruction and 15% of the patients showed moderate nasal obstruction in the subjective method by DNE.

Whereas the ratio were 4: 1 for the severe and moderate nasal obstruction by NOSE for the 20 patients in this group.

POST OPERATIVE REVIEW:

By DNE Method:

None of the patient were found to be have grade III nasal obstruction in 1st, 3rd and 6th month post operative review. During the 6th month review only 2 patients showed grade II nasal obstruction.

By NOSE score method:

No patient complained of the nasalobstruction during the first month review and 3rd and 6th month post operative reviews showed 90% of improvement of nasal obstruction. Friedman et al found that the ideal turbinate surgery would be limited to the erectile submucosal tissue and to the bony turbinate. Reduction of bone creates more space, while surgery on sub mucosal tissue create scarring that minimize the engorgement of inferior turbinate.

They conducted a study in 120 patients with symptoms in the severe and moderate range of nasal obstruction. They found 100% improvement in nasal obstruction post operatively.

- Van Delden*et al* after performing microdebrider assisted turbinoplasty for 100 patients during 1994-1997 found postoperative improvement in nasal patency occurred in 93% of patient.
- Friedman *et al* at 1999, studied 112 patient who underwent bilateral microdebrider– assisted turbinoplasty and suggested that microdebrider usage in turbinoplasty is a safe method for achieving turbinate size reduction with acceptable morbidity in patient with nasal obstruction and bleeding is a rare complication; while preservation of mucosa leads to early healing and absence of crusting and bone exposure. The microdebrider technique lends itself to precise tissue removal with satisfactory reduction of tissue, but also 5% developed synechia.
- Lee *et al* at 2004 during a study of 29 patients with microdebrider – assisted turbinoplasty found that the nasal obstruction improvement was 91%. Joniau*et al* at 2006 performed their study on 19 patients. They did powered turbinoplasty on one side and sub mucosal diathermy on other side, and they found that powered turbinoplasty

(microdebrider) was superior to sub mucosal diathermy. Hegazi*et al* at 2007 observed that 10% of the patients developed mild crustation after microdebriderturbinoplasty and saw complete resolution of nasal obstruction in 80% of patients and mild nasal obstruction in 20% of patients two months after Microdebrider-Assisted turbinoplasty. Chen *et al* at 2007, during a study of 120 patients with chronic nasal obstruction, had divided them into 2 groups, one treated with microdebrider – assisted turbinoplasty and the other with sub mucosal resection. They had found that they are equally effective (both subjectively and objectively) in determining nasal obstruction in patients with hypertrophic inferior turbinate; however, microdebrider –assisted turbinoplasty was superior to sub mucosal resection due to more significant preservation of nasal mucosa resulting from definitive, controlled volume reduction of inferior turbinate sub mucosa.

- Liu *et al* at 2009 noted that microdebriderturbinoplasty and related symptom such as nasal obstruction, sneezing, rhinorhea and snoring significantly decreased from 6 months to 3 years after surgery, and also observed crustation and adhesion in 7 patients of 60 patients. Cingi*et al* at 2009 found that the nasal obstruction significantly improved after microdebrider – assisted turbinoplasty on seventh day and persist after 3 months from surgery.

- Finally, Bahandarkar*et al* at 2010 found that microdebrider-assisted turbinoplasty is a trend toward procedures that are mucosal sparing and may offer better long term outcome than radiofrequency ablation. In conclusion, microdebrider - assisted turbinoplasty is a safe method for achieving turbinate size reduction with acceptable morbidity in patients with nasal airway obstruction secondary to turbinate hypertrophy; with bleeding as a minimal complication. Preservation of mucosa leads to early healing and absence of crusting.
- Our study also had comparative results of the above mentioned studies with success rate of 100% improvement, and complications where 10% for crust formation, 10% for synechiae, and 15% for bleeding.

- **CRYOSURGERY:**

When preoperatively analyzed by DNE, 16 patients had grade III nasal obstruction and other 4 patients complained of the moderate nasal obstruction.

For NOSE score 15 patients complained of the severe nasal obstruction and 5 patients complained of moderate nasal obstruction.

POST OPERATIVE REVIEW:

By DNE method:

First and third month reviews in the grade III nasal obstruction whereas 6^{th} month review showed some changes 1 patients had severe nasal obstruction and 7 patients had moderate nasal obstruction.

By NOSE score method:

None of the patients complained of the nasal obstruction during the 1^{st} month and 1 patient had fairly bad nasal obstruction complaints in the 3^{rd} month and 6^{th} months . whereas 7 patients had moderate obstruction problem during them 6^{th} month review.

- Rakover Y et al(1996), conducted a study on outcome of cryosurgery with success rate of 62%.
- Chiossone and etal(1990), conducted a study, which showed significant improvementin relieving nasal obstruction in 83% of the patients.
- David(2009) studied cryosurgery method of turbinate reduction,which showed 54% improvement in nasal breathing.
- The results found in our study is comparable with other authors.

Although the success rate for the procedure was only 50%, but the improvements from the preoperative grade of nasal obstruction was 100% when compared postoperatively. Complications were 25% for the crust formation, 10% for bleeding and only 5% for synechiae formation.

CONCLUSION

1. 95% of the patients had improved airway after surgery
2. In conventional submucous resection, the overall improvement is 90% by both subjective and objective assessment.
3. In microdebrider assisted submucosal resection , the overall improvement is 100% by both subjective and objective assessment.
4. In cryosurgery, the overall improvement is 95% by both subjective and objective assessment.
5. Comparison of complications rate showed 13.3% for synechiae, 11.7% for bleeding and 16.7% for crusting and dryness .
6. On analyzing these three turbinoplasty procedures, the microdebrider assisted submucosal resection procedure is best for relieving nasal obstruction and for reducing turbinate size in our setting.

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1.

ANNEXURE - 1
PROFORMA

Case No.	:				
Name	:		IP/OPNo.	:	
Age	:		D.O.A.	:	
Sex	:		D.O.D	:	
Occupation	:		Diagnosis	:	
Income	:		Results	:	
Address	:				
Phone No.	:				

I. PRESENTING COMPLAINTS

1. Nasal obstruction :

2. Nasal discharge :

3. Headache :

4. Facial pain:

5. Loss of smell :

6. Bleeding through nose :

II. PAST HISTORY

History of Tuberculosis / Syphilis/ Leprosy

History of infectious fever - Measles/Chicken pox/Typhoid

History of trauma or allergy

Surgery for any other disease in neck and throat

History of irradiation

History of diabetes or myxoedema

Diseases of CNS

III. FAMILY HISTORY

Similar complaints in any other member in the family

History of T.B./Diabetes/ Hypertension

(a) Duration

(b) Onset

IV. PERSONAL HISTORY

Diet/Sleep/appetite Micturation bowel habits

™ Habits : Smoking

: Pan/Beetlenut chewing

: Alcohol intake

: Exposure to venereal diseases status

Hygiene/Socio-economic Status

Exposure to dusty atmosphere or chemical irritants or fumes etc.,

V. PHYSICAL EXAMINATION

(a) Built - Good / Moderate/Poor

(b) Nutrition - Good/Moderate/Poor

(c) Mental Status - Conscious /Co-operative

(d) Pallor / Icterus / Cyanosis! Clubbing / Pedal Edema

(e) Lymph-node status

Size/Shape/No/Consistency/Mobility/Overlying Skin

Vital Data - Temperature

- Pulse
- Respiratory rate
- Blood Pressure

VI. SYSTEMIC EXAMINATION

(a) Cardiovascular system

(b) Respiratory system

(c) Per Abdomen

(d) Central Nervous systems

VII. ENT EXAMINATION

a) Examination of Nose

Anterior rhinoscopy

Postnasal examination

Pre Operative DNE NOSE score

b) Examination of Throat

- Oral Cavity & Oropharynx
- Indirect laryngoscopic examination

c) Examination of Ear

d) Examination of Neck

VIII. PROVISIONAL DIAGNOSIS

IX. INVESTIGATIONS

(a) Blood-Hb%/BT/CT/TC/DC/ESR

Blood Urea/Serum creatinine/Blood Cholesterol

Blood VDRL

(b) Urine - Albumin / Sugar/Microscopy

(c) Stool Examination for - ova / Cyst

(d) Sputum for AFB/ X-ray Chest

(e) X- ray PNS

(f) CT Scan para nasal sinuses

(g) Diagnostic Nasal Endoscopy

(h) Allergic Tests.

X. FINAL DIAGNOSIS

XI. MANAGEMENT

XII. FOLLOW UP	DNE	NOSE score
FIRST MONTH		
THIRD MONTH		
SIXTH MONTH		

XIII. POST OPERATIVE COMPLICATIONS

ANNEXURE - 2

CONSENT FORM

I ____ hereby give consent to participate in the study conducted by Department of Otorhinolaryngology, Thanjavur medical college hospital and to use my personal clinical data and result of investigation for the purpose of analysis and to study the nature of disease. I also give consent for further investigations.

Place :

Date : Signature of participant

ANNEXURE – 3

STATISTICAL ANALYSIS

Conventional (n=20)

	DNE PRE OP						Statistical inference
	Severe		Moderate		Total		
	n	%	n	%	n	%	
DNE Post 1							
Moderate	2	13.3%	0	.0%	2	10.0%	X^2=0.741 Df=1 .389>0.05 Not Significant
Mild	13	86.7%	5	100.0%	18	90.0%	
DNE Post 3							
Severe	1	6.7%	0	.0%	1	5.0%	X^2=2.222 Df=2 .329>0.05 Not Significant
Moderate	4	26.7%	0	.0%	4	20.0%	
Mild	10	66.7%	5	100.0%	15	75.0%	
DNE Post 6							
Severe	2	13.3%	0	.0%	2	10.0%	X^2=2.533 Df=2 .282>0.05 Not Significant
Moderate	7	46.7%	1	20.0%	8	40.0%	
Mild	6	40.0%	4	80.0%	10	50.0%	
Total	**15**	**100.0%**	**5**	**100.0%**	**20**	**100.0%**	

Cyro surgery (n=20)

	DNE PRE OP						Statistical inference
	Severe		Moderate		Total		
	n	%	n	%	n	%	
DNE Post 1							
Mild	16	100.0%	4	100.0%	20	100.0%	-
DNE Post 3							
Moderate	2	12.5%	0	.0%	2	10.0%	X^2=0.556 Df=1 .456>0.05 Not Significant
Mild	14	87.5%	4	100.0%	18	90.0%	
DNE Post 6							
Severe	1	6.3%	0	.0%	1	5.0%	X^2=0.580 Df=2 .748>0.05 Not Significant
Moderate	6	37.5%	1	25.0%	7	35.0%	
Mild	9	56.3%	3	75.0%	12	60.0%	
Total	**16**	**100.0%**	**4**	**100.0%**	**20**	**100.0%**	

Microdebrider (n=20)

	DNE PRE OP						Statistical inference
	Severe		Moderate		Total		
	n	%	n	%	n	%	
DNE Post 1							
Mild	17	100.0%	3	100.0%	20	100.0%	-
DNE Post 3							
Mild	17	100.0%	3	100.0%	20	100.0%	-
DNE Post 6							
Moderate	2	11.8%	0	.0%	2	10.0%	X^2=0.392 Df=1 .531>0.05 Not Significant
Mild	15	88.2%	3	100.0%	18	90.0%	
Total	**17**	**100.0%**	**3**	**100.0%**	**20**	**100.0%**	

Conventional (n=20)

	Nose PRE OP						Statistical inference
	Severe		Moderate		Total		
	n	%	n	%	n	%	
Nose Post 1							
Moderate	1	7.1%	0	.0%	1	5.0%	X^2=0.556 Df=2 .757>0.05 Not Significant
Mild	3	21.4%	1	16.7%	4	20.0%	
No problem	10	71.4%	5	83.3%	15	75.0%	
Nose Post 3							
Severe	1	7.1%	0	.0%	1	5.0%	X^2=0.556 Df=2 .757>0.05 Not Significant
Mild	3	21.4%	1	16.7%	4	20.0%	
No problem	10	71.4%	5	83.3%	15	75.0%	
Nose Post 6							
Severe	1	7.1%	0	.0%	1	5.0%	X^2=3.045 Df=3 .385>0.05 Not Significant
Moderate	2	14.3%	0	.0%	2	10.0%	
Mild	5	35.7%	1	16.7%	6	30.0%	
No problem	6	42.9%	5	83.3%	11	55.0%	
Total	**14**	**100.0%**	**6**	**100.0%**	**20**	**100.0%**	

Cyro surgery(n=20)

	Nose PRE OP						Statistical inference
	Severe		Moderate		Total		
	n	%	n	%	n	%	
Nose Post 1							
Mild	1	6.7%	0	.0%	1	5.0%	X^2=0.351 Df=1 .554>0.05 Not Significant
No problem	14	93.3%	5	100.0%	19	95.0%	
Nose Post 3							
Moderate	1	6.7%	0	.0%	1	5.0%	X^2=1.176 Df=2 .555>0.05 Not Significant
Mild	2	13.3%	0	.0%	2	10.0%	
No problem	12	80.0%	5	100.0%	17	85.0%	
Nose Post 6							
Moderate	1	6.7%	0	.0%	1	5.0%	X^2=2.459 Df=2 .292>0.05 Not Significant
Mild	8	53.3%	1	20.0%	9	45.0%	
No problem	6	40.0%	4	80.0%	10	50.0%	
Total	**15**	**100.0%**	**5**	**100.0%**	**20**	**100.0%**	

Microdebrider (n=20)

	Nose PRE OP						Statistical inference
	Severe		Moderate		Total		
	n	%	n	%	n	%	
Nose Post 1							
No problem	16	100.0%	4	100.0%	20	100.0%	-
Nose Post 3							
Mild	2	12.5%	0	.0%	2	10.0%	X^2=0.556 Df=1 .456>0.05 Not Significant
No problem	14	87.5%	4	100.0%	18	90.0%	
Nose Post 6							
Moderate	1	6.3%	0	.0%	1	5.0%	X^2=0.556 Df=2 .757>0.05 Not Significant
Mild	1	6.3%	0	.0%	1	5.0%	
No problem	14	87.5%	4	100.0%	18	90.0%	
Total	16	100.0%	4	100.0%	20	100.0%	

DEPARTMENT OF ENT

MASTER CHART FOR TURBINOPLASTY

SL.NO	NAME	AGE/SEX	TYPE OF SURGERY	DNE GRADE OF TURBINATE				NOSE SCORE				COMPLICATION		
				PRE OP	POST OP IN MONTHS			PRE OP	POST OP IN MONTHS			SYNECHIAE	BLEEDING	CRUSTING
					1	3	6		1	3	6			
1	RAMESH	37/M	CONVENTIONAL SUBMUCOSAL RESECTION	III	I	I	I	3	0	0	0	-	+	-
2	MANIKANDAN	26/M		III	I	I	I	3	0	0	0	-	-	-
3	BHARATHI	29/F		II	I	I	I	2	0	0	0	+	-	-
4	MUTHUKUMARAN	35/M		III	I	II	II	3	0	0	1	-	-	-
5	CHITHRA	30/F		III	I	I	II	3	0	0	0	-	-	-
6	SARAVANAN	31/M		II	I	I	I	2	0	0	0	-	-	-
7	PANJAVARNAM	29/F		III	I	I	I	3	0	0	0	-	-	-
8	KUMAR	40/M		III	I	I	II	3	0	0	1	-	-	-
9	AASHA	19/F		III	I	II	II	3	0	1	1	-	-	-
10	SANTHA	40/F		III	II	II	III	3	1	1	2	+	-	+
11	BALASUBRAMANIAN	22/M		II	I	I	I	3	0	0	0	-	-	-
12	KATHIRVEL	35/M		III	I	II	II	3	1	1	2	+	-	-
13	ANITHA	29/F		III	I	I	I	3	0	0	0	-	-	-
14	VEERAKUMARAN	41/M		III	I	I	II	3	1	0	1	+	-	-
15	KARTHIKEYAN	23/M		III	I	I	I	2	0	0	0	-	-	-
16	ALAMELU	48/F		III	II	III	III	3	2	3	3	+	+	-
17	VIVEK	21/M		II	I	I	I	2	0	0	0	-	-	-
18	KAJALAKSHMI	40/F		III	I	I	II	3	0	0	1	-	-	+
19	PRAKASH	27/M		II	I	I	II	2	1	1	1	-	-	-
20	RAJESHWARI	24/F		III	I	I	I	2	0	0	0	-	-	-

MASTER CHART FOR TURBINOPLASTY

SL. NO	NAME	AGE/ SEX	TYPE OF SURGERY	DNE GRADE OF TURBINATE				NOSE SCORE				COMPLICATION		
				PRE OP	POST OP IN MONTHS			PRE OP	POST OP IN MONTHS			SYNECHIAE	BLEEDING	CRUSTING
					1	3	6		1	3	6			
1	SADHAM HUSAIN	27/M	MICRODEBRIDER ASSISTED SUBMUCOSAL RESECTION	III	I	I	I	3	0	0	0	-	-	-
2	KAVITHA	35/F		III	I	I	I	3	0	0	0	-	-	+
3	VEERAMANI	21/M		III	I	I	I	3	0	0	0	-	-	-
4	REVATHI	27/F		III	I	I	I	3	0	0	0	-	+	-
5	RAGAVI	19/F		III	I	I	I	3	0	0	0	-	-	-
6	PRABHAHARAN	24/M		III	I	I	I	2	0	0	0	-	-	-
7	VIJAYAKUMAR	38/M		III	I	I	I	3	0	0	0	-	-	-
8	BHASEER AHMAED	50/M		III	I	I	II	3	0	1	2	+	-	-
9	KAVIYA	20/F		II	I	I	I	2	0	0	0	-	-	-
10	PAVITHRA	31/F		III	I	I	I	3	0	0	0	-	-	-
11	ABBAS	26/M		III	I	I	I	3	0	0	0	-	+	-
12	VINOTHA	24/F		III	I	I	I	3	0	0	0	-	-	+
13	RAJESH	34/M		II	I	I	I	3	0	0	0	-	-	-
14	JOHN KENNEDY	40/M		III	I	I	I	3	0	0	0	-	-	-
15	RAJA	44/M		III	I	I	II	3	0	1	1	+	-	-
16	MUTHULAKSHMI	26/F		II	I	I	I	2	0	0	0	-	-	-
17	JOTHI	36/F		III	I	I	I	3	0	0	0	-	+	-
18	RAJENDRAN	46/M		III	I	I	I	3	0	0	0	-	-	+
19	DHANAVATHI	21/F		III	I	I	I	2	0	0	0	-	-	-
20	FAZIL	24/M		III	I	I	I	3	0	0	0	-	-	-

MASTER CHART FOR TURBINOPLASTY

SL.NO	NAME	AGE/ SEX	TYPE OF SURGERY	DNE GRADE OF TURBINATE				NOSE SCORE				COMPLICATION		
				PRE OP	POST OP IN MONTHS			PRE OP	POST OP IN MONTHS			SYNECHIAE	BLEEDING	CRUSTING
					1	3	6		1	3	6			
1	KAVI MANI	30/M	CYRO SURGERY SUBMUCOSAL RESECTION	III	I	I	I	3	0	0	1	-	+	-
2	SURYA	19/M		III	I	I	II	3	0	0	0	-	-	-
3	SHANTHI	29/F		III	I	I	I	3	0	0	0	-	-	-
4	KALYANI	41/F		II	I	I	II	3	0	0	1	-	-	+
5	GAJENDRAN	34/M		III	I	I	II	2	0	0	1	-	-	-
6	PAVITHRAN	25/M		III	I	I	I	3	0	0	1	-	-	+
7	KALAIRANI	28/F		III	I	I	II	3	0	1	1	-	-	-
8	JOHN BRITTO	40/M		II	I	I	I	2	0	0	0	-	-	-
9	SHAKUL AHMED	22/M		III	I	I	I	3	0	0	0	-	-	-
10	VIJAYAN	49/M		III	I	II	III	3	1	2	2	+	-	+
11	SUBATHRA	29/F		II	I	I	I	2	0	0	0	-	-	-
12	CHANDRA SEKAR	34/M		II	I	I	I	3	0	0	1	-	-	-
13	SURESH KUMAR	27/M		III	I	II	II	3	0	1	1	-	-	+
14	MANIMEKALAI	30/F		III	I	I	II	3	0	0	1	-	-	-
15	RAGUPATHI	32/M		III	I	I	I	2	0	0	0	-	-	-
16	PARTHIBAN	24/M		III	I	I	I	3	0	0	0	-	-	-
17	MOHAN	30/M		III	I	I	I	3	0	0	0	-	+	-
18	VINITHA	21/F		III	I	I	I	3	0	0	0	-	-	-
19	PRABHU	24/M		III	I	I	I	2	0	0	0	-	-	-
20	VENKADESH	31/M		III	I	I	II	3	0	0	1	-	-	+