EVALUATION OF HEARING OUTCOME IN MYRINGOSTAPEDIOPEXYAND MYRINGOPLATINOPEXY

By

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Dissertation submitted to
Sri Devaraj Urs Academy of Higher Education and Research,
Kolar, Karnataka

in partial fulfillment of the requirements for the degree of

MASTER OF SURGERY

IN

OTORHINOLARYNGOLOGY

Under the Guidance of

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I hereby declare that this dissertation entitled **"Evaluation Of Hearing Outcome in Myringostapediopexy and Myringoplatinopexy"** is a bonafide and genuine research work carried out by me under the guidance of **Dr.K.C.PRASAD**, Professor, Department of Otorhinolaryngology, Sri Devaraj Urs Medical College, Kolar, in partial fulfilment of University regulation for the award "**M.S. Degree in OTORHINOLARYNGOLOGY**" the examination to be held in April, 2019 by SDUAHER. This has not been submitted by me previously for the award of any degree or diploma from the university or any other university.

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ACKNOWLEDGEMENT

With humble gratitude and great respect, I would like to thank my teacher, mentor and guide, **Dr. K.C. PRASAD** Professor, **Department of Otorhinolaryngology**, Sri Devaraj Urs Medical College and Research Institute, Kolar, for believing in me and giving his relentless guidance, constant encouragement, immense help and advices which went a long way in moulding and enabling me to complete this work successfully. Without his initiative and constant encouragement this study would not have been possible.

I wish my deeply felt gratitude to **Dr. S.M AZEEM MOHIYUDDIN,** Head of the Department of Otorhinolaryngology. For his supervision and useful suggestions have served as a constant source of inspiration during the entire course of my study. His vast experience, patience and knowledge cannot be compared with anything.

I sincerely thank **Dr.A.Sagayaraj** for his encouragement and support and teaching me many ethics required during my clinical practice.

I am forever indebted to **Dr. Shree Harsha Maruvalla and Dr. Prasahanth Babu** who has left deep impression in my life the opportunity to learn from them.thier willingness to share their knowledge has been a constant motivation in me.

I would like to thank all my teachers of Department of Otorhinolaryngology, Sri Devaraj Urs Medical College and Research Institute, Kolar, for their constant guidance and encouragement during the study period.

I am extremely grateful to the patients who volunteered to this study and putting faith in me. Without them this study would just be a dream. Their coping with illness is a constant awareness that our search for a cure must continue.

I express my appreciation to my colleagues **Dr. Pratyusha, Dr.Anjali and Dr. Indu Varsha** for helping me in the process of editing my dissertation.

I extend my acknowledgement to **Mrs. Apoorva HM,** Department of Audiology**,** for their excellent support and professionalism.

I owe debt and gratitude to my mother **Mrs. Munirathna BalaramChandra** and my uncle **Mr. K.M.Srinivas Murthy** for keeping the belief in me and make me do wat I am.

I specially thank **Mr. Vishal Krishna** for being a constant support and encouraging me during all my ups and downs and help me in everything I wanted with this work.without him this would have not been possible for me.

Lastly I thank almighty for blessing me.

Dr. SWAPANTHI. M.B.

LIST OF ABBREVIATIONS

CSOM	-	CHRONIC SUPPORATIVEOTITIS MEDIA
TTD	-	TUBO TYMPANIC DISEAASE
AAD	-	ATTICO ANTRAL DISEASE
A-K	–	AUSTIN KARTUSH
TORP	-	TOTAL OSSICULAR REPLACEMEMNT PROSTHESIS
PORP	-	PARTIAL OSSICULAR REPLACEMENT PROSTHESIS
CWD	-	CANAL WALL DOWN
ICW	-	INTACT CANAL WALL
RWN	-	ROUNG WINDOW NICHE
RWM	-	ROUND WINDOW MEMBRANE
AC	-	AIR CONDUCTION
ABG	-	AIR BONE GAP
BC	-	BONE CONDUCTION
COM	-	CHRONIC OTITIS MEDIA
dB	-	DECIBEL
EAC	-	EXTERNAL AUDITORY CANAL
ENT	-	EAR, NOSE THROAT
FIG.	-	FIGURE
HRCT	-	HIGH RESOLUTION COMPUTED TOMOGRAPHY
Hz	-	HERTZ
KHz	-	KILOHERTZ
PRE-OP	-	PRE OPERATIVE
POST-OP	-	POST OPERATIVE

ABSTRACT

BACKGROUND: Chronic Suppurative Otitis Media is a long-standing infection of the middle ear cleft. This leads to ear discharge and perforation of tympanic membrane. It is highly prevalent in individuals from poor socio-economic conditions. In the time of minimal invasive technique for ear surgeries, the aim of the otologist is to eradicate the disease, prevent recurrence and perform ossiculoplasty for hearing improvement.depending on presence or absence of stapes superstructure the ossiculoplasty procedure were conducted. When stapes superstructure was present myringostapediopexy was performed and if it is absent myringplatinopexy was performed.

AIMS AND OBJECTIVES: To assess the hearing outcomes after myringostapediopexy in chronic supporative otitis media patients by pure tone audiometry.To assess the hearing outcomes after myringoplatinopexy in chronic supporative otitis media patients by pure tone audiometry.To compare the hearing outcome after each procedure in relation to pre-operative hearing loss.

METHODOLOGY: Patients diagnosed with CSOM with conductive hearing loss presenting to the department of Otorhinolaryngology and head and neck surgery of R.L.Jalappa hospital, Tamaka, Kolar from January 2016 to July 2018.

Fulfilling inclusion and exclusion criteria these patients were taken into two groups. group A included myringostapediopexy and group B included myringoplatinopexy with 24 patients in each group. After performing the surgeries all patients were followed up after 3 months to examine the status of tympanic membrane and tuning fork test and PTA was done to evaluate the hearing outcome and those findings were noted and those were compared with preoperative results

TYPE OF STUDY: Observational study

RESULTS: The net improvement of gain in hearing outcome was 22.29±7.97 and 18.33±6.55 in group A and group B respectively which showed a better hearing outcome in Out of 24 patients. In group A, 15 (63%) patients were reconstructed with homologous nasal septal spur cartilage. Autologous Incus was used in 6 patients (25%) and in 3 (13%) patients cortical bone was used for reconstruction, 2 patients presented with the extrusion with autologus incus and cortical bone. In group B, 14 patients were reconstructed with homologous nasal septal spur cartilage (58%) and 10 patients (42%) with autologous Incus. 3 patients had extrusion and all these patients were reconstructed with autologous incus. However after revision surgery reconstruction of ossicle was done with homologous nasal septal spur cartilage all 5 patients had good healing and better hearing. In our study, all patients had well healed neotympanum with no recurrence at 3 months following surgery. The mean AC threshold for pre operative and post operative values among both groups shows that post operative hearing outcome has significantly improved with a statistical significance of 0.012. This says ossicluoplasty significantly improves the post operative hearing.

CONCLUSION: The ossiculoplasty of myringostapediopexy type shows better hearing outcome as compared to myringoplatinopexy.

Among the type of ossiclular graft material homologous septals pur had a better hearing outcome compared to autologous incus.

KEY WORDS:

Myringostapediopexy,

Myringoplatinopexy

Wullstein Classification

Austin Kartush Classification

Hearing Outcome

TABLES OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF GRAPHS

1. INTRODUCTION

The ear is divided into three parts, outer (external) ear, middle (tympanic cavity) ear, inner (labyrinth) ear. Middle ear cleft comprises of Eustacian tube, Middle-Ear Space Mastoid Antrum and Mastoid Air Cells (fig 1)

Chronic Suppurative Otitis Media (CSOM) is a long-standing infection of the middle ear cleft. This leads to ear discharge and perforation of tympanic membrane. It is highly prevalent in individuals from poor socio-economic conditions.

CSOM is divided into two types, they are :

Tubotympanic Disease (TTD) (safe ear): characterized by central perforation of pars tensa, this indicates that the disease is in the Eustachian tube and middle ear and affects the mucosa of middle ear cleft. It is also called as chronic otitis media(mucosal type).

Attico Antral Disease(AAD) (unsafe ear): characterized by perforation in pars flacida or pars tensa marginal perforation which is common in posterosupeior quadrant. There can be cholesteatoma formation in epitympanic region and mastoid antrum with bone erosion, this is also called as “erosive middle ear disease.” AAD is also called chronic otitis media (squamous type).

Midddle-ear Ossicles act as acoustic transformer which compensates loss of sound energy while conducting through inner ear fluids by impedance matching mechanism. When these ossicles get damaged it leads to loss of acoustic transformation or impedance matching mechanism which results in impaired hearing as seen in conductive hearing loss and thereby affects the quality of life of patients.

The conductive deficit in excess of 40dB indicates ossicular discontinuity by erosion. The long process of incus is first affected followed by other ossicle erosions.

Hearing improvement depends on several factors like stage of disease, degree of ossicular destruction, state of middle ear mucosa, Eustacian tube function, degree of pre operative hearing loss and the material used for reconstruction.

In the time of minimal invasive technique for ear surgeries, the aim of the otologist is to eradicate the disease, prevent recurrence and perform ossiculoplasty for hearing improvement.

The term ossiculoplasty relates to the surgery performed in the middle ear for restoration of hearing mechanism and result in long term hearing. Long term success rate with ossiculoplasty is based on control of chronic otitis media and accuracy of middle ear ventilation. The different materials used for ossicular reconstruction are classified as biocompatible materials such as homologous and autologous ossicles, cortical bones or cartilages and alloplastic materials like Total Ossicular Replacement Prosthesis (TORP) and Partial Ossicular Replacement Prosthesis (PORP). The benefit of using autologous grafts for reconstruction of ossicles is that they are safe and not expensive. Septal spur cartilage is a preferred material for reconstruction because of its thickness, can be easily sculptured and stays for a long period. Alloplastic materials such as TORP and PORP are expensive and have high extrusion rate.

There are a number of ossiculoplasty procedures, Myringostapediopexy and Myringoplatinopexy are two among them. There is longstanding and largely unresolved controversy whether these goals are best attained when Canal Wall Down (CWD) or Intact Canal Wall(ICW) mastoidectomies are done in addition to ossiculoplasty and tympanoplasty.

CWD allow good visibility and room for disease clearance. During the post operative period the middle ear can be easily inspected in outpatient setting and second stage reconstruction is not usually required. This surgery has lesser clearance of recurrence and good hearing.

After eradication of disease, reconstruction of conductive apparatus is very important for restoration of hearing. Careful efforts must be made to improve the hearing by single stage tympanoplasty.

This study has been performed with the purpose to study the hearing outcome between the two ossiculoplasty procedures namely myringostapediopexy and myringoplatinopexy with autograft ossicles or cortical bones and homologous nasal septal spur cartilage after performing ICW or CWD mastoidectomie**s.**

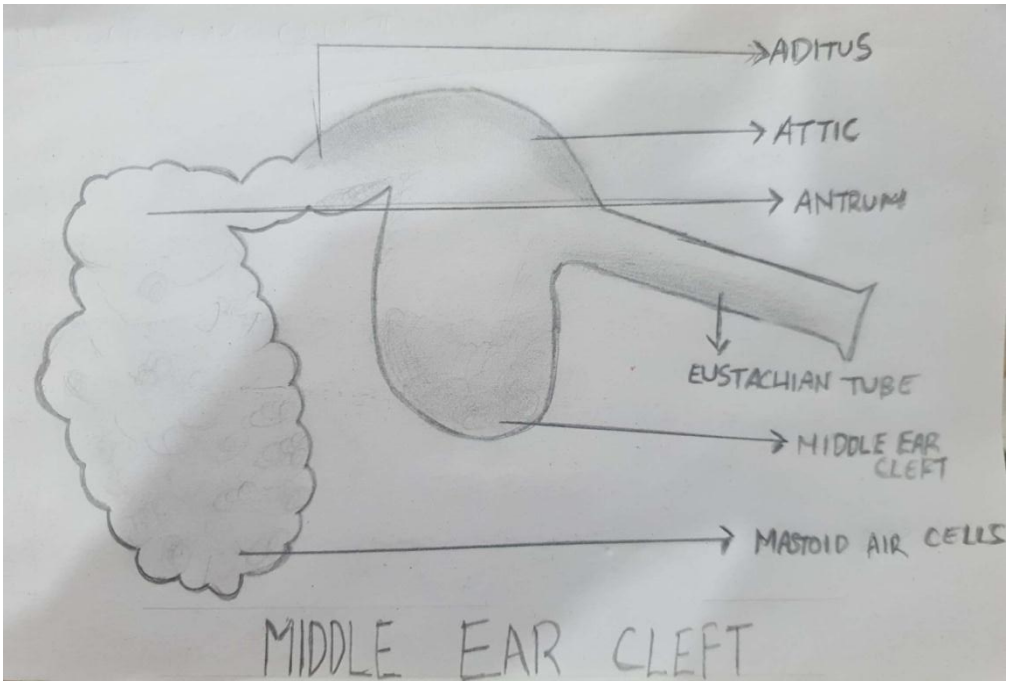

FIG. 1 : MIDDLE EAR CLEFT

2. OBJECTIVE OF THE STUDY

- To assess the hearing outcomes after myringostapediopexy in chronic supporative otitis media patients by pure tone audiometry.
- To assess the hearing outcomes after myringoplatinopexy in chronic supporative otitis media patients by pure tone audiometry.
- To compare the hearing outcome after each procedure in relation to pre-operative hearing loss.

3. REVIEW OF LITERATURE

CSOM is a chronic inflammation of the middle ear and mastoid cavity. Clinical features are recurrent ear discharge through a tympanic membrane perforation, with conductive hearing loss of varying severity and presenting with Tympanic membrane Perforation for more than 3 months[1].

Prevalence of CSOM patients is more in males (61%) with majority of cases belonging to lower and middle socio-economic strata with a rural urban ratio of 2:1. This occurs because of unhygienic living conditions, poverty, illiteracy about the disease and malnutrition. This is the basis of wide spread prevalence of CSOM in male and female patents.[2].

Ossicular chain reconstruction has significantly improved hearing results after tympanomastiod surgeries for chronic otitis media by the following techniques namely myringostapediopexy and myringoplatinopexy.

Myringostapediopexy is performed when malleus and capitulum of stapes is present. The sculptured ossicle/cartilage is placed between the head of stapes and the tympanic membrane graft. Myringoplatinopexy is performed when malleus is present and capitulum of stapes is absent. The sculptured ossicle/cartilage is placed between the mobile footplate of stapes and the tympanic membrane graft.

Reconstruction of ossicular chain aims to surgically amend the middle ear transformer mechanism so that sound energy is conducted from the environment to the inner ear fluid with only minimal loss.

The reconstruction of ossicular chain was first described by Zollner in 1955. Attempts to rebuild the middle ear transformer mechanism began shortly after the introduction of tympanoplasty and great advances have been made in physiological functioning and biocompatibility of autograft and implants.

Long term success with ossicular reconstruction depends on control of otitis media and middle ear ventilation[3].

WULLSTEIN CLASSIFICATION[4]

Type 1 - comparison of middle ear without disruption of ossicles and reconstruction of tympanic membrane (ossicular chain mobile and intact)

Type 2 - malleus handle absent, reconstruction of the tympanic membrane over the remnant of malleus and long process of incus.

Type 3 - malleus and incus absent, reconstruction of tympanic membrane over an intact and mobile stapes (myringostapediopexy) with stapes acting as a collumella.

Type 4 - mobile stapes footplate exteriorized with reconstruction of the tympanic membrane as a round window baffle .

Type 5a - fenestration of lateral semi-circular canal in cases with no ossicles and fixed stapes foot plate. Round window is protected.

Type 5b - platinectomy, the oval window niche is filled with fatty tissue or fibrous tissue (fig:2)

Modern variation of this type III reconstruction include

a) *Minor collumella (myringostapediopexy*)-in which bone/ PORP interposed between capitulum and undersurface of tympanic membrane (fig 3).

b) *Major collumella (myringiplatinopexy*)- in which bone/ TORP extends from stapes footplate to under surface of tympanic membrane[3] (fig 4)

A minor erosion of the lenticular process and a more pronounced resorption of the long process are among the most common ossicular defects encountered in tympanoplasty. Austin-Kartush(A-K) have defined four groups in the absence of an intact incus and also explain percentage of occurrence of each type:

I. Malleus handle present, stapes superstructure present. (60%)

II. Malleus handle present, stapes superstructure absent. (24%)

III. Malleus handle absent, stapes superstructure present. (8%)

IV. Malleus handle absent, stapes superstructure absent[5]. (8%)

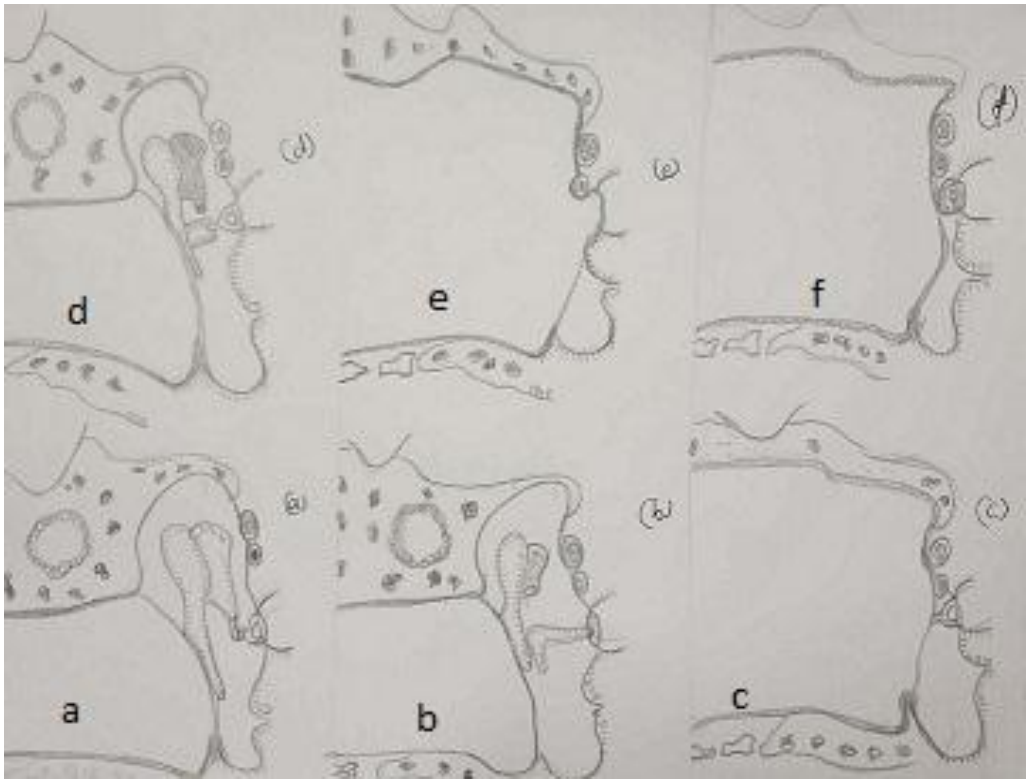

FIG. 2 : WULLSTEIN CLASSIFICATION OF TYMPANOLASTY

(a) Type I: Reconstruction of tympanic membrane graft with intact ossicle.

(b) Type II: Reconstruction of tympanic membrane over the remnant of the malleus.

(c) Type III: Reconstruction of tympanic membrane over an intact and mobile stapes

(d) Type IIIa: myringostapediopexy/ minor collumella

(e) Type Va: Fenestration of Lateral semi circular canal.

(f) Type Vb: platinectomy

- Autograft ossicles are inexpensive, safe and help in primary reconstruction in all patients undergoing tympano-mastoid surgeries.
- Ossicles show a variable degree of destruction. Minimally destroyed ossicles can be refashioned but extensive destruction of ossicles has to be replaced with other matierials from tragal cartilage, septal spur cartilage or autologous malleus/ incus.
- Septal spur cartilage is preferred because it is thick easy to refashion and stays longer.
- Hearing improvement varies depending upon several factors like the materials used, stage of disease, degree of destruction, state of middle ear mucosa, Eustacian tube function and the degree of pre operative hearing loss. Among these, materials used for tympanoplasty is an important factor in determining the long term hearing results.

The type of surgery (open or closed mastoidectomy) prosthesis type, presence of infection, tissue health and Eustacian tube function are the five factors which affect the outcome of ossicular reconstruction. These factors provide accurate preoperative individual assessment when counseling patients regarding the success or failure of the proposed ossicular reconstruction[6].

Myringostapediopexy is an infrequently performed surgery and studies about hearing outcome are less in number several cases of myringostapediopexy functioning as a type III tympanoplasty. Thereis no difference in conduction loss between children and adults. The benefit of this reconstruction can be appreciated only in conductive hearing loss , compared to mixed hearing loss.[7].

Studies show that on comparison of anatomical and functional results using titanium prosthesis for total ossicular reconstruction gives an improvement of the Air Bone Gap(ABG) less than 20db in 66% of the cases there is no difference in the hearing result between CWD or ICW or between primary and revision surgery. Best

results for sound transmissions at high frequencies is best achieved by titanium prosthesis .[8]

A study on myringostapediopexy used as a part of tympanoplasty following mastoid operations describes a technique of placing releasing incisions on tympanic membrane to ensure good contact between graft and stapes head[9].

A study conducted on hearing results with myringostapediopexy with partial ossicular replacement prosthesis (PORP), shows a better hearing gain with myringostapediopexy than with the use of PORP. The overall hearing gain for myringostapediopexy was 11.6dB[10]

Sade and Berco described the following findings wherever present in ossicular destruction.

1. The free margin of the destroyed bone showed osteoid reaction.
2. The bony defect was always lined by either granulations or connective tissue.
3. No epithelium was found in direct contact of the destroyed bone.
4. Stratified squamous epithelium was always found in cholesteatoma with bone destruction.
5. Epithelium was never to be in contact with the bone and this statement has been in argument by Sade in his study in 1977, where he found a squamous epithelium in direct contact with destroyed bone[11].

The ethiological factors causing bone destruction include osteolysis in calcified cartilagenous rests, bone resorption by invading matrix, osteoclast is stimulated by secondary infection and interruption of blood supply to ossicles[12/48]. Degradation and absorption of the organic and inorganic particles cause destruction in bone by absortion of inorganic materials by osteoclasts[13]

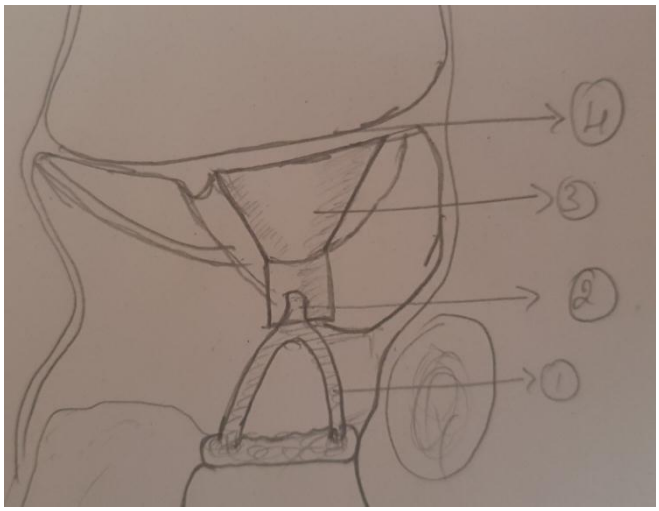

FIG 3: MYRINGOSTAPEDIOPEXY

1. Mobile stapes
2. Stapes superstructure.
3. Ossicular graft material
4. Neotympanum

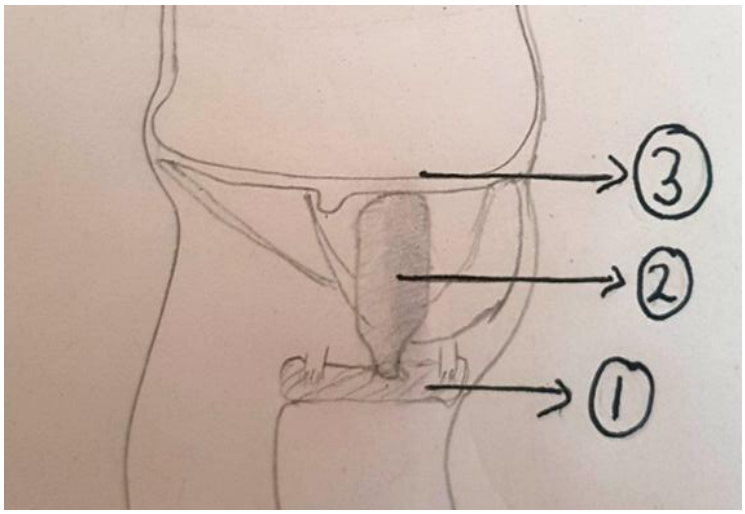

FIG 4 : MYRINGOPLATINOPEXY

1. STAPES FOOTPLATE
2. OSSICULAR GRAFT MATERIAL
3. NEOTYMPANUM

ANATOMY OF MIDDLE EAR

Middle ear is a mucous membrane lined, air filled space bounded between tympanic membrane and bony labyrinth within the temporal bone. It is biconcave in shape. Its vertical anteroposterior diameter measures around 15mm and transverse diameter varies from

2-6mm[14]. It contains ossicles, muscles, ligaments, vascular system, nervous system and aperture of Eustacian tube. Middle ear cleft comprises of Eustacian tube, middle ear cavity and mastoid air cell system.

The middle ear cavity and the epithelial lining of the middle ear cleft and Eustacian tube are derived from first pharyngeal pouch. It gives 4 sacci namely anticus, posticus, superior and medius the mastoid and middle ear are expanded and cover ossicular chain and line tympanomastiod compartment.

The mastoid pneumatisation occurs in squamous part by saccus superior and petrous part by saccus medius of temporal bone and is separated by petrosquamous lamina which is called as *Korner`s septum*. The operating surgeons should be careful in this region as pyramidal segment of facial nerve can get injured.

Middle ear measures around 15mm in antero-posterior and vertical dimension and superiorly extends up to 6mm and 4mm inferiorly.

It is divided into three compartments

1. ***Epitympanum****:* is limited superiorly by tegmen tympani and continues postereriorly as tegmen mastoidea (tegmen antri), medially by lateral and superior semicircular canal ampulae and epitympanic facial canal also called as *fallopian canal*. It contains head and neck of malleus and articulates with body of incus and held by anterior and superior ligament of malleus. This epitympanum continues posteriorly and forms *aditus ad antrum* mastoid cavity through mastoid tract.

2. **Mesotympanum** : lies at the level of pars tensa. It is limited superiorly by horizontal portion of facial canal. Inferiorly by round window niche (RWN). Mesotympanum contains round window and oval window, stapes, stapedius muscle posteriorly and canal for tensor tympani muscle anteriorly. The superior rim of the oval window is convex and concave in inferior rim representing the shape of the kidney where footplate of stapes is supported by annular ligament. RWN is a deep recess formed by many layers of mucous membrane conceals round window membrane (RWM). The two bony recesses, *facial recess* is lateral to vertical segment of seventh cranial nerve and *sinus tympani*, a space medial to facial recess.

3. **Protympanum** : is the anterior portion of tympanic space and bounded by, Eustachian tube orifice superiorly and canal for internal carotid artery anteriorly.

4. **Hypotympanum** : Contains bony trabeculae and bone covering jugular bulb, sometime this bony covering will be absent and exposing jugular bulb in the middle ear.

FLOOR OF THE MIDDLE EAR

Floor is formed by a thin plate of bone separating the hypotympanum from jugular bulb. The tympanic branch of glossopharyngeal nerve enters the middle ear from skull base at the junction of the floor and the medial wall of middle ear.

ROOF OF MIDDDLE EAR

It is formed by a thin plate known as tegmen tympani separating middle ear from middle cranial fossa and runs posteriorly to form the roof of aditus ad antrum known as *tegmen antri.*

LATERAL WALL OF MIDDLE EAR

Central region of lateral wall is formed by tympanic membrane; superiorly it is formed by the scutum (outer attic wall) and bony lateral wall of hypotympanum inferiorly, Petrotympanic fissure opens anteriorly above tympanic membrane and bounds anterior mallear ligament and supply middle ear by anterior tympanic branch of maxillary artery. Chorda tympani nerve enters the medial surface of the fissure through anterior canaliculus also called as *fissure of huguier* and runs posteriorly and runs between fibrous and mucosal layer of tympanic membrane by crossing manubrium of malleus and sits in the tympanic sulcus in posterior bony canal and reaches facial nerve.

MEDIAL WALL OF MIDDLE EAR

It separates middle ear from inner ear. It is also called as surgical floor in middle ear surgeries. The promontory which is formed by basal turn of cochlea occupies major part of medial wall of middle ear. It has small grooves on its surface to form tympanic plexus. Oval window (fenestra vestibuli), which is closed by footplate of stapes and surrounded by annular ligament lies posterior to promontory. Facial nerve runs above the oval window. Anterosuperior promontory, there is a curved hook like projection called as processes cochleariformis for tensor tympani tendon.. Round window fenestra cochleae is covered by secondary tympanic membrane behind, and above by the oval window, from which it is separated by posterior extension of promontory known as subiculum. Sometimes a spicule of bone covers the promontory above subiculum and passes to pyramid on posterior wall of middle ear cavity called as poticulus. A depression between ponticulus and sibuculum is called as sinus tympani bounded at superior and inferior region and posteriorly by semicircular canal. Round window is triangular in shape and lies under over hanging edge of promontory. The size of the round window membrane ranges from 2.30mm to 1.87mm[12]. Singular nerve lies closest to the ampullae of posterior semicircular canal which runs parallel

and 1mm away from medial attachment of the deep portion of the posterior part of membrane (surgical landmark for singular nerve). Medial wall of epitympanum forms the area above the level of facial nerve canal where posterior part of epitympanum is formed by a dome of lateral semicircular canal extending laterally to facial canal[12].

ANTERIOR WALL OF MIDDLE EAR

This portion is very narrow and has medial and lateral wall covering the major portion of it4. The lower portion has a thin plate covering internal carotid artery. This plate is perforated by superior and inferior caroticotympanic nerve and tympanic branches of internal carotid artery. The upper portion has two tunnels for tensor tympani muscle and bony portion of Eustachian tube[14].

POSTERIOR WALL OF MIDDLE EAR

It is wider above than below. It has an opening in the superior part called as aditus going to mastoid antrum. Fossa incudis houses short process of incus below the aditus. Pyramid with stapedius muscle lie below fossa incudis and medial to chordatympani nerve. Facial recess lies in-between pyramid and annulus tympanicus and is bounded by tympanic annulus laterally, facial nerve medially. Sinus tympani lies deep to the pyramid and facial nerve in posterior extension of mesotympanum and related to sibuculum inferiorly and ponticulus superiorly (fig 5).

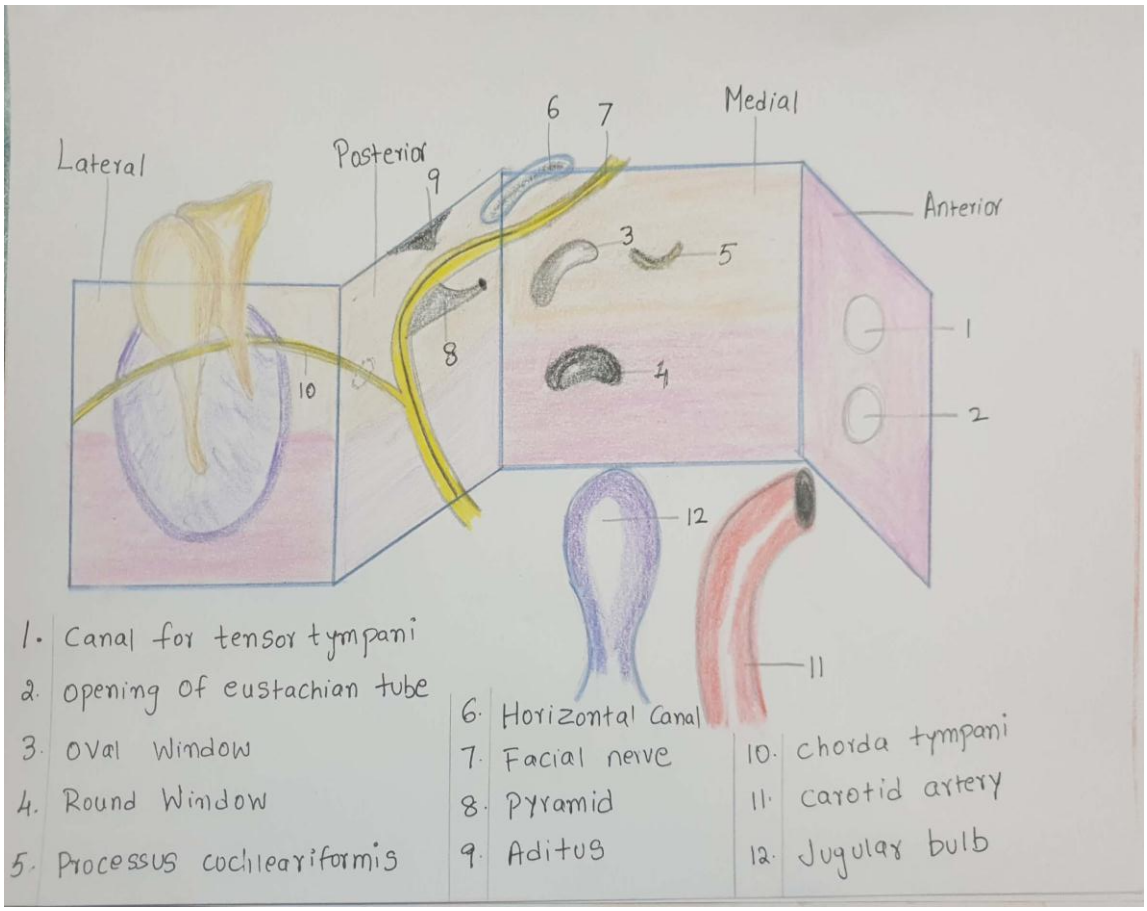

FIG 5 : WALLS OF MIDDLE EAR

CONTENTS OF TYMPANIC CAVITY

Tympanic cavity is an air filled space containing three ossicles, malleus, incus and stapes, two muscles tensor tympani muscle and stapedius muscle, ligaments, chorda tympani nerve, tympanic plexus of veins and tympanic arteries.

THE OSSICLE

The ossicular chain develops at around 4th week of intrauterine life and by 20th week it attains the adult size and ossifications initially begins in incus followed by malleus and stapes.

These ossicles, articulate with each other to form a mobile semi-rigid bony chain known as the ossicular chain (Fig 6) which helps in coupling sound from external ear to the inner ear fluids.

Malleus:

It resembles the hammer, it is the largest of all ossicles measuring about 8-9mm in size and weighs around 25mg. it has head lying in the attic region and articulates with body of incus and with superior and lateral ligaments. Just below the head is the neck lying against pars flacida where chorda tympani lies medially. Anterior process is connected by anterior ligament at petrotympanic fissure; lateral process provides attachment to the malleolar folds by projecting from upper end of handle of malleus. The handle of malleus also known as manubruim of malleus extends backward and medially and is attached in-between the middle fibrous layer and outer epithelial layer of pars tensa of tympanic membrane(fig 7).

Incus:

This resembles the anvil. It weighs around 25-30 mgs and has a body articulating with head of malleus, short process is fixed to fossa incudis below aditus and long process. It projects downwards into middle ear cavity as a long process runs parallel to handle of malleus with lentoform process as the tip turns medially to articulate with head of stapes (fig 8).

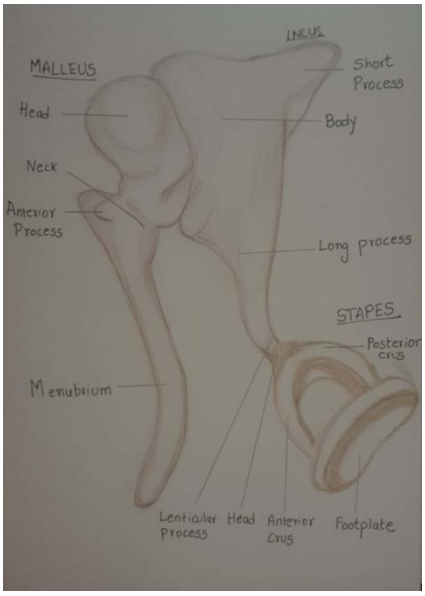

FIG 6 : OSSICULAR CHAIN

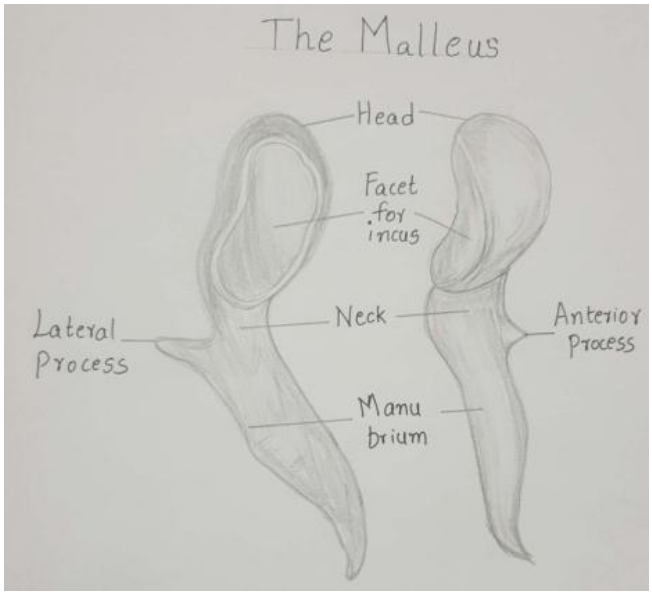

FIG 7 : MALLEUS

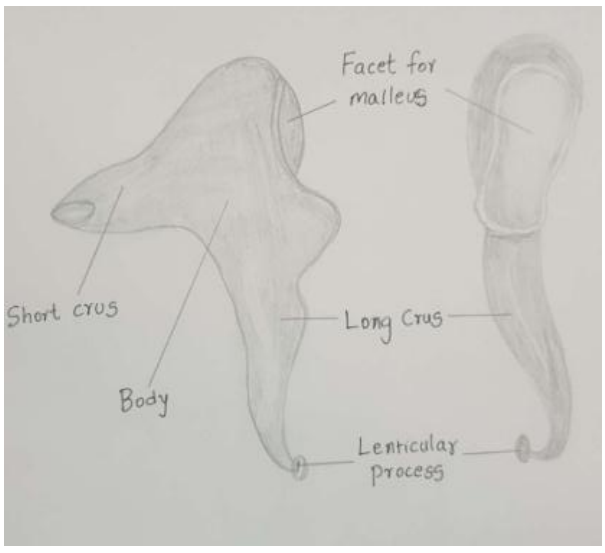

FIG 8 : INCUS

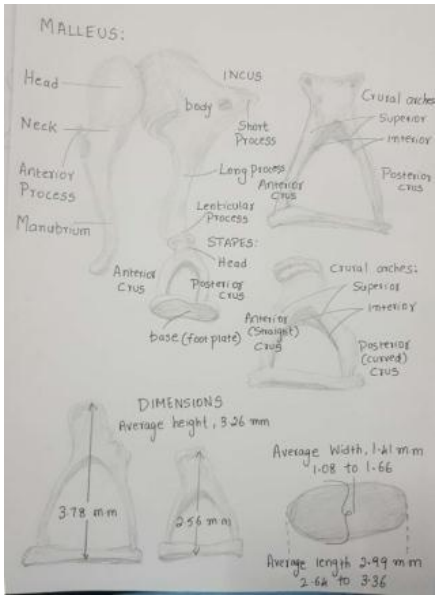

FIG 9 : STAPES WITH DIFFERENT DIMENSIONS

Stapes

It resembles the stirrup. It is a smallest bone in the human body. Measuring about 3.5mm and weighs around 3mg. It has small concave faced head articulating with lentiform process of long process of incus. It has a narrow neck which provides attachment to the thin tendon of stapes and oval shaped footplate fitting on fenestra vectibuli (oval window) surrounded by annular ligament**s(fig 9)**

ARTICULATION OF OSSICLES

The articulations for the ossicle are:

Incudomallear Joint: It is a saddle joint, a form of synovial joint with capsular ligament.

Incudostapedial Joint is a ball and socket joint. Is also a synovial joint held by capsular ligament.

Stapediovestibular Articulation is a fibrous joint where the footplate of stapes articulates with walls of oval window by annular ligament[14]

MUSCLES OF MIDDLE EAR

Tensor tympani muscle: is 2cm in length most of it lies in the bony channel parallel to Eustachian tube. it reduces the intensity of high pitched sound waves by pulling the handle of malleus inward and making the tympanic membrane tense and thus protects the inner ear. It is derived from first branchial arch originates from cartilaginous wall of Eustachian tube, bony wall of semicanal as well as adjoining part of greater wing of sphenoid bone, these merge with central fibrous core and runs posteriorly to form a tendon tha turns laterally and attaches to medial and anterior side of upper part of handle of malleus. It is supplied by mandibular nerve[14].

Stapedius muscle: It is derived from second branchial arch. It arises from the hollow area from pyramid and inserts into the neck of stapes. It is supplied by the facial nerve and acts by reducing the intensity of high pitched sound waves by tilting the footplate laterally and opposing the action of tensor tympani muscle which tends to push the muscle deep onto the oval window (fig 10).

LIGAMENTS OF MIDDLE EAR (Fig. 11)

The ossicles are attached to the walls of tympanic membrane with ligaments. Three for malleus, two for incus and one for stapes.

Anterior Mallear Ligament : is attached to neck of malleus and to anterior wall of tympanic cavity close to petrotympanic fissure with some extension through fissure and reaches sphenoid angle[15].

Superior Ligament of Malleus : it is delicate round bundled descending from roof of epitympanic recess to head of malleus.

Lateral Mallear Ligament : is a triangular band passing through posterior part of notch of Rivinus to malleus head.

Posterior Ligament of Incus : it is short, thick band connecting short process of incus with fossa incudis.

Superior Ligament of Incus : It has been described but it is little more than a fold of mucous membrane.

Annular Ligament : stapes footplate is attached to fenestra vestubuli by fibrous ring called as annular ligament.

POUCHES RELATED TO TYMPANIC MEMBRANE

In 1964 Proctor showed that middle ear is separated from antrum not just by ossicles, but also by mucosal folds. He states that there are two constant openings between tendon of tensor tympani muscle and other by short process of incus and stapedius muscle. Prussak`s space is present between pars flacida and neck of malleus. Lateral process of mallues forms the inferior border(apex) and lateral mallear fold forms the superior border. Posterior pouch of VonTroeltsch lies between tympanic membrane and posterior mallear fold. Anterior pouch of VonTroeltsch is between tympanic membrane and anterior mallear fold.

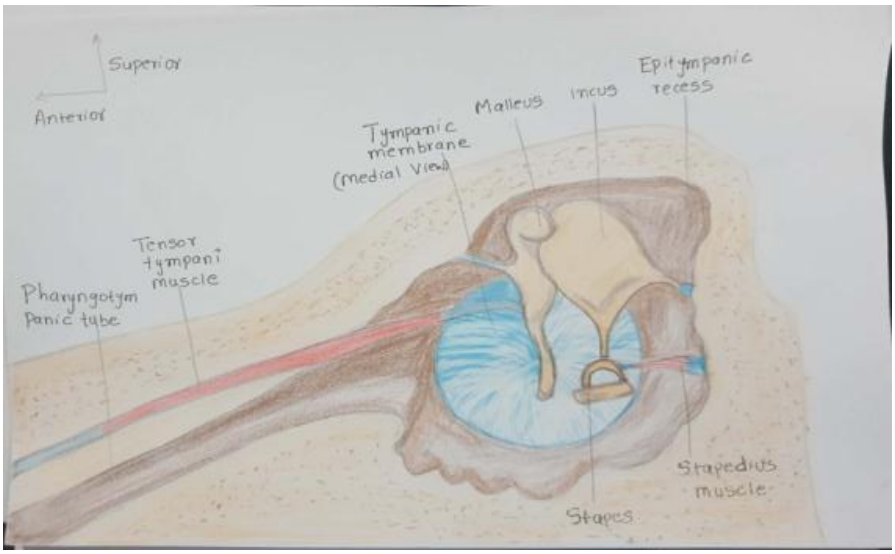

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FIG 10 : MUSCLES OF MIDDLE EAR

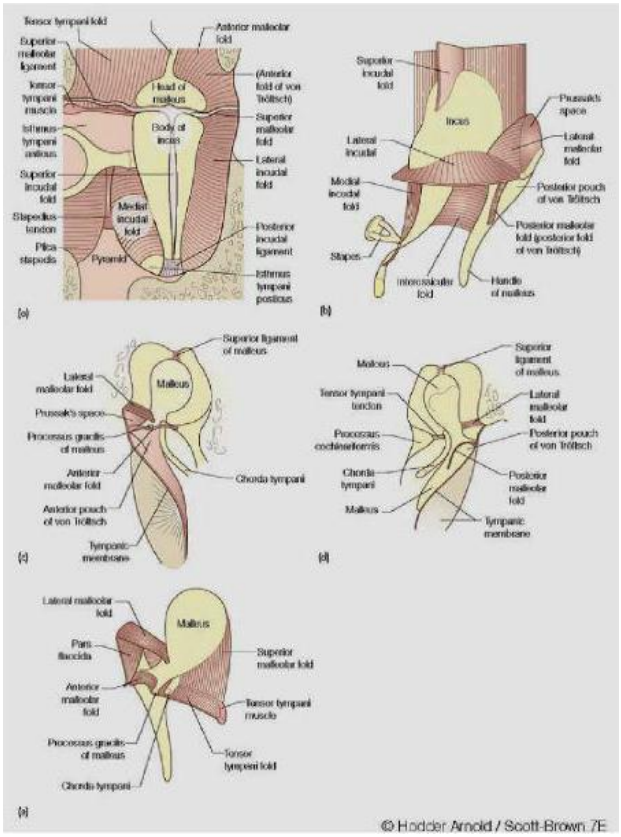

FIG 11 : LIGAMENTS AND POUCHES IN THE MIDDLE EAR[15].

MASTOID PNEUMATIZATION

The mastoid is pneumatized are two parts. They are, squamous portion o temporal bone and petrous portion of temporal bone. These are separated by wall of Schwartz, eyeshell and Korner`s septum.

Allan and Schuknect classified pneumatic tract into following:

Perilabyrinthine:

Supralabyrinthine

- Posterosuperior
- Posteromedial
- Subrcuate

Infralabyrinthine

- Hypotympanic
- Retrofacial

Apical

Peritubal

- Anteroposterior
- Anterolateral

Apical

- Hypotympanum
- Peritubal
- Perilabyrinthine

THEORIES OF HEARING

Place theory of cochlear action (Helmholtz)

This states that perception of pitch depends on vibrations in a selected portion at basilar membrane. The air cells and the particular nerve fibres activated by them related to the point of maximum displacement of the membrane by the waves travelled.

Von Bekesy's travelling wave theory:

This states that a wave travelling from the basilar membrane from base to apex, reaches a peak and then perishes rapidly. This travelling wave takes time to reach its maximum displacement and thereby introduced a phase delay between the stimulus entering the cochlear and the peak displacement at basilar membrane.

Rutherford telephone theory

This theory suggests that perception of pitch is dependent on rate of firing in individual nerve fibre. The latent period of nerve action limits this theory to the perception of frequencies below 1000Hz only, if the relation between sound wave frequency and nerve impulse has a simple 1:1 ratio.

Wavers wave theory

It states that high frequencies are perceived by place alone (in Basal turn).Low frequencies below (1000 hz): Stimulate nerve action potentials at a rate equal to the stimulus frequency.

Edward's wave theory : Here the basilar membrane gets segmented where waves will have notes and antinotes stimulated by sound. As segmentation increases with frequency, distance between the notes decreases. The antinode patterns produced are a result of discrimination of pitch.

PHYSIOLOGY OF HEARING

For the normal function of hearing the ear can be divided in two parts, one is conductive apparatus and the other is a sensory neural apparatus. Conducting apparatus consists of structures from pinna, middle ear cleft and labyrinth and the inner ear fluid. Sensory neural apparatus consists of organ of corti, auditory division of seventh cranial nerve and central connections.

Sound energy is a form of vibratory mechanism consisting of alternating condensation and rarefaction of the molecules of a circulating medium. The speed of a sound wave depends on the nature of the medium and is proportional to its density. Therefore sound travels fast through solids and less through liquids and slow through gas.

Sound travels at 344 meters per second in air at sea level, but in water it is four times faster at 1437 meters per second. In the bone it is approximately 3030 meters per second. The middle ear receives sound signals from external auditory canal by the actions of the tympanic membrane and ossicular chain. The transformer system of the middle ear can be divided in to three stages. [17]

1. **Caternary Lever Action** by the tympanic membrane: Helmholtz proposed the concept called Caternary lever for the action of tympanic membrane. He compared it with the lever of the tennis net. Tighter the tennis net, greater the force exerted. Similarly the bony annulus surrounding the tympanic membrane is immobile. The sound energy applied over here is directed from the edges of the drum and is intensified at the central attachment. The study conducted by Tonndorf and Khanna[16/18] used the sensitive method of time average holography to determine the vibratory pattern of tympanic membrane and found it to be similar with Helmholtz hypothesis.

2. **Ossicular Lever Action**: Helmholtz described the lever action of the second class an arm extending between short process of incus and umbo with the incudal ligament serving as fulcrum and later found that malleus and incus as a single unit rotating between anterior malleal ligament and incudal ligament. This concept measures the lever arms from rotational access to the tip of the malleus and the tip of the long process of incus. The handle of malleus is 1.3 times longer than the long process of incus providing mechanical advantage of 1.3 and therefore the ratio level ranges from 1.3:1[17].

3. **Hydraulic Lever** : The sound pressure collected over the larger areas of the tympanic membrane and transmitted to the smallest area results in increase in force propotional to the ratio of areas.

By means of this transformer action, amplitude at oval window is largely reduced as compared with amplitude at tympanic membrane. Pressure at oval window is increased in the same proportion or 18.3 times.

AUDITORY PATHWAY

Auditory pathway consists of eight cranial nerves, cochlear nuclei, superior olivary complex, lateral laminiscus, inferior colliculus, medial geniculate body and auditory cortex from below upwards.

95% of afferent fibers of spiral ganglia of vestibulocochlear nerve supply inner hair cells (IHC) and outer hair cells (OHC) receive only 5% of it. The efferent fibers supplying (OHC) are received from superior olivary complex via olivocochlear bundle. The dendrites of bipolar cells of spiral ganglion are innervated by hair cells. Auditory sounds generated by cochelear are transferred to both sides of brain.

Axons of cochlear nerve which end on dorsal and ventral ipsilateral cochlear nuclei.

In the brain stem the cochlear nuclei send neural impulses to bilateral sides of brain.

From the cochlear nuclei some fibers go directly to inferior colliculus while others go through superior olivary nucleus and lateral leminiscus on both sides. Therefore they have multiple discussion points.

From inferior colliculus the axon fibers go to medial geniculate body of metatalamus through inferior brachium. From medial geniculate body fibers go to primary auditory cortex of temporal lobe of cerebrum through sublenticular part of internal capsule. The area of hearing is situated in the superior temporal gyrus known as Brodmann`s area 41[19](fig12).

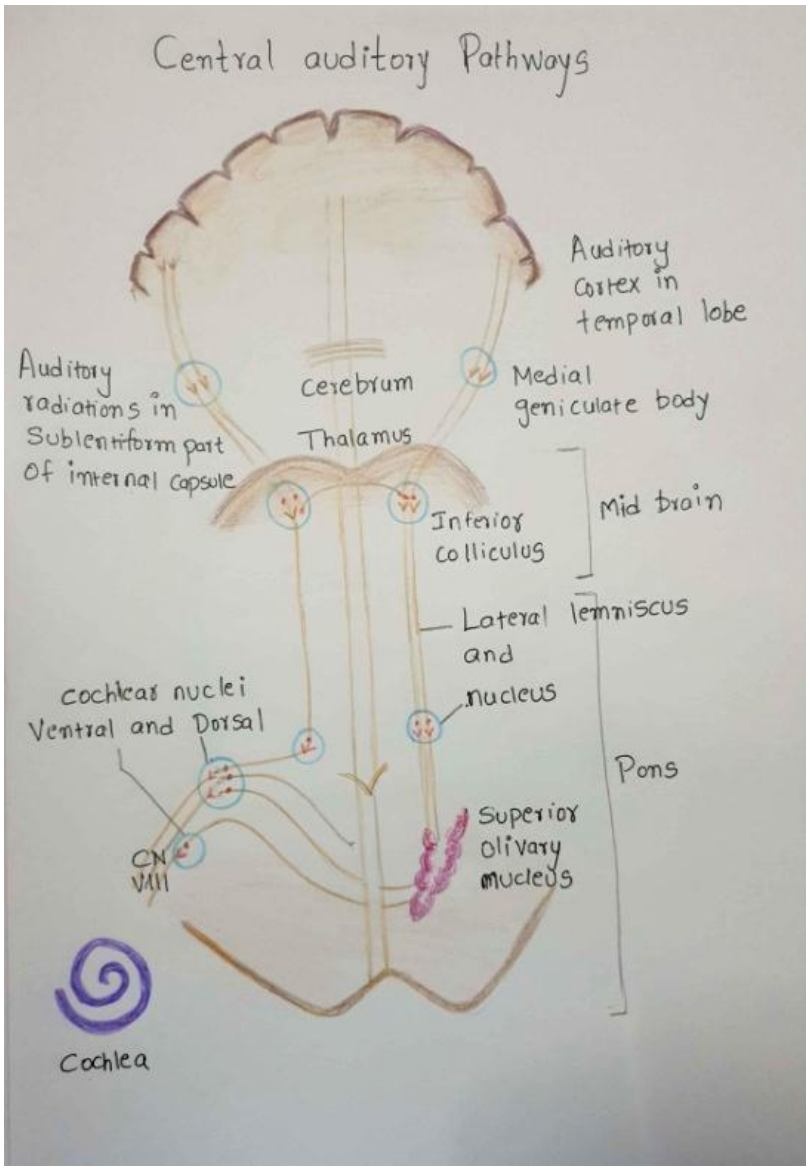

FIG 12. : CENTRAL AUDITORY PATHWAY

PATHOPHYSIOLOGY OF CHRONIC SUPPURATIVE OTITIS MEDIA

CSOM is the most common disease of childhood after viral upper respiratory infection. CSOM is defined as condition of the middle ear that is characterized by persistent or recurrent discharge for three months or more through the perforation of tympanic membrane[20]. It has a negative impact on development of speech, language, social interaction in school going children and workplace[21] and it is also responsible for significant morbidity and mortality associated with complications as per WHO standards[22].

Ossicular chain erosion occurs very commonly as one of the complication of CSOM. Incus is the first ossicle to get eroded followed by stapes superstructure due to osteoclast activity in relation to granulation tissue or by avascular necrosis and also the location, delicate structures around can also be the reason for weakness predisposing to erosion[23,37]. Ossicles can get eroded in Chronic Otitis Media(COM) with or without cholesteatoma[21,24]. Inflammation is the major factor for granulation tissue, which is commonly associated with ossicle chain erosion[23]. On microscopic examination, a subepithelial layer of granulation tissue is identified close to eroded bone[23].

While performing otologic surgeries attention to most minute details is the prerequisite. If any errors occur during surgery this can lead to poor outcomes and many errors during surgery. The operating room includes the surgeon, experienced scrub nurse, circulating nurse, good light source, well maintained instruments, an experienced anaesthetist and an operating microscope. Therefore the routine and protocol is a must in the operating room[24].

The aim of the middle ear surgery is to restore tympanic membrane free from disease and provide hearing improvement. 60% of chronic otitis media disease may require ossicular replacement for necrosed ossicles to restore sound conduction in middle ear[25]. There are different triggering factors such as infection, inflammation, pressure and keratin which direct to detailed different molecular factors and other cytokines like interleukin-I, Interleukin-6 and tumor necrosis factor and other non-protein mediators like prostaglandins, neurotransmiiters and nitric oxide. These molecular factors provide an initiating signal that can direct to recruitment, development and activation of osteoclasts. The activated osteoclasts get resorbed in bone. Explaining the exact relationship between the causes of (COM) and osteoclastogenic factors is important to develop new approaches for therapeutic intervention and prevention of bone resorbtion in COM[26].

The bone erosion and ossicle erosion can be suspected if there are large central perforations or posterosuperior marginal perforation of tympanic membrane, the most common problem in middle ear is long process of incus necrosis, followed by other Ossicles and requires surgical correction. The preferred option is to replace a collumella which could be homologus materials such as septal spur cartilage or autograph ossicles such as malleus, incus and cartilages or alloplastic prosthesis, which are made up of hyalurinadase, titanium, gold these are called "Total Osscicular Replacement Prosthesis" (TORP) and "Partial Osscicular Replacement Prosthesis" (PORP). Depending on presence or absence of stapes super structure, the choice of material depends on situation of operated ear and surgeon's personal choice. Some authors do not prefer homograph materials have risk of transferring diseases[27].

The ideal prosthesis for ossicular reconstruction should be biocompatible, stable, and easily insertable and capable of yielding optimal sound transmission

HISTORY OF OSSICULOPLASTY

In 1901 matte had attempted myringostapediopexy to place a collumella between tympanic membrane and oval window[28,31]. In 1951 Wullstein used a vinyl acrylic as an ossicular prosthesis. Since then, several other techniques of ossicular chain reconstructions have been attempted. Hall and Rytzer did the ossicular reconstruction by sculpturing patients own incus after accidentally dislocating the stapes superstructure while mobilizing stapes in otosclerosis[29,31]. In the early 1960s homograft material became popular for ossicular chain reconstruction[30]. In 1966 House, Patterson and Linthicum introduced homograft incus from a patient undergoing surgery for acoustic neuroma and this was preserved in 70% ethyl alcohol which showed no inflammation in and around the graft even after 9 months post operatively[30]. In 1958 Hough used sculptured autologous cortical bone from outer mastoid cortex, bony external auditory canal, and spine of Henle. In 1963 Jansen

found autologous tragal cartilage for tympanic membrane to stapes head and septal cartilage for and tympanic membrane to footplate.

Due to the risk of disease transmission like, HIV, Creutzfeldt-Jakob disease, etc and high chance of resorption of bone and cartilage autograft materials, and the potential risk of infection from homograft implants manufacture of different types of alloplastic materials for implantation became popular. As a result of these efforts, of three porous plastic materials, namely Proplast, Plastipore, and Polycel, together with a vast range of ceramic materials have been developed for ossiculoplasty, Which are classified as biocompatible, bioinert, or bioactive. In the late 1950s and the 1960s, biocompatible materials, such as polyethylene, Teflon, and Proplast, were used. Ossicular reconstruction with these materials often resulted in migration, extrusion, penetration into the inner ear, or significant middle ear reactivity. Therefore, use of these solid polymeric substances was stopped[31].

Later in 1970s, a high-density polyethylene sponge (HDPS) that had nonreactive properties was developed which indeed is an original form of machined-tooled prosthesis (Plastipore); Later, thermal-fused HDPS (Polycel) that was even more versatile was used. This formed a pairing with other materials, such as stainless steel, which lead to a wide variety of prosthetic designsand lead to high extrusions with either Plastipore or Polycel which was placed in contact with the tympanic membrane. This defect was reduced considerably when cartilage was placed between a Plastipore or Polycel prosthesis and the tympanic membrane[32, 33].

Myringoplasty and ossiculoplasty can be done on one or two stage surgeries. It is said that the success rate of ossiculoplasty is higher if the procedure is staged as this has a close aerated middle ear for second stage procedure. But many surgeons carry out a single stage procedure as it is very feasible.

In chronic otitis media complications are relatively rare and surgical removal is the only effective treatment for excision of cholestatoma or any granular matter or disease in ear. Surgery itself can cause a complication. In 1901, Matte described mastoidectomy in which the tympanic membrane was placed on the head of the stapes to improve hearing.

CANAL WALL DOWN MASTOIDECTOMY:

This is also called as modified radical mastoidectomy. A classical radical mastoidectomy was described by Jensen in 1873. Later Bondy started modified radical mastoidectomy in 1910[35] by using posterior to anterior approach where the mastoid is opened behind external auditory canal and followed through aditus and in to antrum by removing posterior wall of external auditory canal, which results in large cavity in the ear. The large cavities usually cause prolonged discharge through ear even after it is well epithelialised.

Atticoantrostomy also called as small cavity mastoidectomy which by using anterior to posterior approach is being done often at present by clearing epitympanic region and following the disease backwards. This results in much smaller cavity with a mean volume of 1.4 cms^3 where MRM requires 2.4 cms^3.

INTACT CANAL WALL MASTOIDECTOMY

Leaves the external auditory canal without mastoid cavity. In case of cholesteatoma surgeries with this procedure it has a disadvantage of performing a second look surgery after 12-18 months. The advantage of this procedure is that external auditory canal can be preserverd without mastoid cavity opening into it with post operative better hearing threshold compared to canal wall down mastoidectomy[36].

INTACT CANAL WALL VERSES CANAL WALL DOWN MASTOIDECTOMY

Post operative hearing is better in intact canal wall mastoidectomy compared to canal wall down mastoidectomy. As the mastoid cavity is not opened into the external ear, it is cosmetic. It can only be performed in limited disease in middle ear.

MATERIALS USED IN TYMPANOPLASTY

In 1853, Toynbee performed first tympanoplasty, by using a rubber disk and a silver wire. Since then, several materials have been used to reconstruct the human tympanic membrane. Later, Wullstein and Zollner used a split thickness skin graft as the first practical tympanoplasty.

The term `Tympanoplasty` is defined as an operation to eradicate disease in the middle ear and to reconstruct the hearing mechanism with or without tympanic membrane grafting.

There are few criteria for the ideal material in place of tympanic membrane, they are as follows:

- Biocompatible material that has the ability of an implant to take in the host immune system and recognize the graft as part of the host itself. With true biocompatibility, the body would not attempt to extrude a foreign body.
- Material must resist and tolerate infectious processes. As the middle ear has a high chances of spread of infection because of the patency of the eustacian tube. Some implanted materials are prone to infection as they can easily allow the organisms to enter the middle ear
- Remain without becoming dislodged, fibrosed, or ankylosed. Once an implant is put into the middle ear, it must stay where it was placed and tolerate the biologic milieu.

A number of ossicular replacements showed excellent early results, with these materials.

These can be classified into three broad subgroups: autografts, homografts, and alloplasts.

Autograft

This material is obtained from the same patient from a different part of the body. The materials used in this way include: fascia, areolar tissue, cartilage, perichondrium, periosteum, ossicles, and bone. Sheehy states that "It is always preferable to use the patient's own tissues."

homograft

A tissue graft is obtained from the donor of a same species as the recipient. The technique to prepare these homografts involves taking a cadaveric tympanic membrane and ossicles and preserving them in such a way that it reduces the antigenic load. There are at least three different ways of preserving the tympanic membrane, including the use of formaldehyde, cialit, and ethanol and freezing.

Alloplasts

Alloplastic materials are man-made and are the most convenient to obtain and biocompatible.

Several such grafts have been used for reconstruction of tympanic membrane and ossicular chain. Autografts are preferred more likely that Alloplastic materials are easily available, ensure a low extrusion rate, biocompatible leading to better graft uptake.

INDICATION FOR OSSICULOPLASTY:

- As a second stage tympanoplasties surgeries.
- Patients with COM with clinicl or radiological evidence of ossicular chain erosion.
- As a second stage procedure after extensive cholesteatoma surgery with a tie gap of 6-12 months[37].
- Ossicular discontinuity resulting in hearing loss following noise trauma, adhesive otitis media,or suppurative otitis media.
- congenital ear malformation with eroded ossicular chain[38]

CONTRAINDICATIONS OF OSSICULOPLASTY

ABSOLUTE

- ONLY HEARING EAR

RELATIVE

- Mixed hearing loss with lower bone conduction than contraleteral ear.
- Severe atelectasis

PRE OPERATIVE EVALUATION[39,45]

- A detailed history and complete ear, nose and throat examination should be performed in all patients. The otoscopic examination must be accomplished with the operating microscope. All hearing should be confirmed by tuning fork tests.

- Audiological evaluation should be done by pure tone audiometry which should include air and bone conduction thresholds with masking as well as speech discrimination scores.
- Tympanometry can also be done to differentiate between ossicular fixation and discontinuity and also to know the eustachian tube function. Acoustic reflex testing is helpful in distinguishing hearing losses resulting from otosclerosis versus an inner ear hearing loss associated with superior semicircular canal dehiscence wherein the reflex is present.
- Thin sections of Computed tomography (CT) scan of temporal bones may be helpful, particularly in cases with cholesteatoma, in determining the ossicular status, degree of mastoid pneumatisation, possible intracranial involvement, labyrinthine fistula and fallopian canal dehiscence.

OPERATING ROOM ARRANGEMENT

The operating room table is unique in otology. The operating surgeon sits next to the side of the ear that has to be opearated. The operating microscope should be freely mobile and locked in required position to prevent drift is kept at the head of the patient. It should be placed over the patients head. The scrub nurse with their instrument table at the opposite side to the surgeon so that it is easy for them to pass the instruments while the surgeon is operating without cross over in the surgical field. The anaesthetist should be positioned away from the patients head beside the legs with intravenous infusion stand on the same side infront of the anaesthetist[40].

A chair with a back and arm rest is very important for the operating surgeon for support and reduce the fatigue while operating[42].

An scrub nurse controls the suction and irrigation. The fine suction will be controlled by the operating surgeon with his thumb nail over control hole. The scrub nurse should be positioned across the head from the surgeon to pass the instruments straight forward[42].

POSITION OF THE PATIENT

Patient is placed in supine position on the surgical bed that allows the head to be raised and lowed when required. The head of the patient is tilted to the opposite side with the shoulder of the operating site to be stretched as far as possible to obtain a good surgical field for the operating surgeon as the surgeon should stay in a narrow area limited by a small operating field[44].

ANAESTHESIA

Patient can be taken under local or general anesthesia. For patient taken in local anesthesia The premedications, Pethidine: 1.0 – 1.5 mg/kg body weight, intra muscular (analgesic and sedative) Promethazine: 25 mg, intra muscular (antiemetic), Atropine : 0.6 mg, intra muscular (anti-vagal and cardioprotective) are given 30 minutes before surgery and advised the patient to keep the head in the position till the procedure is completed and not to shake.

COMPLICATIONS OF OSSICULOPLASTY

The complications of ossiculoplasty can be dislocation of the stapes, fracture of the stapes suprastructure, perilymphatic fistula due to tear of annular ligament[45]. Other complications include graft extrusion, sensorineural hearing loss, dizziness, infection, ipsilateral taste disturbance, tinnitus and facial nerve paralysis[46]

4. METHODOLOGY

SOURCE OF DATA

Patients diagnosed with CSOM with conductive hearing loss presenting to the department of Otorhinolaryngology and head and neck surgery of R.L.Jalappa Hospital , Tamaka, Kolar from January 2016 to July 2018.

INCLUSION CRITERIA

Patients of age group between 8 years and 80 years diagnosed with chronic supporative otitis media planned for myringostapediopexy or myringoplatinopexy with an Air Bone Gap of more than 20 dB.

EXCLUSION CRITERIA

- Patients with sensory neural hearing loss.
- Intracranial complications of the middle ear disease.
- Inner ear diseases.
- Patients with fixed stapes

METHOD OF COLLECTION OF DATA

The patients with CSOM were subjected to clinical history taking into account of ontological symptoms like ear discharge, reduced hearing, predisposing factors like nasal obstruction, nasal discharge . Otoscopic examination was done to document the condition of middle ear and stage of ear discharge. Location, size and type of perforation of tympanic membrane and evaluation of hearing based on Tuning Fork Test with different frequencies, 256,512 and 1024Hz were performed to conform the inner ear involvement. Patients underwent Pure Tone Audiometry (PTA)(fig 9) prior

to surgery followed by X-ray mastoid in sculler`s view (fig 8). Safe CSOM were taken up for surgery when the ABG showed more than 40dB and where unsafe CSOM high resolution commuted tomography (HRCT) of temporal bone was done to know the extent of cholesteatoma or granulations and also the status of ossicular chain. When malleus and incus was eroded and the superstructure of stapes was intact Myringostapediopexy was done. Where incus along with superstructure of stapes was eroded Myringoplatinopexy was planned. In addition to examine the of middle ear under microscope, reconstruction of tympanic membrane with temporalis fascia graft and ossicular reconstruction was done. The materials used for reconstruction of ossicles are as follows:

- Autologous incus
- Autologous malleus
- Autologous cortical bone
- homologous Septal spur cartilage

FIG 13 : X-RAY MASTOID SCHULLER'S VIEW SHOWING SCLEROTI C MASTOID

FIG 14 : PTA EVALUATION PERFORMED

OPERATING PROCEDURE

The surgery was done by the operating surgeon sitting beside of the ear that had to be operated. The operating microscope should be freely mobile and locked in required position to prevent drift. it should be placed over the head of the patients head (fig 15). The scrub nurse with their instrument table(fig 16) at the opposite side to the surgeon so that it is easy for them to pass the instruments while the surgeon is operating without cross over in the surgical field. The anesthetist should be away from the patients head with intravenous infusion stand on the same side in front of the anaesthetist[42]

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ANAESTHESIA

Patient can be taken under local or General Anesthesia(GA) our study all patients were taken in GA.

FIG 15 : POSITION OF THE OPERATING SURGEON

Fig 16 : INSTRUMENTS USED IN EAR SURGERY SURGICAL STEPS

The Ear canal was instilled with 4% lignocaine. The ear and the surrounding areas were painted with 5% povidine iodine solution. The patient is then draped with sterile surgical towels.

Infiltration was given 10 minutes before giving incision with 10ml of 2% xylocaine and adrenaline in 1:2lakh ratio diluted with 10ml of normal saline in the post auricular area to block the the great auricular nerve branches that supply auricle and external auditory meatus, and 1ml was infiltrated in all four quadrants of external auditory canal at bone cartilaginous junction, without creating blebs. 1ml was infiltrated in incisura terminalis to block auricular branches of auriculotemporal nerve which supplies the superior part of auricle the dermis above the meatus and also infiltrated in the anterior surface of mastoid process. By bocking the auricular branch of vagus nerve.

The external auditory canal and the tympanic membrane are exposed using

Lemperts endaural speculum.(fig 17) Through the external auditory meatus initial inferior vertical canal incision was made starting about 5 mm lateral to the fibrous annulus at about 7 o'clock position (5 o'clock position for left ear) and a superior canal incision was made at about 10 o'clock position (2 o'clock position for left ear) using canal side knife. The medial ends of the incisions are joined by a horizontal incision using circular angled knife parallel to fibrous annulus. Posterior meatal skin was elevated laterally up to bony cartilaginous junction to develop a laterally based posterior meatal skin flap.

William wilde incision was given 0.5-1cm away from retroauriclar groove, by holding the auricle anteriorly with left hand . The incision extending superiorly and inferiorly at 180^0 of external auditory canal, to allow maximum anterior flexion. The cut should be perpendicular to the surface of skin and reach up to subcutaneous layer. The incision should be advanced anteriorly with 15 number blade towards external auditory canal with electrocautery. Following William wilde incision, a small shallow

opening was made in subcutaneous tissue upon temporalis mucles(temporal fascia) and the facia was dissected underlying temporalis

FIG 17 : LEMPERT`S ENDAURAL SPECULUM

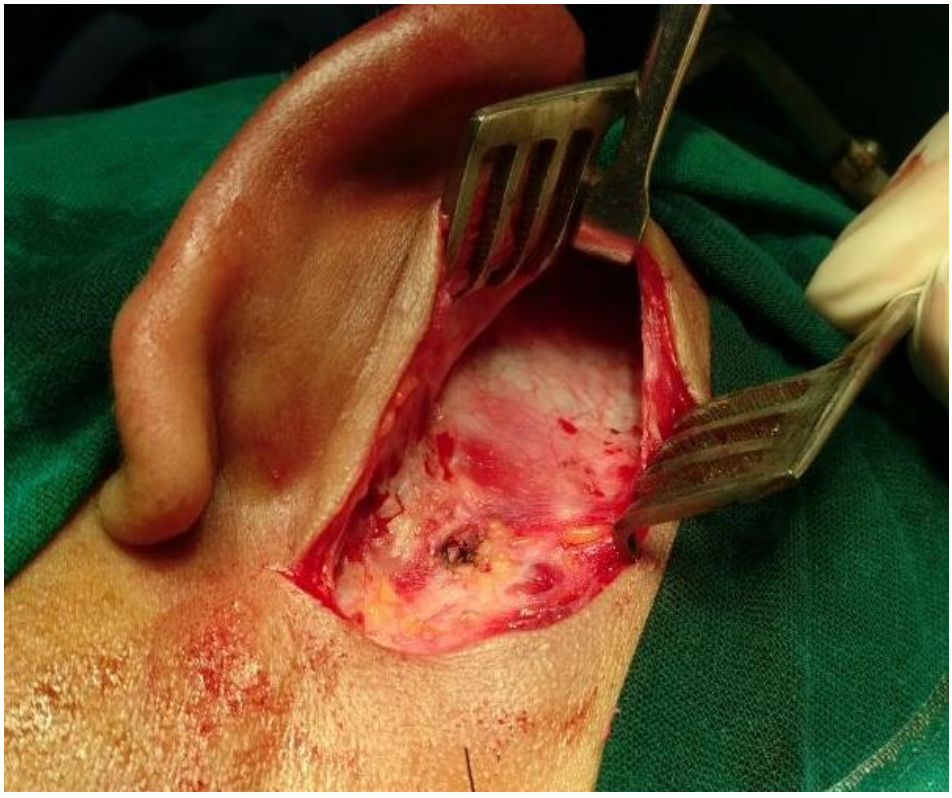


FIG 18 : HARVESTING TEMPORALIS FASCIA GRAFT

After infiltarion into the plane with normal saline and desired size of temporalis fascia was harvested using a scissors

A self retaining retractor was applied to expose the area for a maximum exposure and the langenback retractor was applied and retracted by the scrub nurse for the better visibility of the graft plane. The temporalis fascia graft is composed of superficial and deep layer. The fascia was elevated from the underlying temporalis muscle by infiltrating normal saline underneath the fascia to aid easy removal of uniform thin fascia without underlying muscle or fat. The sufficient size of fascia was resected with scissors or a scalpel and the shape was modified by scrapping its surface using a blunt instrument to avoid tear in the graft and allowded to dry unit it was used.

Mastoidectomy was performed depending upon status of the disease. If there was pars tensa perforation with ossicular disruption, cortical mastoidectomy was performed. If it was AAD, CWD mastoidectomy was performed**.**

ICW was carried out by marking a line tracing, linea temporalis superiorly, posterior bony meatus anteriorly and a line tangential to bony meatus perpendicular to linea temporalis posteriorly (McEwen`s triangle.) till mastoid antrum was reached.. It was bounded by temporal line and middle cranial fossa plate superiorly, anteriorly by posterior wall of external auditory canal, posteriorly by sigmoid sinus, Mastoid tip inferiorly, Lateral Semicircular Canal medially.

CWD mastoidectomy was performed by transcortical, or transmeatal approach. Transcortical was carried out by simple mastoidectomy and atticoantrostomy , the posterior wall of external auditory canal was removed by drilling.

The mucosa in the undersurface of remnant tympanic membrane was tattered through the perforation edges using curved pick. The margins were excised using crocodile forceps or cup forceps The tympanomeatal incision was extended superiorly and inferiorly depending on the size and location of the perforation. The

tympanomeatal flap was elevated first from the posterior bony canal wall in a lateral to medial portion till the fibrous annulus has reached using oval angulated canal elevator. The middle ear mucosa was entered below 9 o'clock position (3 o'clock for left ear) by taking apart of fibrous annulus using a curved pick, and not to injure the underlying chorda tympani nerve. The handle of malleus was then skeletonised using a curved pick Ossicular chain was checked for mobility and erosion. Patients with Austin type A (erosion of incus with intact malleus and stapes) and type C (erosion of incus and malleus with intact stapes) ossicular defects were considered for ossiculoplasty. Depending on the availability and viability autologous incus, tragal cartilage or cortical bone was harvested and sculptured for ossiculoplasty.

The incus with necrosed lenticular/long process was separated from the incudomaleal joint and taken out and held with Derlacki's ossicle holding forceps(fig 13). Incus was sculptured using 0.6mm diamond burr. For Myringostapediopexy, the remnant long process was drilled out to make it cylindrical with a flat base. A socket was drilled under resculptured long process of incus to fit the head of stapes. A slit was made to at the undersurface of collumella to fit the stapedius muscle in it.Part of short process and the articular facet of the body was removed to avoid ankylosis with the posterior canal wall. The superior part of the body was firmed to support its attachment with TM.

For myringoplatinopexy, the sculptured collumella was placed in the similar way as mentioned earlier but instead of placing the collumella on the head of stapes it was places on the footplate as the head of the stapes was already eroded. When autologous incus was used for ossiculoplasty and the scutum was curetted, attic reconstruction was done using a piece of periostium and temporalis fascia graft to avoid postoperative retraction of tympanic membrane.

If the incus was not available homologous septal spur cartilage was used which had a better advantages as mentioned earlier using a 11 number blade. The inferior

portion of cartilage was drilled using 0.6mm diamond burr to form a socket for the head of stapes. The superior surface was angled to provide greater surface of contact with the temporalis fascia graft.

Fig 19 : SCULPTURING OF INCUS OSSICULOPLASTY

FIG 20 : CARTILAGE OSSICULOPLASTY

A cortical bone graft was also harvested from the mastoid region in few cases where :

- Necrosed incus was left in place for attic support to prevent postoperative retraction of neo-tympanum

- Incus was eroded upto the bony annulus
- Incus was too fragile for drilling or
- Incus was lost during drilling
- Homoseptal cartilage was not available.

Bone graft was held with a Derlacki's ossicle holding forceps and drilled into appropriate size (fig 19). A socked was drilled on one surface for the head of stapes and the opposite surface was made flat or a notch was made to lodge the handle of malleus. Middle ear with hypertrophied mucosa, cholesteatoma, granulations, sqoumus epithelium was cleared of all diseases.

The mobility of the footplate was first established by gentle touch over the stapes head and looking for round window reflex. The middle ear cavity was packed with gel foam soaked with antibiotic-steroid solution to make the bed for the graft. The temporalis fascia graft was placed. The fascia and the tympanomeatal flap are secured anteriorly. Then the temporalis fascia was gently elevated till the oval window area was seen. The sculptured ossicle, cartilage or cortical was placed dependng on the status of capitulum of stapes between the neotympanum and the head of stapes in myringostapediopexy between stapes footplate and neotympanum in myringoplatinopexy (fig 20). The temporalis fascia and the tympanomeatal flap was replaced..The canal was packed with gelfoam and canal pack. The postauricular wound was sutured and mastoid dressing was done (fig 21).

POSTOPERATIVE CARE

In the immediate post-operative period patient was checked for any facial nerve weakness, presence of nystagmus, bleeding and treated accordingly. All the patients were treated with a course of antibiotics, analgesics, and antihistaminics for a period of one week.The mastoid dressing was removed after 3days and in some patients after 5 days and the suture removal done on the 7^{th} post-operative day. External auditory

canal pack was removed after 21 days. All patients who underwent tympanoplasty and ossicular reconstruction were classified in two groups. Patients who underwent Myringostapediopexy were classified in Group A and patients who underwent myringoplatinopexy were classified as group B.

FIG 21: MASTOID DRESSING

FOLLOW UP PERIOD

All the patients were followed up at the end of 3 months after surgery. During their visit, history regarding earache, ear discharge and subjective improvement in hearing were obtained.

The neo-tympanum was examined and tuning fork tests and pure tone audiogram was done to assess the improvement in hearing. The hearing results were compared in terms of mean pre-op and post-op Air conduction thresholds, Air-Bone gap and hearing gain or ABG closure. Postoperative ABG closure was measured as the difference between the preoperative ABG and postoperative ABG.The audiometric results were reported according to AAO-HNS guidelines, except that threshold at 4 KHz were used in all cases instead of threshold at 3 KHz..

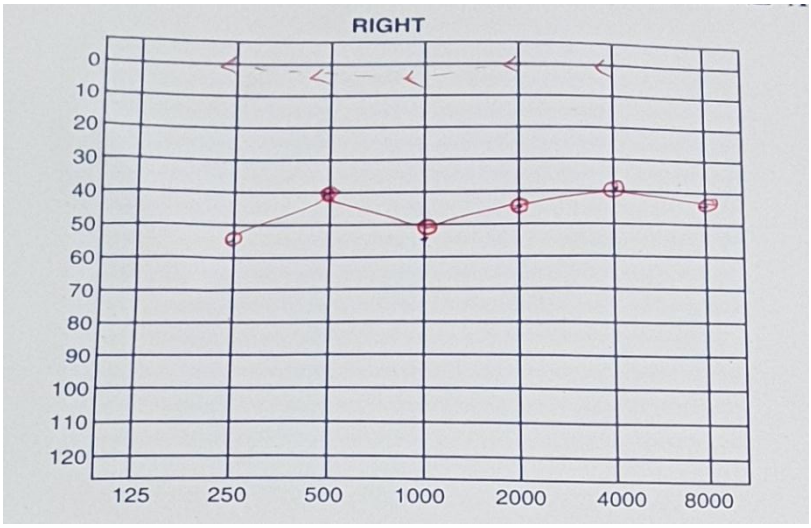


FIG 22 : PRE OP PTA IN MYRINGSTAPEDIOPXY

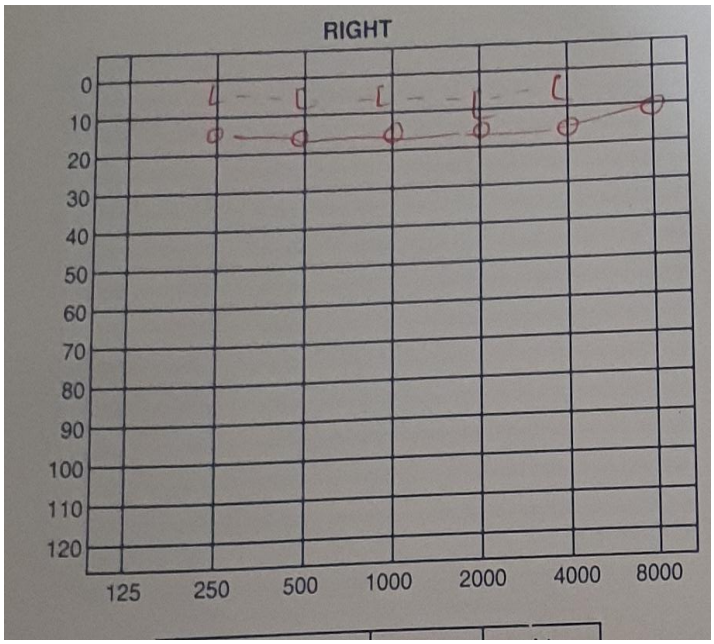


FIG 23 : POST OP PTA IN MYRINGOSTAPEDIOPEXY

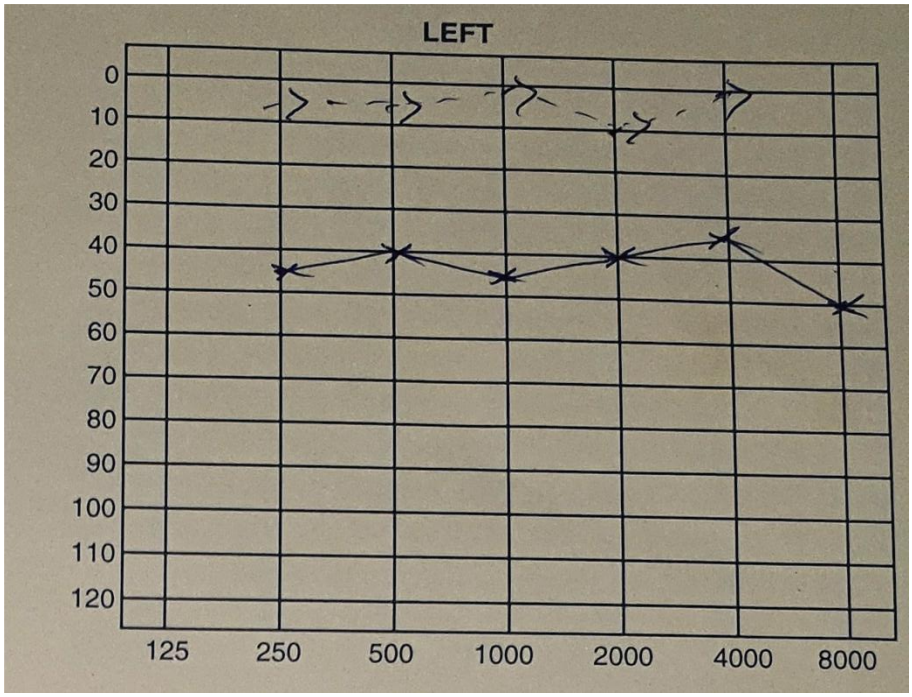


FIG 24 : PRE OPERATIVE PTA IN MYRINGOPLATINOPEXY

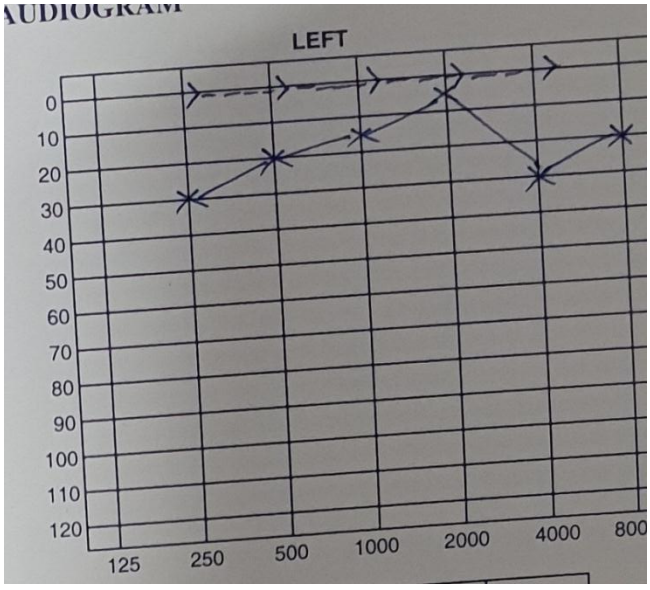


FIG 25 : POST OPERATIVE PTA AFTER MYRINGOPLATINOPEXY

5. RESULTS

STATISTICAL ANALYSIS

STUDY DESIGN:

Observational study.

SAMPLE SIZE:

The sample size was estimated based on the proportion of conductive hearing loss less than 25dB at all frequency was 53% at Brazil in 2013 with 95% confidence interval with absolute error of 15% , the estimated sample size was 43 expecting dropout rate of 10%

The final sample size of 43+5=48 ears will b taken.

Was estimated based on the difference in proportion of hearing improvement <20dB air-bone gap at post operative period between myringostapediopexy and myringoplatinopexy.

Based on hospital statistics 15 cases of myringostapediopexy and 5 cases of myringoplatinopexy were performed since 1 year

$$\text{Sample size} = \frac{r+1}{r}\frac{(p^*)(1-p^*)(Z_\beta + Z_{\alpha/2})^2}{(p_1 - p_2)^2}$$

r = Ratio of control to cases, 1 for equal number of case and control

p^* = Average proportion exposed = proportion of exposed cases + proportion of control exposed/2

Z_β = Standard normal variate for power = for 80% power it is 0.84 and for 90% value is 1.28. Researcher has to select power for the study.

$Z_{\alpha/2}$ = Standard normal variate for level of significance as mentioned in previous section.

$p_1 - p_2$ = Effect size or different in proportion expected based on previous studies. p_1 is proportion in cases and p_2 is proportion in control.

STATISTICAL ANALYSIS:

Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation. Independent t test was used as test of significance to identify the mean divergence between two quantitative variables. Paired t test was the test of significance for paired data such as before and after surgery for quantitative data. Graphical representation of data: MS Excel and MS word was used to obtain various types of graphs such as bar diagram.

p value (Probability that the result was true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

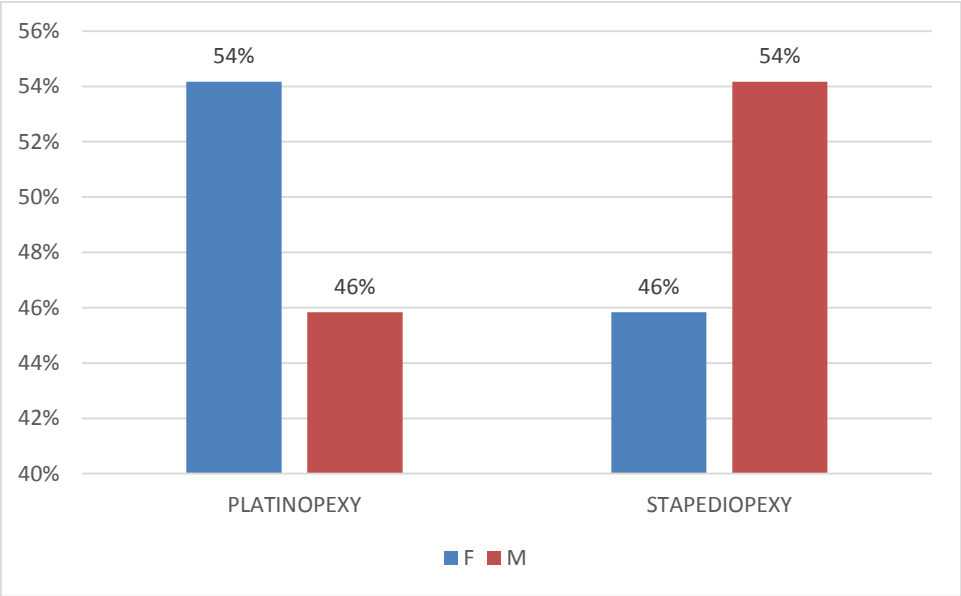
Statistical software: MS Excel, SPSS version 22 (IBM SPSS Statistics, Somers NY, USA) was used to analyze data.

Table 1 : Gender distribution of subjects and difference between two groups

GENDER	GROUPS			
	MYRINGOSTAPEDIOPEXY (group A)		MYRINGOPLATINOPEXY (group B)	
	n =24	**%**	***n =24***	**%**
MALE	13	54%	11	46%
FEMALE	11	46%	13	54%

P value:0.56, df:1 x^2***:O.333***

In Group A, 46.6% were females and 54% were males and in Group B, 54% were females and 46% were males. There was no significant difference in gender distribution between two groups.



Graph 1 : Bar diagram distribution showing gender distribution and evaluation between two groups

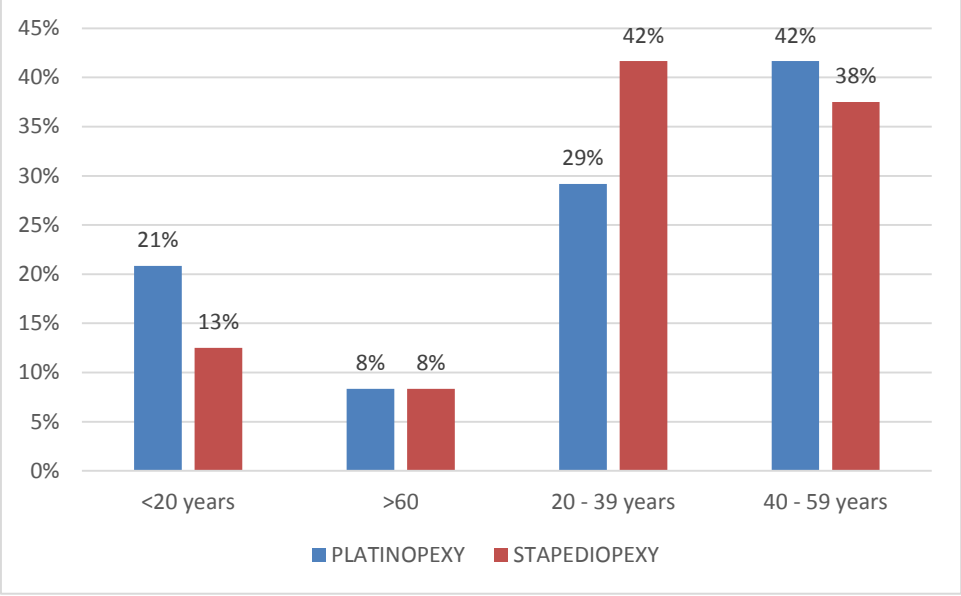
Table 2 : Age distribution of the subjects between two groups

Age	Groups			
	Myringostapediopexy (group A)		Myringoplatinopexy (Group B)	
	n=24	%	*n =24*	%
<20 years	3	13%	5	21%
>60	2	8%	2	8%
20 - 39 years	10	42%	7	29%
40 - 59 years	9	38%	10	42%

P value: 0.78 df: 3 x^2: 1.082

The age of the subjects ranged from 12 to 61 years in Group A and 10 to 62 in Group B.

Majority of subjects in both the groups belonged to the age group of 20 to 39 years, Group A with 42% and 40-59years in Group B with 42 and was statistically not significant.



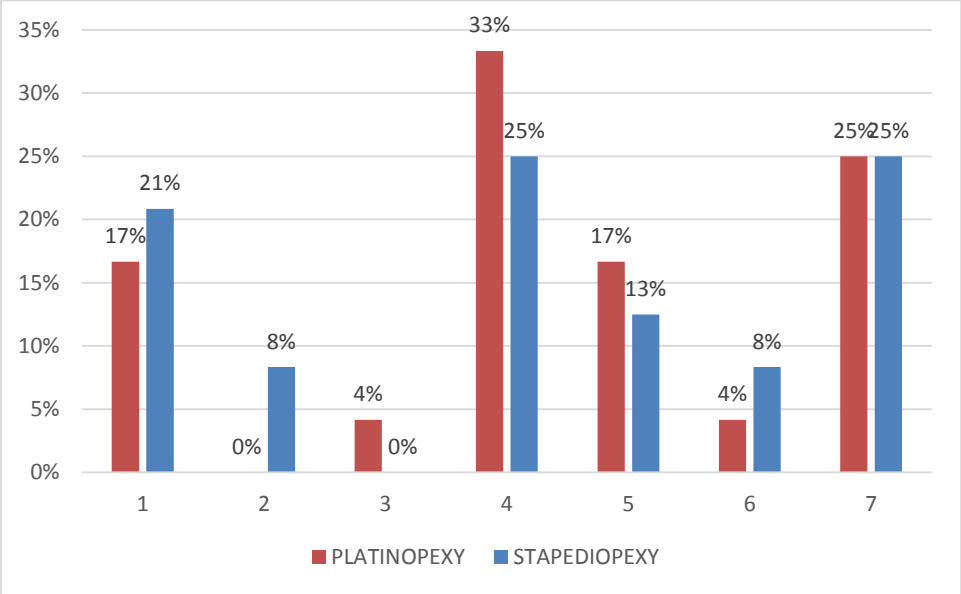
Graph 2 : Bar diagram distribution of different age groups and comparison between two groups.

Table 3 : Distribution according to presenting complaints between two groups

PRESENTING COMPLAINTS	GROUPS			
	Myyringostapediopexy (group A)		Myringoplatiopexy (Group B)	
	n= 24	%	n=24	%
Reduced Hearing	5	21%	4	17%
Earache	2	8%	0	0%
Tinnitus	0	0%	1	4%
Ear Discharge + Reduced Hearing	6	25%	8	33%
Ear Discharge + Earache	3	17%	4	13%
Reduced Hearing+ Earache	2	8%	1	4%
Reduced Hearing + Ear Discharge + Tinnitus	6	25%	6	25%

P value: 0.69 **df:6** ***x^2:3.873***

Most common presenting complaint was Ear discharge + reduced hearing in both groups, 33% in Group A and 25% in Group B. There was no significant difference in presenting complaint between two study groups.



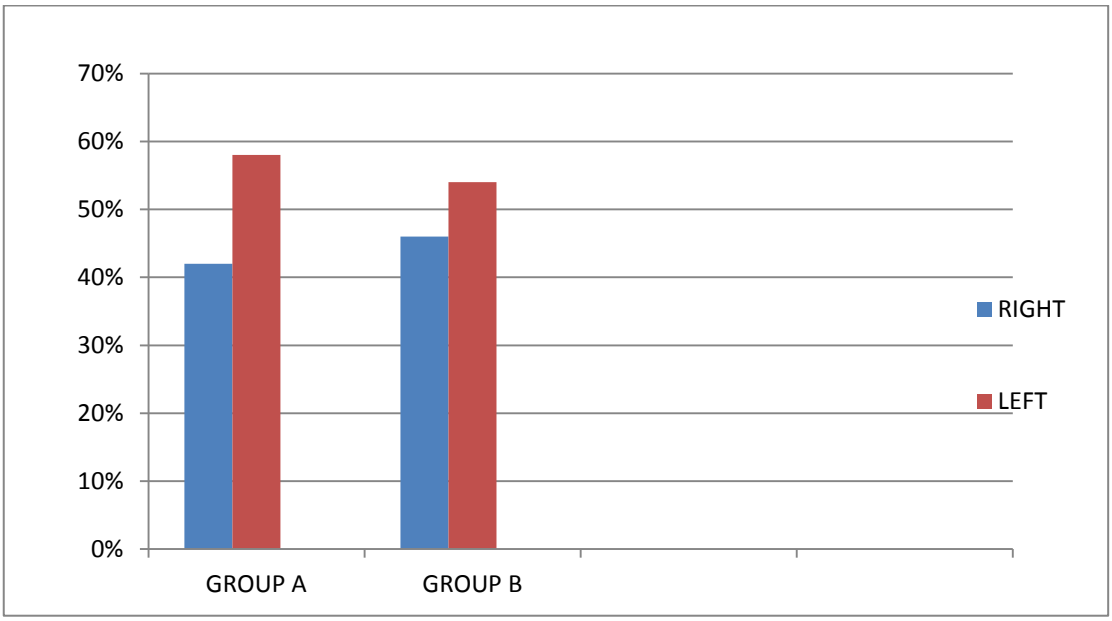
Graph 3 : Bar diagram distribution with presenting complaints and comparison between two groups

Table 4 : Side of ear involved distribution of the subject between the two groups

Side	Groups			
	Myringostapediopexy (GROUP A)		Myringoplatinopexy (GROUP B)	
	n=24	%	n=24	%
Right	10	42%	11	46%
Left	14	58%	13	54%

P value: 0.7 df: 1 x^2***:0.085***

The disease involved both the ears, with more left ear involvement in both groups that was 58%in group A and 54% in Group B. There was no difference in distribution according to side of ear involved between two study groups.



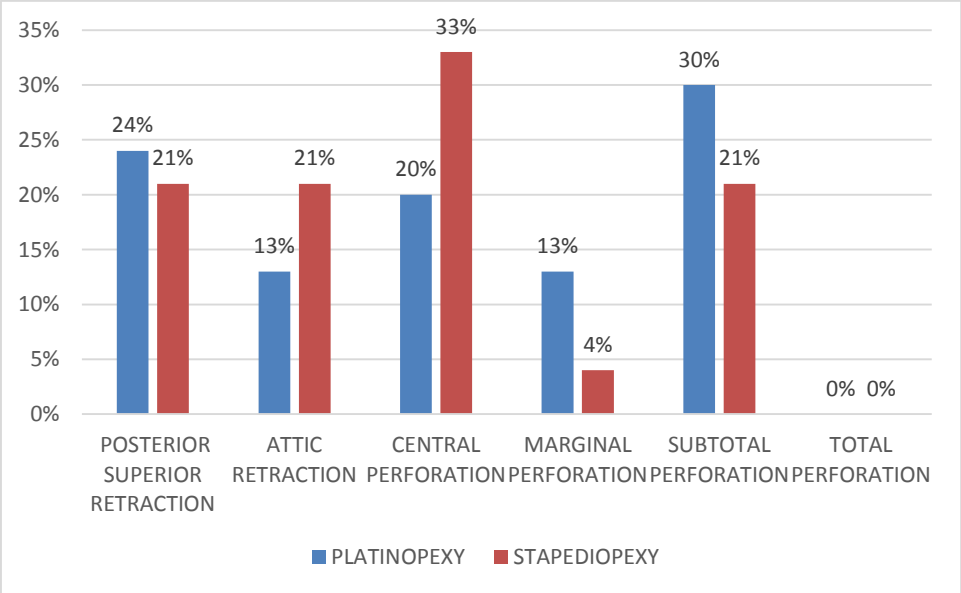
Graph 4 : Bar diagram distribution side of ear involved and comparison between two groups.

Table 5 : Distribution of various pathology of Tympanic Membrane findings and comparison between two groups

pathology	Groups			
	Myringostapediopexy (GROUP A)		Myringoplatinopexy (GROUP B)	
	n=24	%	n=24	%
Posterior Superior Retraction	5	21%	6	24%
Attic Retraction	5	21%	3	13%
Central Perforation	8	33%	5	20%
Marginal Perforation	1	4%	3	13%
Subtotal Perforation	5	21%	7	30%
Total perforation	0	0%	0	0%

P value:0.084 df: 5 $x^2$9.698

Central perforation 33% was common in Group A and subtotal perforation was common in Group B which was not statistically significant.



Graph 5 : Bar diagram distribution of various pathology of Tympanic Membrane findings and comparison between two groups

Table 6 : Pre Op and Post Op AC distribution and comparison between two groups

	Myringostapediopexy (group A) n=24		Myringoplatinopexy (group B) n=24		Value b/w two groups
	MEAN	SD	MEAN	SD	
Pre op AC	55.83	5.26	56.46	5.09	0.678
Post op AC	30.5	5.59	35.46	7.36	0.012

The post operative hearing outcome has improved with a statistical significance of 0.012 as p value. And states that ossicluoplasty significantly improves the post operative hearing.

Table 7 : Pre Op and Post Op BC distribution and comparison between two groups

	Myringostapediopexy (group A) n=24		Myringoplatinopexy (group B) n=24		Value b/w two groups
	MEAN	SD	MEAN	SD	
Pre op BC	**11.25**	**2.21**	**10.83**	**1.90**	0.816
Post op BC	**8.13**	**2.87**	**7.92**	**3.26**	

Though the BC threshold in post operative outcome has improved it is statistically not significant

(p value: 0.816)

Table 8 : Pre op ABG and post op ABG distribution and comparison between two study groups

	Myringostapediopexy (group A) n=24		Myringoplatinopexy (group B) n=24		Value b/w two groups
	MEAN	SD	MEAN	SD	
Pre op ABG	**44.58**	**5.06**	**46.044.48**	**4.48**	
Post op ABG	**22.58**	**6.46**	**27.63**	**6.52**	**0.010**

There was improvement in post-op ABG in both groups which was statistically significant.(p value: 0.010)

Table 9 : Distribution according to ABG closure and comparison between two groups

	Myringostapediopexy (group A)		Myringoplatinopexy (group B)		P value b/w two groups
	MEAN	SD	MEAN	SD	
Net improvement	22.29	7.97	18.33	6.55	0.067

There was significant statistically in difference between ABG closure of the two groups.

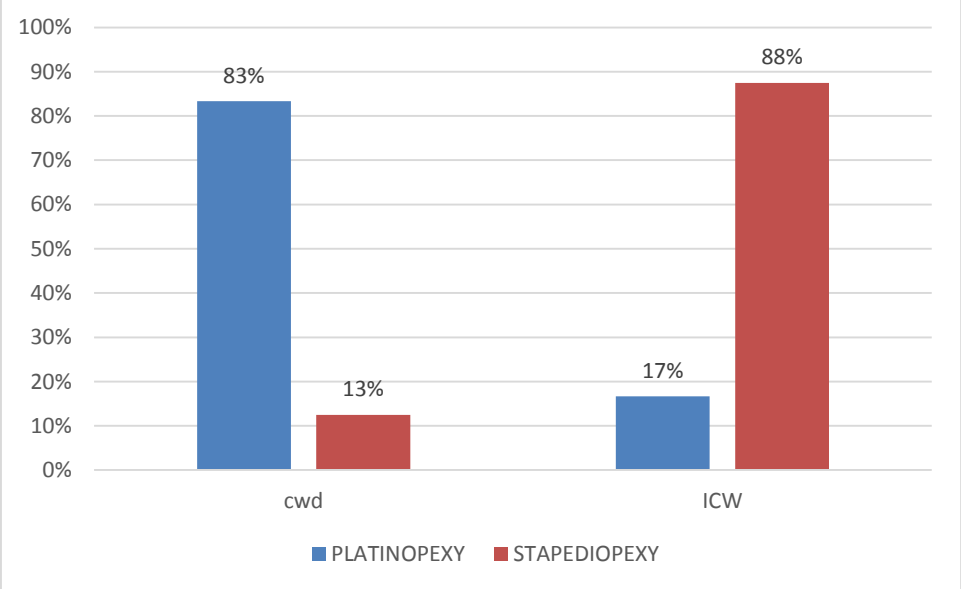
Group A had higher ABG closure compared to Group B

Table 10 : ABG closure in distribution among two study groups with respet to CWD and ICW mastoidectomy

	GROUPS					
	Myringostapediopexy (Group A)			Myringoplatinopexy (groupB)		
	n =24	***MEAN***	**%**	***n=24***	***MEAN***	**%**
Canal wall down	3	16.33	13%	20	19.15	83%
Intact canal wall	21	23.14	88%	4	14.25	17%

P value : 0.001 df:1 x^2:24.12

In group A, 3 (13%) patients were CWD mastoidectomy with mean value 16.33 ±7.4 and ICW mastoidectomy were 21 pateints(88%) with mean gain 23.14±6.7 DB, in group B CWD mastoidectomy were 20 patients(83%) with mean gain of 19.15±5.5DB and ICW mastoidectomy were 4 patients(17%) with mean gain of 14.25±6.8. and has statistical significance.



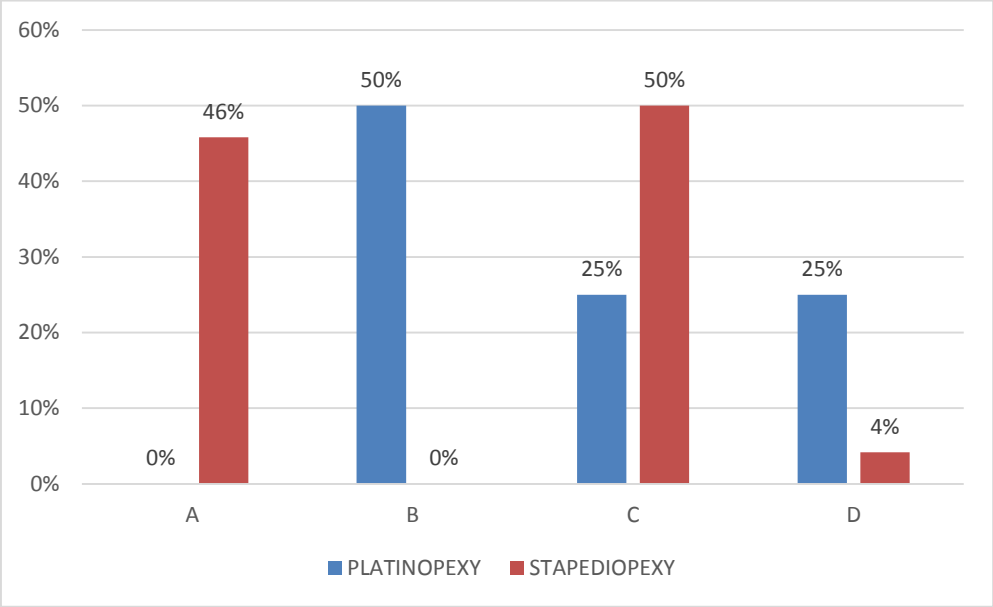
Graph 6 : Bar diagram distribution of ABG closure of two study groups with respect to CWD and ICW mastoidectomy and comparison between two groups

Table 11 : Distribution by Ossicular Status (according To A-K Classification) and between two groups

Ossicular status	Groups			
	Myrngostapediopexy (group A)		Myringoplatinopexy (group B)	
	n=24	%	n=24	%
Type A	11	46%	O	0%
Type B	0	0%	12	50%
Type C	12	50%	6	25%
Type D	1	4%	6	25%

P value:0.0006 df : 3 x^2 8.5

Subjects in Group A belonged to type C while subjects in Group B belonged to type B of A-K classification.



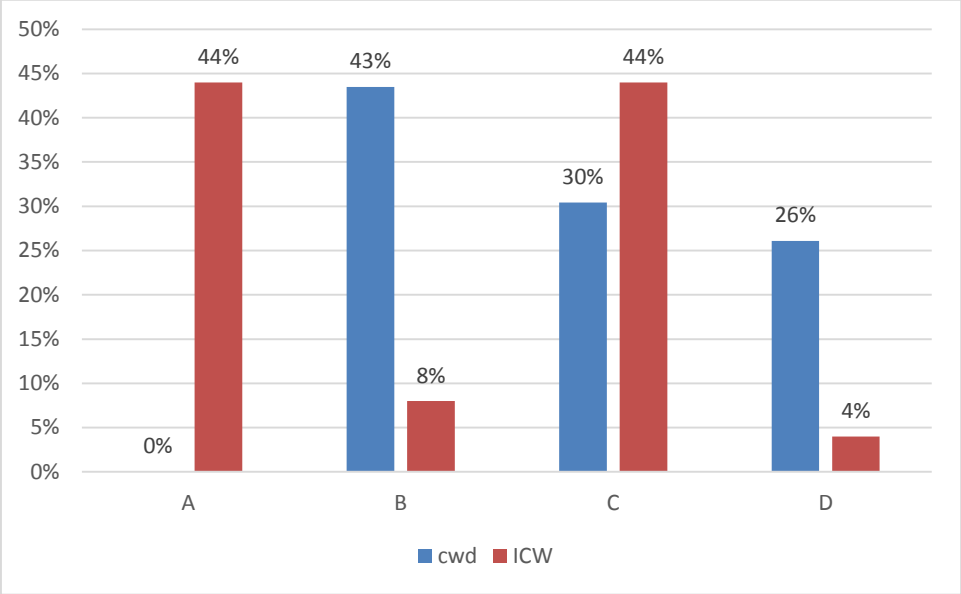
Graph 7 : Bar diagram showing distribution by Ossicular Status (according To AK Classification) and comparison between two group

Table 12 : Distribution by Ossicular Status (according To A-K Classification) and comparison between two mastoidectomy procedures

OSSICULAR STATUS	CANAL WALL DOWN		INTACT CANAL WALL	
	n=23	%	n=25	%
GROUP A	0	0%	11	44%
GROUP B	10	43%	2	8%
GROUP C	7	30%	11	44%
GROUP D	6	26%	1	4%

P value: 0.004 df : 3 x^2 0.74

Subjects in canal wall down belonged to Class b while subjects in intact canal wall belonged to Class A and C of A-K classification.



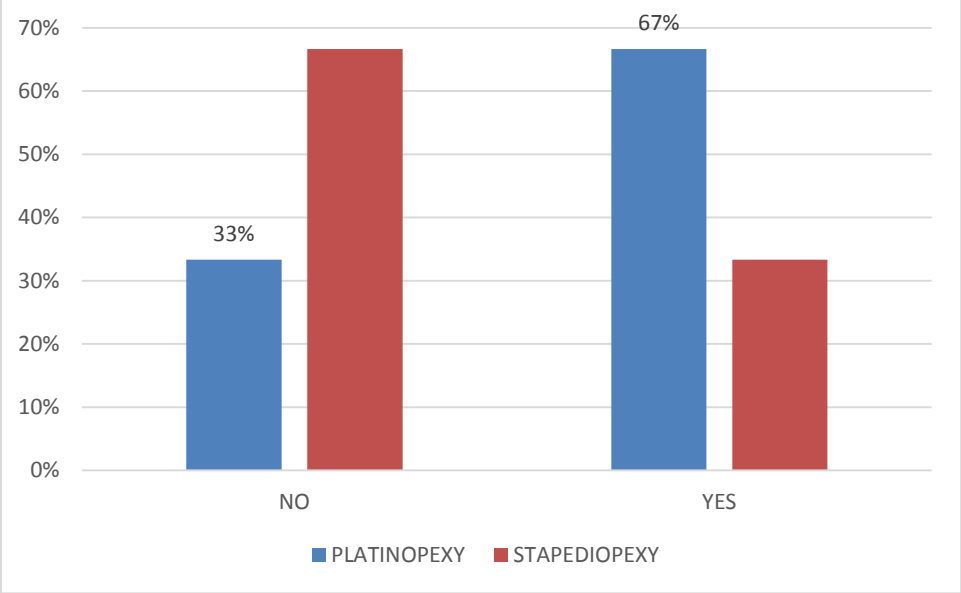
Graph 8 : Bar diagram showing distribution by Ossicular Status (according To AK Classification) and comparison between two mastoidectomy procedures.

Table 13 : Distribution of subjects according to the presence of Cholesteatoma and comparison between two groups

Cholesteatoma	Groups			
	Myringostapediopexy (group A)		Myringoplatinopexy (group B)	
	n=24	%	n=24	%
YES	15	59%	18	67%
NO	8	41%	6	33%

P value:0.02 df : 1 x^2 :5.33

Majority of Cholesteatoma was in Group B with 67% which was statistically significant.



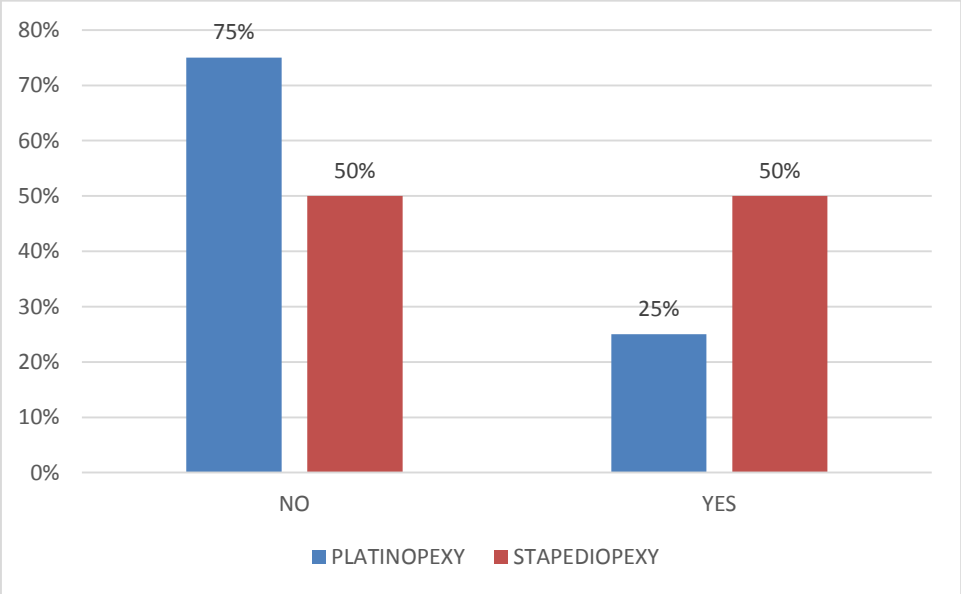
Graph 9 : Bar diagram showing Distribution of subjects according to the presence of Cholesteatoma and comparison between two groups.

Table 14 : Distribution according to presence of granulation tissue and comparison between two groups

GRANULATION	GROUPS			
	Myringostapediopexy (group A)		Myringoplatinopexy (group B)	
	n= 24	%	n= 24	%
YES	12	50%	6	25%
NO	12	50%	18	75%

P value: 0.07 df: 1 x^2 : 3.20

In Group A presence and absence of granulation tissue showed equal distribution and in Group B 75% dint have granulation where 25% showed presence of granulation tissue. The difference was not statistically significant between two study groups.



Graph 10 : Bar diagram showing distribution according to presence of granulation tissue and comparison between two groups.

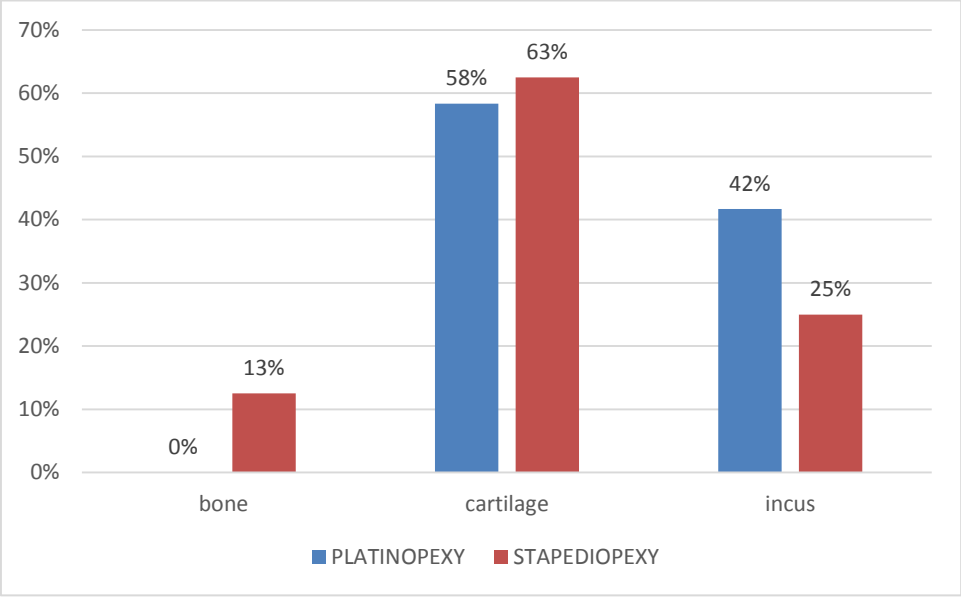
Table 15 : Distribution according to material used for reconstruction with ossicle and comparison between in two groups

MATERIALS USED	GROUPS			
	Myringostapediopexy (GROUP A)		Myringoplatinopexy (GROUP B)	
	n=24	%	n=24	%
Bone	3	13%	0	0
Cartilage	15	63%	14	58%
Incus	6	25%	10	42%

P value:0.13 df:2 x^2 : 4.03

In Group A homologous nasal septal spur cartilage was used in 15(63%) subjects, ossicular reconstruction with autologous incus in 6 (25%) subjects, and cortical bone was used in 3 (13%) subjects.

In Group B, homologous nasal septal spur cartilage was used in 14 (58%) subjects. autologous incus was used in 10 (42%) subjects. Is statistically not significant



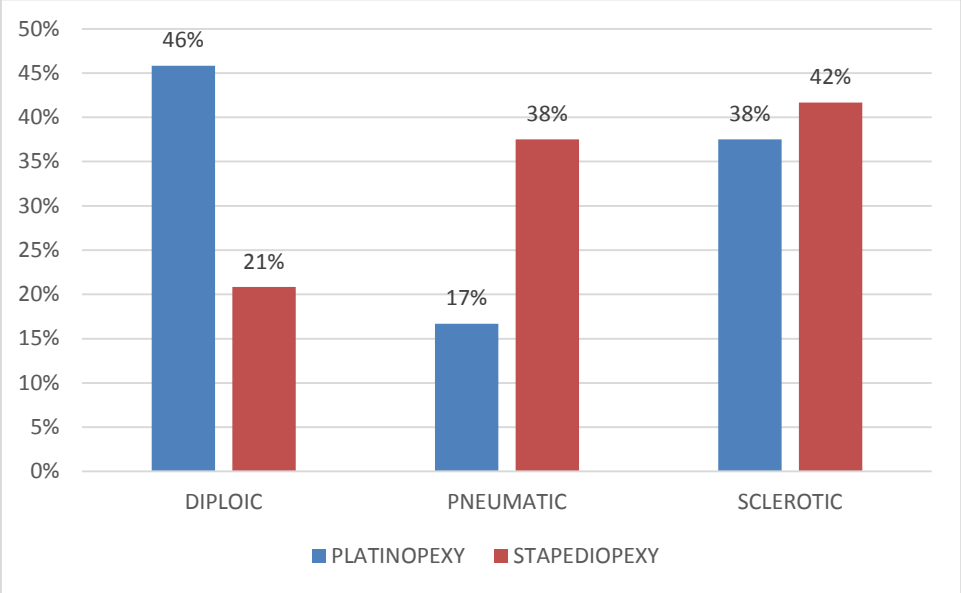
Graph 11 : Bar diagram showing distribution according to material used for reconstruction of ossicle and comparison between two groups

Table 16 : Distribution of type of mastoid and comparison between in two groups

MASTOID	GROUPS			
	Myringostapediopexy (GROUP A)		Myringoplatinopexy (GROUP B)	
	n=24	%	n=24	%
DIPLOIC	5	21%	11	46%
PNEUMATIC	9	38%	4	17%
SCLEROTIC	10	42%	9	38%

P value:0.121 df :2 x^2 22

Majority of patients had sclerotic mastoid with 10 (42%) subjects in group A and diploic mastoid in 11(46%) subjects in group B.



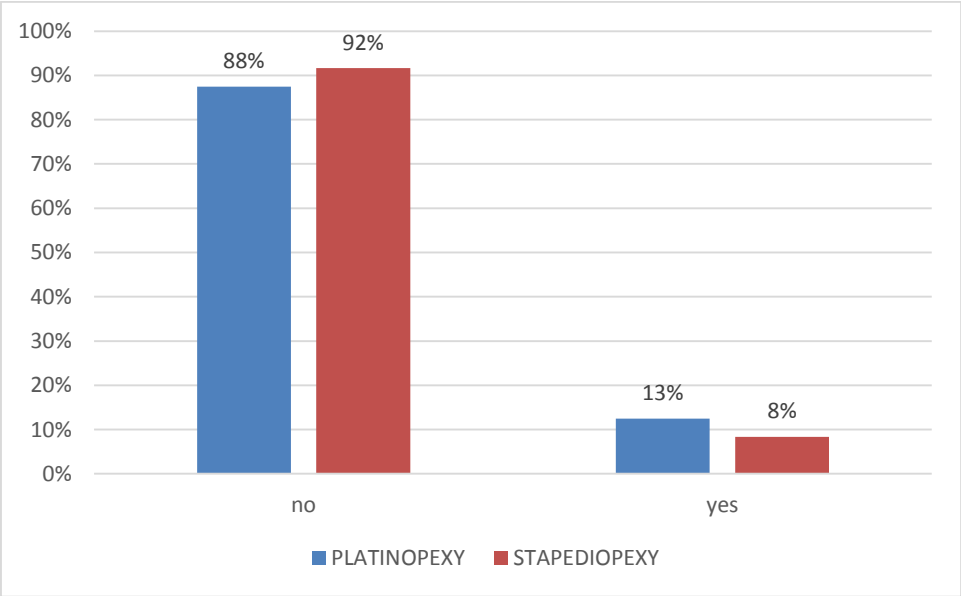
Graph 12 : Bar diagram showing type of mastoid and comparison between two procedures

Table 17 : Distribution according to the extrusion rate and comparison between to two groups.

EXTRUSION RATE	GROUPS			
	Myringostapediopexy (GROUP B)		Myringoplatinopexy (GROUP A)	
	n=24	%	n=24	%
YES	2	8%	3	13%
NO	22	92%	21	88%

P value:0.63 df : 1 x^2 0.223

In group A there was no extrusion rate was in 22 patients with 92% and in group B there was no 2 extrusion rate in 88%.



Graph 13 : Bar diagram distribution of extrusion rate and comparison between two groups.

6. DISCUSSION

Chronic Otitis Media is characterized by pathological findings consistent with irreversible inflammatory changes within the middle ear and mastoid and therefore lead to perforation of tympanic membrane and ossicular chain erosion. The hearing outcome after performing ossiculoplasty has shown clear improvement of hearing in most of the patients.

In our study 48 patients underwent type III tympanoplasty in which they were grouped as group A and group B. Group A consists of patients who underwent Myringostapediopexy and group B consists of patients who underwent Myringoplatinopexy

In our study, patients from 8-80 years were included. In group A the age distribution ranged from 12-61 years with a mean age of 38±14.02, majority of patients belonged to age group of 20-39 years(42%). In group B, the age distribution ranged from 10-62 years with the mean age of 31.67±15.56. Majority of patients were included in 40 to 59 years (42%).

In a study conducted in Aurangabad, patients aged from 15-62 years where the mean age at presentation was nearly 34years 3 months[50]. Another study in ossiculoplasty conducted in Italy, the mean age was 45 years[51].

In our study, there was male predominance in group A and female predominance in group B. However there was no statistical significance among both groups

In group A, The most presenting symptoms in our study included decreased hearing, ear discharge and tinnitus and decreased hearing with ear discharge in 6 patients (25%) each. 5 patients (21%) complained of reduced hearing. 3 patients

(17%) presented with ear discharge and ear ache. 2 patients(8%) presented with decreased hearing with ear ache and ear ache as a only complaint. In group B, 8 patients (33%) complained of ear discharge and reduced hearing, 6 patients (25%) presented with decreased hearing, ear discharge with tinnitus. 4 patients (17%) presented with reduced hearing. 4 patients presented with ear discharge and ear pain. 1 patient (4%) presented with tinnitus and decreased hearing and ear pain.

A similar study by Tushar Sharma and Vaibhav Kuchal complains of ear discharge with reduced hearing and tinnitus which was similar to our study followed by_ear pain in 14 patients(23.3%) which was similar to our study. However in this study some patients presented with aural fullness, itching and vertigo which were not seen in our study[52].

In our study, on otoscopic examination 8 (33%) patients had central perforation, and subtotal perforation, attic retraction and posterior superior retraction in 5 (21%) patients each. Only one patient had marginal perforation in group A. In group B, subtotal perforation was seen in 7 patients (30%), posterior superior retraction was seen in 6 patients (24%), and central perforation was seen in 5 patients (20%), Attic retraction and marginal perforation was seen in 3 patients each (13%) there was no total perforation seen in our study.

Another study conducted in Aurangabad, had a prospective study of 80 patients showed Decreased hearing (100%), as a common presenting symptom followed by ear discharge (97.5%). However they also complained of tinnitus (15.0%), earache (3.75%), and vertigo (5.0%)[50].

The fair statute for ossicular reconstruction is that it has to be suspended without stinting in the middle ear space and only connect undersurface of tympanic membrane to the immediate available ossicle; if it is attached to any adjoining structures it can

cause extrusion and suboptimal hearing and might lead to recurrence of disease with failure of graft uptake.

In our study, out of 24 patients. In group A, 15 (63%) patients were reconstructed with homologous nasal septal spur cartilage. Autologous Incus was used in 6 patients (25%) and in 3 (13%) patients cortical bone was used for reconstruction, 1 patient the extrusion was seen autologus incus and other with cortical bone was used for reconstruction. In group B, 14 patients were reconstructed with homologous nasal septal spur cartilage (58%) and 10 patients (42%) with autologous Incus. 3 patients had extrusion and all these patients were reconstructed with autologous incus. In both groups extrusion presented back with ear ache and reduced hearing and were subjected to revision surgery and were reconstruction of ossicle was done with homologous nasal septal spur cartilage and with septal spur all 5 patients had good healing and better hearing.

In our study, all patients had well healed neotympanum with no recurrence at 3 months following surgery.

Studies performed in India and abroad suggest that ossiculoplasty using bne had better hearing outcome and superior to cartilage aand claim that it had low extrusion[49,50] .

There are different methods to calculate the PTA with respect to ABG closure, in our study we used an average of three frequencies 500, 1000 and 2000 Hz of AC threshold and BC threshold and the difference between these two threshold were taken as ABG and analyzed prior to surgery and during follow up period at 3 months.

In our study, the mean AC threshold for pre operative and post operative values for group A were, 55.83±5.26 and 30.5±5.59dB respectively.This showed that there

was improvement of 20 to 25 dB in AC after surgery. In group B, the pre operative AC threshold was 56.46±5.09DB and post operative BC threshold shows 35.46dB. This shows that post operative hearing outcome has significantly improved with a statistical significance of 0.012. This says ossicluoplasty significantly improves the post operative hearing.

The mean BC thresholds for pre-operative and post-operative values are 11.25±2.21 and 8.13±2.87 respectively in group A. in group B, the preoperative BC average was 11.83± 1.9 and post operative BC average is7.92 ±3.26dB the overall significance between these two groups showed no statistical significance

In group A, the mean pre Op ABG threshold 44.58±5.06 and post operative ABG was22.58±6.46. in group B, the pre operative ABG shows 46.04 and post operative ABG shows 27.63± 6.52 where they showed good improvement in hearing in both groups which are statistically signigicant with p value 0.010.

A study conducted in Nepal, also state that, the post-operative ABG had statistical significant improvement as compared to pre operative ABG[55]

A retrospective study conducted at Japan, out of 68 patients operated for type III tympanoplasty and 24 pateints were operated for type IV collumella tympanoplasty (myringoplatinopexy) the hearing results were better after type III tympanoplasty compared to type IV collumella tympanoplasty, similar to our study.though they showed post op ABG closures due to several other factors[54].

A study conducted in Haldwani, ABG of pre operative and posterative period of 6 months on different materials used as ossicular graft staes that, in cartilage group pre-operative mean ABG was 31.55±5.44dB, in bone group it was 31.93±5.14dB. While the post-operative air bone gap after 6 months was, 17.17±7.27 in cartilage group, 15.27±7.02 in bone group. In this study they had also used a Teflon as a

ossicular prosthesis material apart from cartilage and bone that showed a least ABG closure of less than 10dB[52].

The net improvement of gain in hearing outcome was 22.29±7.97 and 18.33±6.55 in group A and group B respectively which showed a better hearing outcome in myringostapediopexy compared to myringoplatinopexy but was not statistically significant.

In our study in group A, the hearing gain with respect to CWD included for 3 patients (13%) with the mean gain in hearing improvement was 16.33±7.4DB and ICW was 21 patients(88%) with the mean gain in hearing improvement as 23.14±5.5DB. In group B, 20 patients (83%) underwent CWD with gain in hearing improvement was 19.15±6.7dB and 4 patients underwent ICW mastoidectomy with hearing gain 14.25±6.8DB. The hearing improvements was better in patients who underwent myringostapediopexy with respect to ICW mastoidectomy .that could be because in ICW the middle ear space and acoustic middle ear mechanism is maintained surgically compared to myringoplatinopexy and in myrinoplatinopexy as the graft material used vary with size, shape and consistency compared to stapes crura and it directly sits on the stapes footplate and therefore,enhances the middle ear acoustic transformer mechanism and could lead to better hearing outcome with respect to CWD mastoidectomy and was statisticalyl highly significant with p value 0.001.

A study conducted in Gujarat says that CWD mastoidectomy with type III tympanoplasty with cartilage graft assembly had better hearing outcome of 11.2dB improvement when compared to stapes graft material which correlates with our study[53].

In a study conducted in mysore, however CWD and type III tympanoplastyusing homologous septal spur cartilage showed a gain of 8.8dB [56].

In our study ossicular status was grouped according to A-K classification showed that, about 12 patients(50%) had group c followed by 11 patients (46%) , and only one patient had type D classification. None of them had type B in myringostapediopexy group. In myringoplatinopexy group 12 patients (50%) had belonged to type B and followed by group C and D with 6 patients (25%) each . None of the patients belonged to type A. however it showed a very high significance in statistics p value(0.0006). similarly among canal wall down patients 10 patients(43) had belonged to type B followed by 7 patients (30%) in group C and 6 patients in type D no patients had type A classification. In ICW mastoidectomy type A and C high percentage of patients with 44%(11 patients) 2 patients belonged to type B and only one patient belonged to type D and this variable was also staistically significant with p value(0.004)

Cholesteatoma was present in both groups but majority of patients with cholesteatoma was seen in group B which was also statistically significant

In Group A presence and absence of granulation tissue showed equal distribution and in Group B 75% dint have granulation where 25% showed presence of granulation tissue. The difference was not statistically significant between two study groups.

7. CONCLUSION

The conclusion gained from our study is as below:

- The ossiculoplasty of myringostapediopexy type shows better hearing outcome as compared to myringoplatinopexy.
- Among the type of ossiclular graft material homologous septals pur had a better hearing outcome compared to autologous incus
- The net improvement in myringostapediopexy was better when compared to myringoplatinipexy though it is not statistically significant
- Myringostapediopexy showed the better hearing outcome with respect to Intact canal wall mastoidetcomy when compared to canal wall down mastoidectomy. In myringoplatinopexy canal wall down mastoidectomy showed better hearing outcome compared to intact anal wall mastoidectomy. However the sample size in these two procedures was not significantly same among them and shows a good statistical significance.

8. SUMMARY

Chronic Suppurative Otitis Media (CSOM) is a long-standing infection of the middle ear cleft. This leads to ear discharge and perforation of tympanic membrane. It is highly prevalent in individuals from poor socio-economic conditions.

When these ossicles get distorted it causes to loss of acoustic transformation or impedance matching mechanism which results in impaired hearing as seen in conductive hearing loss.

The term ossiculoplasty means the surgery performed in the middle ear for restoration of hearing mechanism and result in long term hearing.

There are a number of ossiculoplasty procedures performed, Myringo-stapediopexy Myringoplatinopexy are two among them with respect to presence and absence of stapes superstructure.

Based on the middle ear cleft pathology CWD or ICW mastoidectomy procedures will be decided.

This study has been performed with the purpose to study the hearing outcome between the two ossiculoplasty procedures namely myringostapediopexy and myringoplatinopexy with autograft ossicles or cortical bones and homologous nasal septal spur cartilage after performing intact canal wall(ICW) or canal wall down mastoidectomies.

Our objectives were.

- To measure the hearing outcomes after myringostapediopexy in CSOM patients by Pure Tone Audiometry.
- To measure the hearing outcomes after myringoplatinopexy in CSOM patients by Pure Tone Audiometry.

- To compare the hearing outcome after each procedure in relation to pre-operative hearing loss.

Patients diagnosed with CSOM with conductive hearing loss presented to the department of Otorhinolaryngology and head and neck surgery of R.L.Jalappa hospital , Tamaka, Kolar from January 2016 to July 2018.

With an age group between 8 years and 80 years diagnosed with CSOM were planned for myringostapediopexy or myringoplatinopexy with an ABG of more than 20 DB were included in the study.

Patients with sensory neural hearing loss, intracranial complications of the middle ear disease, Inner ear diseases, Patients with fixed stapes were excluded in our study.

Patients were addressed for surgery after taking detailed history, examination, Tuning Fork Test and PTA assessment. We took a sculler`s view of X- ray mastoid To see for sclerotic, pneumatic or diploic pattern in both the groups. The decision was taken intraoperatively by the presence or absence of stapessuperstructure. If the stapes superstructure was present then myringstapediopexy was done and grouped as group A. If stapes superstructure was absent, then myringoplatinopexy was performed and was grouped as group B.

The sample size being 48 ears, 24 samples were collected in group A. and 24 samples were collected in group B.

All patients underwent pre operative PTA and AC threshold, bone conduction threshold and ABG were counted at 500, 1000, AND 2000 Hz. After performing surgery among these two groups at 3rd month of follow-up a repeat PTA was done to evaluate the hearing outcome ABG closure(gain) was calculated as a difference between preoperative and post operative ABG values.

In group A majority were male patients and in group B females were more affected. They presented at the age group of 20-39 years in group a and 40-59 years in group B . Taking presenting complaints into consideration many patients presented with decreased hearing, ear discharge and tinnitus and decreased hearing with ear discharge in in group A and in group B, ear discharge and reduced hearing were more common.

Left side was more affected in both groups. On otoscopic examination majority of patients presented with central perforationin group A and subtotal perforation in group B.This shows that post operative hearing outcome has significantly improved with a statistical significance of 0.012. This says ossicluoplasty significantly improves the post operative hearing. The mean BC conduction between the two study groups did not show any statistical significance. The mean pre op ABG showed good improvement in hearing in both groups which are statistically signigicant with p value 0.010.

However, the net improvement of gain in hearing outcome was 22.29±7.97 and 18.33±6.55 in group A and group B respectively which showed a better hearing outcome in myringostapediopexy compared to myringoplatinopexy but was not statistically significant.

In our study most of the patients were reconstructed with homologous nasal septal spur cartilage followed by atologous incus in both groups and 3 patients with cortical bone in myringostapediopexy. In this group 2 patients had an extrusion who underwent myringostapediopexy where ossicular graft reconstruction was done with autologous incus and cortical bone each and in myringoplatinopexy 3 patients had extrusion who underwent reconstruction with autologous incus. Remaining all patients had a healthy neotympanum with a better hearing improvement.

In our study in group A, the hearing gain with respect to CWD included for 3 patients(13%) with the mean gain in hearing improvement was 16.33±7.4DB and ICW was 21 patients(88%) with the mean gain in hearing improvement as 23.14±5.5DB. In group B, 20 patients (83%) underwent CWD with gain in hearing improvement was 19.15±6.7dB and 4 patients underwent ICW mastoidectomy with hearing gain 14.25±6.8DB. The hearing improvements was better in patients who underwent myringostapediopexy with respect to ICW mastoidectomy.and the hearing improvement was better in myrinoplatinopexy with respect to CWD mastoidectomy and was statisticalyl highly significant with p value 0.001.

In our study ossicular status was grouped according to A-K classification showed that, about 12 patients(50%) had group c followed by 11 patients (46%) , and only one patient had type D classification. None of them had type B in myringostapediopexy group. In myringoplatinopexy group 12 patients (50%) had belonged to type B and followed by group C and D with 6 patients (25%) each . None of the patients belonged to type A. however it showed a very high significance in statistics p value(0.0006). Similarly among canal wall down patients 10 patients(43) had belonged to type B followed by 7 patients (30%) in group C and 6 patients in type D no patients had type A classification. In ICW mastoidectomy type A and C high percentage of patients with 44%(11 patients) 2 patients belonged to type B and only one patient belonged to type D and this variable was also staistically significant with p value (0.004). Cholesteatoma was present in both groups but majority of patients with cholesteatoma was seen in group B which was also statistically significant

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SRI DEVARAJ URS MEDICAL COLLEGE
MYRINGOSTAPEDIOPEXY AND MYRINGOPLATINOPEXY

PROFORMA

CASE NO. : **DATE :**

PERSONAL DETAILS

NAME: HOSPITAL NUMBER :

AGE : DATE OF ADMISSION :

SEX : DATE OF DISCHARGE :

TELEPHONE NUMBER : DATE OF SURGERY :

CHIEF COMPLAINTS

EAR DISCHARGE RIGHT/LEFT/BILATERAL- SINCE

REDUCED HEARING RIGHT/LEFT/BILATERAL- SINCE

EAR ACHE RIGHT/LEFT/BILATERAL -SINCE

TINNITUS RIGHT/LEFT/BILATERAL -SINCE

HISTORY OF PRESENTING ILLNESS

I. EAR DISCHARGE

I. Side:right/left/bilateral
II. Duration:
III. Onset:sudden/insidiuous
IV. Severity:profuse/scanty
V. Characteristics:watery/mucoid/mucopurulent/purulent
VI. Progress:continuous/intermittent
VII. Colour
VIII. Associated with URT infections
IX. Duration of each attack
X. When was the last discharge?

II. REDUCED HEARING

a) Side:right/left/bilateral
b) Duration:
c) Onset:sudden/insidious
d) Is the noise better heard in noisy or silent environment
e) Is the hearing noise fluctuating?
f) Progressive/not
g) h/o noise induced trauma
h) h/o fever in childhood
i) h/o drug abuse

III. EAR PAIN

a) Site:right/left/bilateral
b) Duration
c) Onset:sudden/insidious
d) Type:pricking/throbbing/stabbing
e) Severity:mild/moderate/severe.
f) Aggrevatingfactors:
g) Relieving factors
h) Associated with ottorrhea

IV. TINNITUS

a) Side: right/left/bilateral
b) Duration
c) Progress:progressive/continues/intermittent/constant.
d) Character:hissing/buzzing/rustling/bell sound
e) High pith/low pitch
f) Sleep disturbance
g) h/o drug abuse:
h) h/o exposure to loud noise
i) h/o trauma

PAST HISTORY

History of similar complaints in the past

H/o hypertension/diabetes/asthma/thyroid disease/radiation/tuberculosis

h/o any previous surgery

FAMILY HISTORY:

PERSONAL HISTORY:

DietSleepAppetiteBowel and bladder habbits

Smoking/alcohol/betel nut chewing

GENERAL PHYSICAL EXAMINATION

PR: BP: RR: TEMP:

Pallor/cyanosis/icterus/clubbing/oedema/lymphadenopathy

LOCAL EXAMINATION

EAR: **RIGHT** **LEFT**

PREAURICULAR REGION :

- PINNA

POST AURICULAR REGION :

EXTERNAL AUDITORY CANAL :

TYMPANIC MEMBRANE :

MIDDLE EAR MUCOSA :

MASTOID TENDERNESS:

TUNING FORK TEST RIGHT LEFT

RINNES TEST

128HZ :

512HZ :

1028HZ :

WEBERS TEST:

ABC TEST:

FACIAL NERVE EXAMINATION:

EXAMINATION OF NOSE:

ANTERIOR RHINOSCOPY:

DIRECT NASAL ENDOSCOPY:

ORAL CAVITY AND OROPHARYNX EXAMINATION:

EXAMINATION OF NECK:

SYSTEMIC EXAMINATION:

INVESTIGATIONS

X-RAY MASTOID(Sculler`s view):

PRE-OPERATIVE PTA FINDINGS

AIR CONDUCTION THRESHOLD:

BONE CONDUCTION THRESHOLD:

AIR-BONE GAP:

DIAGNOSIS:

OPERATIVE PROCEDURE:

INTRAOPERATIVE FINDINGS:

POST OPERATIVE FOLLOW UP:

TUNING FORK TEST **RIGHT** **LEFT**

RINNIS TEST

128HZ :

512HZ :

1028HZ :

WEBER`S TEST :

ABC TEST:

PTA FINDINGS :

AIR CONDUCTION THRESHOLD :

BONE CONDUCTION THRESHOLD :

AIR BONE GAP :

INFORMED CONSENT

I have read this consent form/have been read to me and I understand the purpose of this study, the procedures that will be used, the risks and benefits associated with my involvement in the study and the confidential nature of the information that will be collected and disclosed during the study.

I understand that I remain free to withdraw from the study at anytime and this will not change my future care.

I have had the opportunity to ask questions regarding various aspects of the study and my questions have been answered to my satisfaction.

I, the undersigned agree to participate in this study and authorize the collection and disclosure of my personal information as outlined in this consent form.

I, have also been told that homologous septal spur cartilage that will used for reconstruction of ossiclethat is stored in 70% alcohol and there by give full consenrt to use the homologous septal spur cartilage.

SUBJECT/GUARDIAN'S NAME :

SIGNATURE/THUMB IMPRESSION:

DATE :

PATIENT INFORMATION SHEET

EVALUATION OF HEARING OUTCOME IN MYRINGOSTAPEDIOPEXY AND MYRINGOPLATINOPEXY

The purpose of the study is to analyse hearing results after myringostapediopexy and myringoplatinopexy. All the information regarding this purpose and risks associated with it will be explained in detail. After providing all the information, you will be invited to be a part of this study. You do not have to decide right away, as to whether you are interested to participate in the study or not. Before finalizing your decision, you may consult with anyone you feel comfortable with about the research.

If there is anything which is not clear to you, please do not hesitate to ask me as we go through the information. If any questions persist later, you may ask for me, other doctors or staff.

A detailed clinical history and ENT examination will be done. Tuning fork test and pure tone audiometry will be done preoperatively to report the type and extend of the hearing loss along with routine blood investigations and X-ray mastoid (schuller`s view). Otoscopic examination and tuning fork test and PTA will be done for follow up visits after 3 months postoperatively

PURPOSE

The aim is to study hearing improvement following ossiculoplasties namely myringostapediopexy and myringoplatinopexy using auto incus/homologous septal spur cartilage/tragal cartilage/automalleus. A review of literature in otorhinolaryngology suggest that there is a deficiency of comparative data related to this particular procedures and therefore we wish to do the study.

VOLUNTARY PARTICIPATION

Your participation in this research is entirely voluntary. It is your choice wheather to participate or not. If you choose not to participate in this research projectyou will still be offered treatment for the disease.

INFORMATION REGARDING THE OPERATIVE PROCEDURE:

Tympanoplasty with ossicular reconstruction will be done using autoincus/ automalleus / homologous septal spur cartilage/tragal cartilage depending upon presence of or absence of malleus.

I have also been told about the use of homologous material that can be used for reconstruction of ossicle an I am aware that homolous septal spur cartilage will be used for the reconstruction.

CONFIDENTIALITY:

Only the principle teacher, those assisting with the tests and data analysis need and your self will have access to the research results associated with your identity in the events of publications of this research. No personal information will be disclosed.

COMPENSATION AND COST:

You will have to pay for the basic investigations and surgical procedures which are routinely done. You will not receive any monetary benefits for participating in the research.

WHO TO CONTACT?

If you have any questions you may ask them or even after the commencement of the study.

If you wish to ask questions later.

You may contact the following doctor:

Dr.M.B.Swapanthi :
Mob. +91 9008508292
M.S.ENT,
Department of otorhinolaryngology and head and neck surgery.
R.L. Jalappa Hospital. Tamaka, KOLAR

KEY TO MASTER CHART

AGE

<20 YEARS – 0

20-39 YEARS -1

40- 59 YEARS – 2

> / = 60 YEARS -3

SEX

MALE -0

FEMALE -1

EAR-

RIGHT -0

LEFT-1

PRESENTING COMPLAINTS-

DECREASED HEARING-1

EARPAIN-2

TINNITUS-3

EAR DISCHARGE + DECREASED HEARING -4

EAR DISCHARGE + EARPAIN -5

DECREASED HEARING+ EARPAIN -6

DECREASED HEARING + EAR DISCHARGE + TINNITUS -7

PRE – OPERATIVE PTA-

AC,BC AND ABG:

Refer to master chart

TYMPANIC MEMBRANE PATHOLOGY-

CENTRAL PERFORATION - 0

SUBTOTAL PERFORATION – 1

MARGINAL PERFORATION - 2

TOTAL PERFORATION – 3

POSTERIO-SUPERIOR RETRACTION – 4

ATTIC RETRACTION - 5

OSSICULAR STATUS ACCORDING TO AUSTINE KARTUSH CLASSIFICATION -

M+ /S+ / I - (TYPE A) - 0

M+ / S FOOTPLATES +/ I - / S. SUPRASTRUCTURE - (TYPE B)-1

M-/ I - / S + (TYPE C) -2

M- / I - / S. SUPRASTRUCTURE - /S. FOOTPLATE + (TYPE D)-3

CHOLESTEATAOMA-

NO - 0

YES - 1

GRANULATION TISSUE-

NO - 0

YES - 1

MASTOID-

SCLEROTIC-0

PNEUMATIC-1

DIPLOIC-2

PROCEDURE-

MYRINGOSTAPEDIOPEXY-0

MYRINGOSPLATINOPEXY-1

MATERIALS USED-

AUTOLOGUS INCUS-0

HOMOSEPTAL SPUR CARTILAGE-1

CORTICAL BONE-2

EXTRUSION

NO - 0

YES - 1

POST OPERATIVE PTA-

AC, BC AND ABG:

Refer to chart

MASTOIDECTOMY

INTACT CANAL WALL: 0

CANAL WALL DOWN: 1

GAIN

Refer to chart

Sl. No.	Age (yrs)	Gender	presenting complaints	SIDE OF THE EAR INVOLVED	PRE OP AC	PRE OP BC	PRE OP ABG	Pathology	OSSICULAR STATUS	Cholesteatoma	Granualations	Mastoidectomy	Procedure	Material	Mastoid	Extrusion	post op AC	POST OP BC	Post op ABG	ABG Closure
1	45	1	5	1	63.7	10	53.7	0	2	0	0	0	0	1	0	0	31.1	10	21.1	32.6
2	38	0	1	0	61.2	15	46.2	5	0	0	1	0	0	1	1	0	29.9	5	24.9	24.3
3	35	1	4	0	53.7	10	43.7	4	2	1	0	0	0	0	2	1	27.5	10	17.5	26.2
4	15	1	7	0	50	10	40	0	0	0	0	0	0	1	1	0	32.5	5	27.5	12.5
5	48	1	7	1	61.2	10	51.2	5	0	0	0	0	0	0	2	0	30	10	20	31.7
6	50	1	2	1	48.5	10	38.5	0	2	0	0	1	0	2	1	1	41.7	5	36.7	1.8
7	55	0	4	1	48.7	15	33.7	4	2	1	0	0	0	1	0	0	27.6	10	17.6	16.1
8	60	0	6	0	57.2	10	47.2	0	0	0	1	0	0	1	0	0	25.1	10	15.1	32.1
9	18	1	1	1	60.1	10	50.1	1	2	0	1	0	0	1	1	0	21.9	5	16.9	33.2
10	24	1	5	0	50	10	40	4	0	0	0	0	0	0	2	0	27.5	10	17.5	22.5
11	35	0	4	1	53	15	38	5	2	1	1	0	0	2	1	0	32	5	27	11
12	12	0	7	1	64.9	15	49.9	0	2	0	1	1	0	1	0	0	36.1	10	26.1	21.8
13	20	0	4	1	50	10	40	1	2	0	1	0	0	1	0	0	17.5	5	12.5	27.5
14	61	0	6	1	63	15	48	0	0	0	1	0	0	0	1	0	40	15	30	18
15	24	0	7	0	53.4	10	43.4	1	0	1	1	0	0	1	1	0	28.6	5	23.6	19.8
16	38	0	2	0	48.6	10	38.6	0	2	0	1	0	0	1	1	0	22.6	10	12.6	26
17	52	1	7	1	60.1	10	50.1	1	0	0	1	0	0	1	1	0	26	10	16	34.1
18	36	1	1	1	59.7	15	44.7	2	2	1	0	0	0	1	2	0	35	5	30	14.7
19	42	1	1	1	52.1	10	42.1	0	0	0	1	0	0	0	2	0	31	10	21	21.1
20	36	0	4	1	51.1	10	41.1	4	2	1	0	0	0	1	0	0	28	10	18	26.1
21	56	0	5	0	58.7	10	48.7	5	2	0	0	0	0	2	0	0	36	5	31	17.7
22	45	1	7	0	57.2	10	47.2	1	0	1	1	0	0	1	0	0	34	10	24	23.2
23	39	0	1	1	56.7	10	46.7	5	0	0	0	0	0	0	0	0	35.6	5	30.6	16.1
24	40	0	4	0	56.7	10	46.7	4	3	1	0	1	0	1	0	0	31.7	10	21.7	25
25	18	0	7	0	67	15	52	2	3	1	1	0	1	0	1	1	62	15	47	5
26	62	1	1	0	66.2	10	56.2	5	2	1	1	1	1	1	2	0	36.2	5	31.2	25
27	16	0	6	1	63.7	10	53.7	0	1	0	0	1	1	0	2	0	32	10	22	31.7
28	19	1	4	0	54.8	10	44.8	0	1	1	0	1	1	0	2	0	31.8	10	21.8	23
29	40	0	1	1	61.8	10	51.8	0	3	0	0	1	1	1	0	0	35.7	5	30.7	21.1
30	56	1	5	1	56.6	15	41.6	0	2	1	1	1	1	1	0	0	35.6	15	20.6	21
31	32	1	7	0	49.5	10	39.5	0	1	1	0	1	1	1	2	0	32.4	5	27.4	12.1
32	10	0	4	0	50	10	40	4	2	1	1	1	1	1	1	0	37.1	10	27.1	12.9
33	42	1	4	1	55.6	10	45.6	0	1	1	0	0	1	1	2	0	35.1	5	30.1	15.1
34	52	0	7	0	58.9	10	48.9	1	1	0	0	1	1	0	2	1	50.1	10	40.1	8.8
35	24	0	3	0	52	10	42	1	2	1	0	0	1	1	2	0	28.9	5	23.9	18.1
36	26	1	5	1	48.2	10	48.2	4	1	1	1	1	1	0	2	0	30.2	10	20.2	28
37	25	1	4	1	57	10	47	2	1	0	0	1	1	0	0	1	40.7	5	35.7	11.3
38	32	0	4	0	56	10	46	5	2	1	0	1	1	1	2	0	32.2	10	22.2	23.8
39	39	0	7	0	50	10	40	1	3	1	0	1	1	1	2	0	27.6	5	22.6	17.4
40	12	1	4	1	54.9	10	44.9	4	1	0	0	1	1	0	2	0	33.1	10	23.1	21.8
41	40	0	1	1	53.1	10	43.1	0	1	1	0	1	1	1	1	0	30.5	5	25.5	17.6
42	61	0	5	0	59	15	44	1	1	0	0	1	1	0	0	0	30.5	5	25.5	18.5
43	42	1	4	1	56.9	10	46.9	5	3	1	0	1	1	1	0	0	30.4	10	20.4	26.5
44	21	1	7	0	56	10	46	1	2	1	0	1	1	1	0	0	37.7	5	32.7	13.3
45	45	1	1	1	56.7	10	46.7	2	1	1	1	0	1	0	0	0	37.7	10	27.7	19
46	40	1	5	1	60	10	50	4	3	1	0	1	1	1	0	0	36.7	10	26.7	23.3
47	45	1	4	1	59.1	15	44.1	1	1	1	0	1	1	0	1	0	32.1	5	27.1	17
48	57	0	7	1	50	10	40	1	3	1	0	1	1	1	0	0	34.7	5	29.7	10.3