"CORRELATION OF MIDDLE EAR RISK INDICES SCORES AND HEARING GAIN AFTER TYMPANOPLASTIES IN PATIENT WITH CHRONIC SUPPURATIVE OTITIS MEDIA, A 1-YEAR PROSPECTIVE STUDY"

BY

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v

LIST OF ABBREVIATIONS

GLOSSARY	ABBREVIATIONS
MERI	Middle ear risk indices
COM	Chronic Otitis Media
TM	Tympanic Membrane
SPITE	Surgical, prosthetic, infection,tissues, and eustachian tube system
EAC	External auditory canal
SNHL	Sensorineural hearing loss
CHL	Conductive hearing loss
PTA	Pure tone audiometry
CWD	canal wall-down
PORP	partial ossicular replacement prosthesis
TORP	Total ossicular replacement prosthesis
ET	Eustachian Tube
SD	Standard deviation
AB	Air Bone
WHO	World Health organization

ABSTRACT

Introduction

Middle ear risk index (MERI) can be an effective, prognostic factor for surgeons to determine the type of surgical procedure with a view to favourable outcome. The present study has been undertaken to evaluate the efficiency of MERI score in predicting the outcome of tympanoplasty and hearing gain

Aims and Objectives

Our study was designed with the following objective.

- To correlate the Middle Ear Risk Indices (MERI) and hearing gain in the evaluation of post operative outcomes of tympanoplasties.

Materials and Methodology

65 patients of either sex having chronic otitis media with conductive hearing loss of >20 dB was included in the study. Each patient had to undergo preoperative and postoperative pure tone audiometry to calculate the average AB gap. Patients underwent tympanoplasty, with or without mastoid exploration depending on the disease status. Pure tone audiometry (PTA) was done at 2 months and 4 months and compared with pre-operative PTA.

Results

This study shows that most of the patients had severe MERI (90%), followed by moderate MERI (9%). After 4 months number of patients with No improvement(<10dB) with moderate MERI- 2, (22.22%) and severe MERI- 7, (77%). Under Improvement(10-20dB) moderate MERI- 1 (4%), severe MERI- 24 (96%) and

Successful improvement (>20dB) moderate MERI-3(9%), severe MERI- 28 (90. %). MERI score was found to be statistically significant on successful graft uptake, reduction of AB gap and hearing gain.

Conclusion

In our study one can infer higher indices of (MERI) and lower age group had superior hearing gain and graft absorption rate when compared to older age groups. The patient of COM could be given accurate information about the chances of surgical success, the potential benefits to their hearing, and the choice of tympanoplasty type. To improve tympanoplasty outcomes by reducing middle ear disorders (granulation, smoking, and otorrhea) before surgery and the likelihood of surgical success and hearing benefit could be explained to the patient of COM to give them realistic expectations.

Keywords: Chronic otitis media (COM) · Tympanoplasty · Pure tone audiometry · Middle ear risk index (MERI) · Graft uptake. Age

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INTRODUCTION

India is a high prevalence country for chronic Otitis Media (COM) and COM continues to remain a public health challenge globally. ―The worldwide burden of COM ranges from 1 to 46%. A public health issue that requires attention is indicated by a prevalence of 4% or above.[1] COM is a potentially harmful illness that frequently has the potential to cause significant harm and lasting after effects, like deadly intracranial complications, which can place an excessive burden on the patient, their family, and society. ―It presents major health issues in under developed nations like India because of a lack of knowledge and access to expert medical care. Malnutrition, overcrowding, poor hygiene, recurrent upper respiratory tract infections, and inadequately funded healthcare are risk factors that exacerbate issues and increase the prevalence of the disease in both adults and children. [2,3]

Hearing loss and an increased risk of infection and discharge are two effects of COM. [3-5] Hearing loss is almost typically the most important of all the consequences linked to COM, ―Loss from perforations is influenced by middle-ear air space volume, frequency, and perforation size‖.[5–6] ―A significant factor in determining the loss is the size of the perforation; larger perforations lead to greater hearing losses. In order to prevent recurrent otorrhea and restore hearing, surgical repair (tympanoplasty) of the perforated tympanic membrane (TM) is recommended.[7]

―Berthold was the first to introduce tympanoplasty, and Wullstein and Zollner went on to develop and modify it. [4,7] Tympanoplasty can be performed via endomeatal (per meatal), endaural, or post-auricular techniques. Based on the dimension and region of the perforation, these methods have varying effects on the surgical outcome. ―Single-

stage surgery for both disease eradication and tympanoplasty was supported by certain research. [2,3]

The surgical concept and the pathological elements linked to the disease are both important for the effectiveness of tympanomastoidectomy with tympanoplasty. [4,5] Despite the abundance of literature on tympanomastoidectomy and tympanoplasty methods, there is little information available regarding the variables influencing the results. In the literature, the middle ear's pathologic state as a predictor of prognosis has been a perplexing topic. [6–8] Depending on the pathogenic causes linked to the disease, a one- or two-stage process can be used. The MERI, or The Middle Ear Risk Indices is a grading system that has been developed for this purpose.

Another crucial factor that affects how much hearing loss is brought on by perforation. ―The sound pressure inside the middle ear cavity will change inversely with middle ear volume if there is a certain sound pressure in the ear canal and a particular perforation. Therefore, with smaller middle-ear volumes, the trans tympanic membrane sound-pressure difference will be less and the conductive loss correspondingly bigger‖. [5,7] Thus, resulting in hearing impairment, delayed speech development, and potential repercussions on the child's academic advancement. Histopathological characteristics associated with COM include the presence of granulation tissue, cholesterol granulomas, or the development of cholesteatoma. Complications arising from perforations in the tympanic membrane include recurrent ear infections and hearing loss; severe perforations caused by infections or poor treatment of recurrent otitis media are frequently blamed for chronic perforations.

The chance of acquiring middle ear pathology is gauged by the middle ear risk indices (MERI). The Middle Ear Risk Indices (MERI) is a numerical rating system used to categorize the disease's severity. ―Each risk factor is given a precise number, and the MERI score is calculated by adding these values. Bellucci criteria, which measure the severity of otorrhea, are among the risk factors. A prognostic classification based on disease categories, stage categories, and disease descriptors was proposed by Austin. [5] Kartush created the middle ear risk index (MERI) [7] whereas ―Black presented the surgical, prosthetic, infection, tissues, and eustachian tube system (SPITE). MERI was updated and redesigned by Becvarovski and Kartush in 2001. The following factors are added to the list of middle ear risks: smoking, ossicular status, perforation, cholesteatoma and granulation tissue, cholesteatoma middle ear granulations/effusion, and prior surgical history. The following are the recommended risk categories that can be obtained from MERI.[6]

Normal is represented by MERI 0, mild disease by MERI 1–3, moderate disease by MERI 4–6, and severe disease by MERI 7 and above. The aforementioned parameters were used to analyze the numerical values from the Middle Ear Risk Indices (MERI), which was created by the aforementioned authors. The Middle ear risk indices (MERI) combines the known preoperative and intraoperative risk factors for tympanoplasty. Two-stage surgical procedures are severely limited by the expense of the procedure and the absence from regular work. In addition to improving the cost-effectiveness of the surgery, predicting the result of the procedure based on the middle ear pathologic condition will also increase patient compliance. ―Very few studies have examined the correlation between MERI and hearing gain. Such a study has not been undertaken here in Karnataka and a successful result will also greatly

help doctors and patients to have better prognosis and confidence in completing the procedure.[7]

With the evolution of several techniques and surgical approaches, tympanoplasty is commonly done surgery, the result of the study can be used for general population.

The Middle Ear Risk Indices (MERI) are a succinct and developed tool that will guide the decision and design of tympanoplasties to provide prognostics for audiological gain. They are used to forecast the results of patients having tympanoplasty procedure for COM in terms of the extent of graft uptake and closure of the Air-Bone gap. Tympanoplasty operations are becoming more common these days, thus it's critical to forecast surgical results and provide patients with appropriate counselling.

AIMS AND OBJECTIVES

Our study was designed with the following objective

- To correlate the Middle Ear Risk Indices (MERI) and hearing gain in the evaluation of post operative outcomes of tympanoplasties.

REVIEW OF LITERATURE

Tympanic Membrane

The tympanic membrane serves as a thin, fibrous layer between the middle ear and the EAC. It is situated at the external canal's lateral end in an oblique position and has a diameter of around 9 mm. ―It resembles a medially oriented cone, with the apex representing its attachment to the umbo. The tympanic membrane is made up of three cell layers: an interior mucosa layer, a central fibrous layer made up of both radiating and circular connective tissue fibres, and a lateral epithelial lining that runs parallel to the EAC's skin. The tympanic membrane is anchored within the bone tympanic sulcus by the fibrous annulus, a coalescence of the fibrous layer at its rim. The lamina propria of the pars tensa is thin and strong, made up of abundant type II collagen. The medial layer of the pars flaccida contains thicker and more loosely arranged collagen fibrils, mainly type I collagen, and it is more elastic than the pars tensa. The pars flaccida sits in a region of the tympanic ring deficient of bone, named the notch of Rivinus‖,[8] ―The most frequent location for primary cholesteatoma formation is Prussak's space. Lateral surface: Provided by the maxillary artery's deep auricular branch the anterior and posterior tympanic arteries provide support for the medial surface. Drainage: The medial side empties into the transverse venous sinus, whereas the lateral side empties into the external jugular vein. The tympanic membrane is supplied by branches of the auriculotemporal nerve (Vc), the auricular branch of the vagus, and the tympanic branch of the glossopharyngeal nerve.[8]

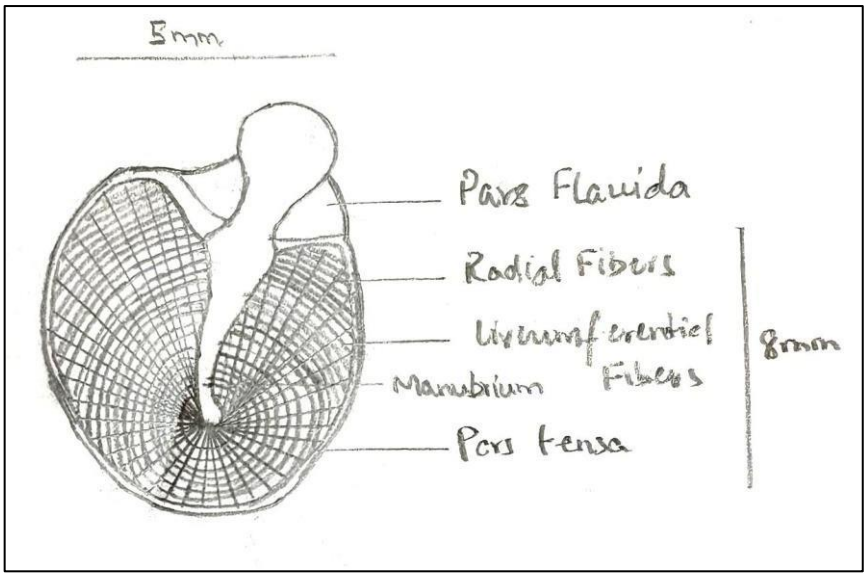


Fig 1. Tympanic Membrane

Ear Ossicles

—The middle ear's three ossicles—the malleus, incus, and stapes—are joined by synovial joints to form a bone chain that runs from the tympanic membrane to the oval window across the tympanic cavity. They carry sound waves from the oval window to the tympanic membrane and then to the inner ear fluid‖.[8]

Malleus

—It has an anterior process, a lateral process, a handle (manubrium), and a head. The handle is embedded in the fibrous layer of the tympanic membrane, whereas the head and neck are located in the epitympanum. On the tympanic surface, the lateral process creates a protrusion that resembles a knob. The incudomalleolar joint, a saddle-type synovial joint, is formed by the articulation of the malleus head and the incus body. [8] Epitympanum, is suspended by the superior ligament, which stretches upward to the tegmen tympani. Through a synovial joint, a saddle-shaped facet on the malleus head's posteromedial surface articulates with the incus body. The

handle, anterior process, and lateral process are born as the bone enlarges behind the malleus' neck. The lateral process receives the anterior and posterior malleolar folds from the tympanic annulus., a noticeable landmark on the tympanic membrane.[9]

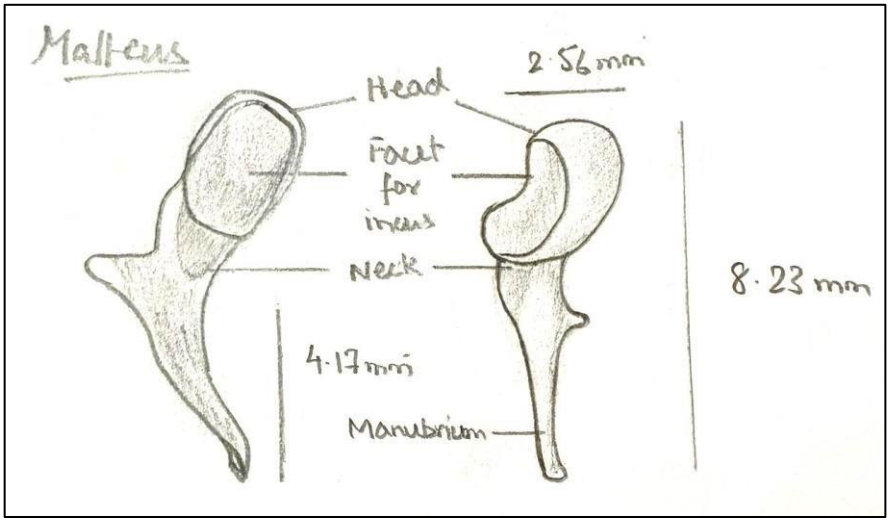


Fig 2. Malleus

Incus

—Its form is similar to that of a premolar tooth or an anvil. It has two thin processes—a short process and a long process—and a comparatively large body. The epitympanum contains the body, which has a cartilage-covered facet on the malleus. The incus body is suspended by the superior incudal ligament, which is attached to the tegmen tympani. The short process, which extends backward from the body to rest in the fossa incudis, is connected by a tiny suspensory ligament. There is a little medially directed lenticular process near the tip of the long process, which descends below the malleus and medial to their handle into the mesotympanum. The incudostapedial joint, a ball and socket type of synovial joint, is formed when its bulbous point (lentiform nodule) is directed medially to articulate with the stapes head‖.[10]

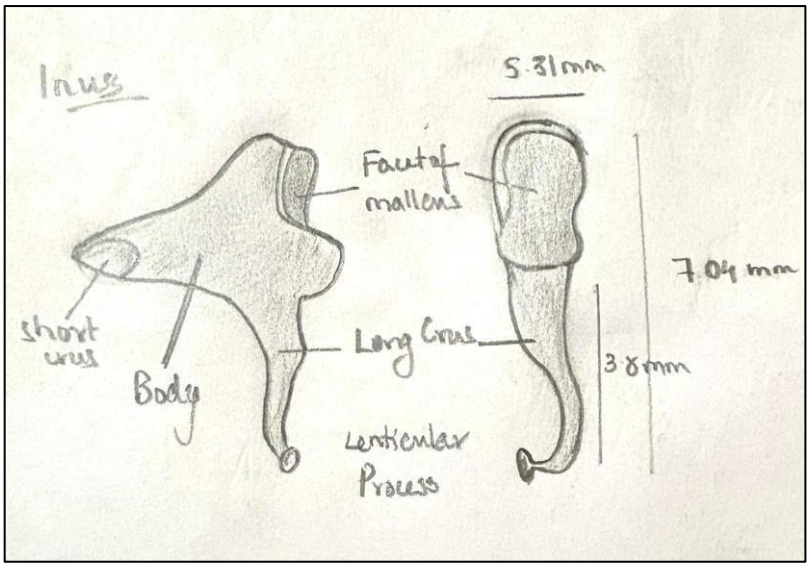


Fig 3. Incus

Stapes

Stapes looks like stirrup. It is made up of the footplate, anterior and posterior crura, head, and neck. The annular ligament connects the footplate, which shuts the oval window, to its edge. [5] The upper section of the stapedius tendon inserts into the back of the neck and the posterior crus. The anterior crus are thinner and less curved than the posterior, and both emerge from the wider bottom region of the neck. The concave surfaces of each are hollowed out, providing the ideal balance of strength and light weight. The two crura connect the footplate, which normally has a bent anterior and posterior end, an essentially straight inferior margin, and a convex superior margin‖.[10]

The ossicular chain vibrates anteriorly to posteriorly along an axis that passes through the malleus head and the incus body. Through the oval window, the smallest bone in the body, the stapes, transfers the middle ear's output to the inner ear. In order to facilitate effective sound transmission, the middle ear is crucial to the process of "impedance matching" between the fluid-filled inner ear and the air-filled middle ear.

The "area ratio" between the stapes footplate and the tympanic membrane is the most crucial component in the middle ear's impedance matching capacity‖.[8] —The surface area of the human tympanic membrane is around 20 times that of the stapes footplate (69 vs. 3.4 mm2). The force per unit area on the stapes footplate would be 20 times greater (26 dB) than on the tympanic membrane if all of the force applied to the tympanic membrane were transferred there. [8] The difference in length between the malleus's manubrium and the incus's long process is known as the lever ratio, and it serves as a second mechanism for impedance matching. A minor force applied to the lever's long arm (manubrium), which is somewhat longer than the incus's long process, produces a larger force on the short arm of the lever (incus long process) .[8]

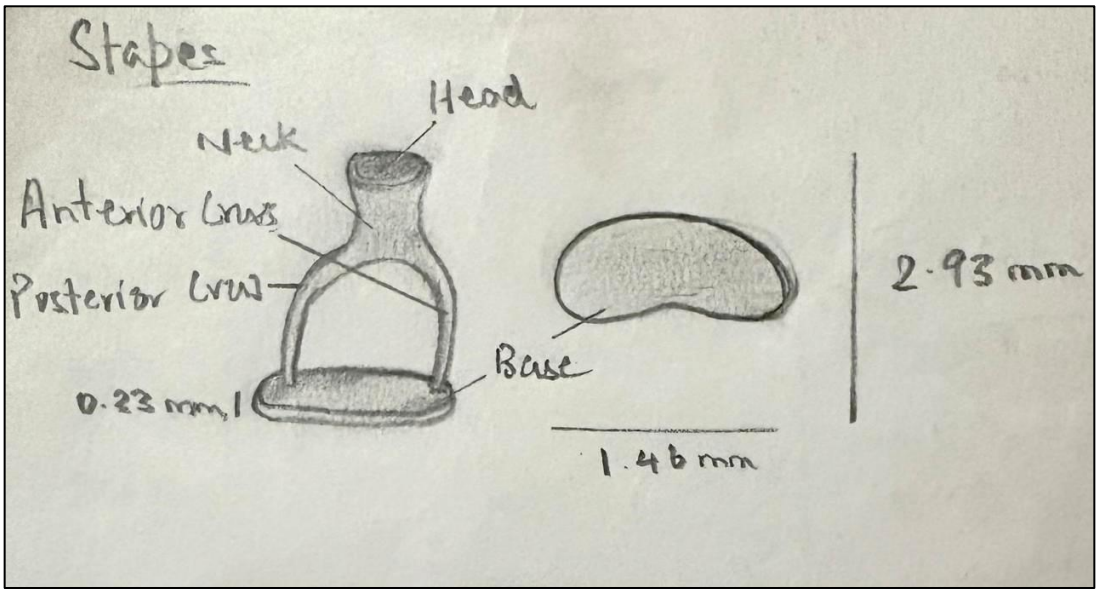


Fig 4. Stapes

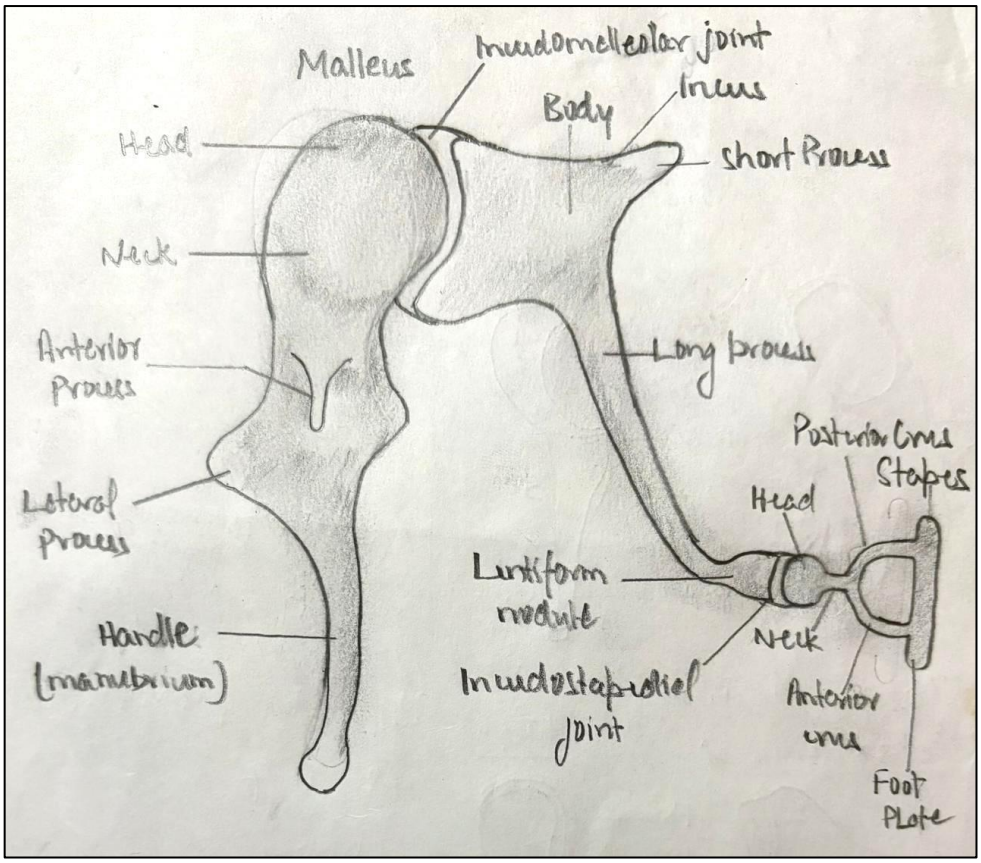


Fig 5. Ear ossicles

The Tensor Tympani Muscle

This long, thin muscle extends from the sides of the bone canal above the Eustachian tube. Additionally, parts of the muscle come from the larger wing of the sphenoid and the cartilaginous part of the Eustachian tube. The muscle travels backwards from its starts then into the tympanic cavity, where it lies directly beneath the facial nerve on the medial wall. In the canal's tympanic section, where a thin tendon replaces the muscle, the bony covering is frequently lacking. This passes via right angle, travels laterally, and enters the processus cochleariformis, where it is held in place by a transverse tendon. It then enters the medial portion of the malleus handle's upper end. Through a branch from the medial pterygoid nerve, the mandibular nerve supplies the muscle‖.[10]

Middle Ear Protection

—In the resting state, the blocked aperture of the middle ear prevents microorganisms from invading the nasopharynx. The cartilaginous eustachian tube and innate protective mechanisms present within it, because the tube's bony section stays open all the time. This "reflux" up the eustachian tube is physiological and is facilitated when the tympanic membrane is perforated because of absence of the middle ear and mastoid gas cushion.[9]

There aren't many Middle ear immunocompetent cells area, which is usually sterile. Only after inflammation has taken place does it start to produce an immunological response. —When bacterial organisms reach the inflammatory cascade in the middle ear space events leads to migration of immunocompetent cells (lymphocytes) and antigen-presenting cells (macrophages).

Respiratory viruses can disrupt tube bacteriology. Viruses have been shown to predispose to otitis media by three mechanisms:

1. Eustachian tube dysfunction is brought on by the nasopharyngeal production of cytokines and inflammatory mediators.
2. Growth in bacterial pathogen colonization of the nasopharynx.
3. Immunosuppression of the cell-mediated immune response, which modifies the host immunological response.[9]

—Sterility of the middle ear space is also guarded by molecules of innate immunity secreted by the tubal mucosa. These include lysozyme, a muramidase that creates cell wall disruption; lactoferrin, an iron-binding glycoprotein that acts synergistically with immunoglobulins; β-defensins, antimicrobial peptides that

increase permeability of cell walls; and collectins, oligomeric polypeptide chains that bind microbial carbohydrates and assist phagocytosis.[9]

Effects of tympanic membrane perforations on hearing

—The round window starts to become more involved in the mechanics of hearing when the tympanic membrane is perforated. Because sound tends to reach both windows at almost the same time, a tympanic membrane rupture eliminates sound shielding from the round window, cancelling out the perilymph's subsequent movements. When the middle ear's transformer ratio is higher, as there is a small tympanic membrane breach and the ossicular chain is still intact, the sound reaches. [5] The cancelling impact of sound on the exposed round window increases quickly as the perforation gets larger and the transformer ratio decreases, until a complete perforation results in a loss of 40 to 45 dB. By building a closed, air- containing middle ear, the ideal tympanoplasty restores sound protection for the round window. For the oval window, it rebuilds the sound-pressure transformation mechanism by joining a large tympanic membrane with the stapes footplate via an intact or reconstructed ossicular chain.[4]

Table 1. "Specific Lesions of the Conductive Apparatus and the Associated Hearing Loss".[9]

Classification	Component Disrupted	Expected Loss
Perforation of tympanic membrane	Loss of areal ratio, catenary lever	Proportional to size of perforation
Perforation of tympanic membrane with ossicular interruption	Hydraulic lever, areal ratio, catenary lever	38.3 dB
Total loss of tympanic membrane and ossicular chain	Hydraulic lever, areal ratio, catenary lever, phase cancelation	50 dB
Ossicular interruption with an intact tympanic membrane	Hydraulic lever, areal ratio, catenary lever, phase cancelation, reflection of sound energy away from the middle ear at the tympanic membrane	55–60 dB
Ossicular interruption with an intact tympanic membrane and closure of the oval window (distinct congenital malformation)	Hydraulic lever, areal ratio, catenary lever, phase cancelation, reflection of sound energy away from the middle ear at the tympanic membrane	55–60 dB

Chronic Otitis Media:

—Sensorineural hearing loss (SNHL) and conductive hearing loss (CHL) are both significantly increased by chronic otitis media (COM) in affected individuals. The diagnosis of chronic otitis media primarily relies on otoscopic examination, with a comprehensive evaluation of presenting symptoms and prior treatment history.[2]

Etiology of COM:

The etiology of COM has been attributed to a number of factors, such as

a) —Children with Down syndrome and cleft palate have a patulous Eustachian tube that allows for nasopharyngeal reflux, as well as Eustachian tube malfunction.
b) The existence of atopy and deficits in the mucosal immune system that are exclusive to the upper respiratory tract
c) Immune system deficiencies d. Inadequate mastoid pneumatization.[8]

"Classification of chronic otitis media

- Chronic active otitis media
  - With cholesteatoma
  - Without cholesteatoma
- Chronic inactive otitis media
  - With perforation
  - With retraction pocket
  - Adhesive otitis media
  - With ossicular fixation or resorption.[8]

Cholesteatoma

—A central white mass made up of keratin debris and keratinizing squamous epithelium resting on a thin stroma of fibrous tissues characterizes cholesteatomas, the final stage of (squamous epithelial) retractions of the pars tensa or flaccid that are not self-cleaning, retain epithelial debris, and frequently cause a secondary, inflammatory mucosal reaction. Because of this, it has also been referred to as keratoma or epidermosis. [10]

—By definition, congenital cholesteatomas develop from regions of the middle ear cleft's keratinizing epithelium and typically develop in children who have never had otitis.

Tympanic membrane invagination from the attic. or retraction pockets in the posterosuperior region of the pars tensa (Wittmaack's theory). Stratified squamous epithelium lines the tympanic membrane's outer surface. After invaginating, this epithelium creates the cholesteatoma matrix and deposits keratin in the pocket.

Hyperplasia of basal cells (Ruedi's idea). Under the impact of infection, the germinal layer of skin's basal cells multiplies and produce keratinizing squamous epithelium.

The Habermann theory of epithelial invasion. Through an existing perforation, particularly of the marginal variety where a portion of the annulus tympanicus has already been damaged, the epithelium from the meatus or outer drum surface develops into the middle ear.

Metaplasia (the theory of Sades). Like respiratory mucosa elsewhere, middle ear mucosa metaplasia results from recurrent infections and changes into squamous epithelium.[9]

"Chronic Active Otitis Media with Cholesteatoma

The confined squamous epithelium that creates and collects desquamated keratin debris is what defines the erosive process known as cholesteatoma. With a small male predominance (l.4X female), the estimated annual incidence is 3 per 100,000 for children and 9.2 per 100,000 for adults. According to a study of people from Finland and Denmark, cholesteatoma can be broadly classified as either acquired or congenitall. [8] The majority of mature cholesteatomas exhibit bone degradation, which at first is limited to the scutum and ossicular chain. The normal mucosal lining degenerates as the cholesteatoma comes into touch with bone, and inflammatory mediators of destruction such osteoclasts, monocytes, and macrophages start to proliferate. Substantially increased populations of mast cells have been found in granulation tissue and in ossicles along their eroded surfaces. Biofilm formation can also help explain the difficulty in eradicating the frequent infections that occur with Cholesteatomas.[8]

"Chronic Active Otitis Media Without Cholesteatoma

Chronic middle ear and mastoid inflammation is known as chronic active otitis media without cholesteatoma. Clinically, it presents chronic otorrhea that varies in amount, color, and consistency. Typically, otalgia is not severe and consists of a dull earache that waxes and wanes. Otorrhea can occur, particularly with aural polyp formation. Hearing loss is virtually always present and conductive. Chronic active otitis media without cholesteatoma is an indolent process that can persist for years, or indefinitely, in the absence of definitive management. As the condition progresses, soft, friable granulation tissue begins to form, which consists of new capillaries and connective tissue as well as inflammatory cells. Variable a1nounts of mucoid and

purulent otorrhea occur chronically. With continued inflammation, the mastoid air cell tracts can become blocked, occasionally causing the formation of a cholesterol granuloma reaction of giant cells to cholesterol crystals from degraded blood products.[8]

"Chronic Inactive Otit1s Media with Perforation

A permanent tympanic membrane perforation without any ongoing middle ear or mastoid infection is known as chronic inactive otitis media with perforation. The tympanic membrane has been ruptured in the past as part of previous acute or chronic inflammation. Perforations can be in the pars flaccida or pars tensa of the tympanic membrane, and can be marginal, central, subtotal, or total. The squamous epithelial layer of the tympanic membrane and the mucosa of the medial tympanic membrane meet at the mucocutaneous junction, is typically located at the edge of the perforation, epithelium Cells move through the perforation medially. The cause of this migration has significant clinical implications. If the tympanic membrane is surgically repaired and migrating epithelial cells were left in place in the middle-ear space, an iatrogenic cholesteatoma forms‖.[8]

"Chronic Inactive Otitis Media with Ossicular Fixation or Resorption

One consequence of chronic otitis media is ossicular fixation or resorption, which is a kind of chronic inactive otitis media. Some patients have substantial fixation including the malleus, incus, and/or stapes in combination, as part of the ossicular chain. Ossicular resorption is common with chronic inactive otitis media. The incudostapedial joint is particularly vulnerable to resorption given the incus's lenticular process's shaky blood supply, as well as its delicate structure. However, Resorption can happen anywhere on the ossicles and frequently requires the lengthy

incus process. and the capitulum and crura of the stapes. involvement of the body of the incus and manubrium of the malleus can occur but are less common.[8]

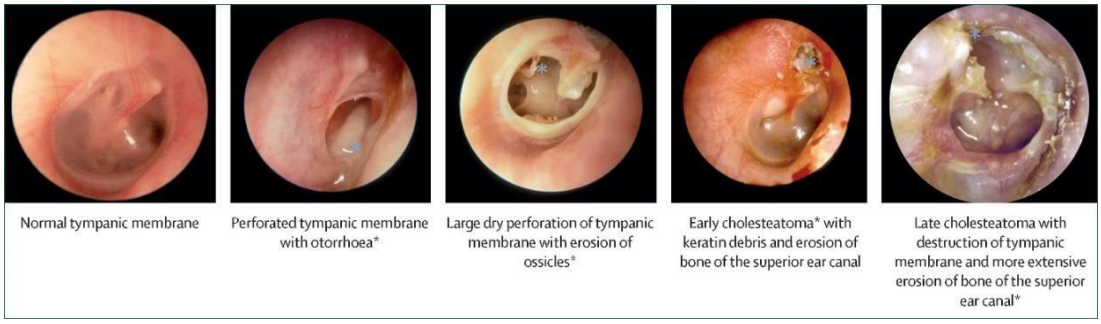


Fig 6. Stages of cholesteatoma [9]

Factors affecting the progression of CSOM

—A tympanic membrane perforation's incapacity to heal is owing to persistent infections in the middle ear cavities with continuous purulent otorrhea. Eustachian tube obstruction causes hypo pressure in the tympanic cavity, resulting in inflammation and local secondary hypoxia obstructing epithelial repair.[8]

—Extensive perforations have also been linked to the process of healing, as the spontaneous closure might be hindered by the size of the perforation and the migration patterns of epithelial cells. Further, the development of polyps and granulation tissue in the middle ear cavity as a result of the host's immunological response polyps, also complicates the healing process. When tympanic membrane perforation is evident without any signs of inflammation, it is called dry perforation and is vital for ensuring suitable treatment strategies.[8]

Hearing loss in COM

Several studies have reviewed hearing loss after tympanic membrane perforation. The resultant lowering of pressure differential is known to compromise

auditory function. Moreover, a larger size of perforations is strongly linked to a more noticeable decrease in the efficiency of the eardrum, due to a further decrease in pressure difference. The level of hearing loss is directly related to the size of the perforation, rather than its location within the eardrum.

Ossicular Bone Necrosis is connected to conductive hearing loss. When there is complete disconnection of the ossicular bones without any damage to the eardrum, a notable reduction in the middle car's sound transmission, resulting in a reduction of 40-60 B, depending on the specific frequency being evaluated.

The correlation between the volume of the middle ear and mastoid and hearing loss is inversely related when there is tympanic membrane perforation. In cases where the perforation is consistent in size and position, the air-bone gap caused by the perforation could show fluctuations of about 35 decibels, influenced by the volumes of the middle ear and mastoid. By lessening the difference in sound pressure between the two sides of the TM, TM perforation reduces ossicular coupling and results in hearing loss. ―Hearing loss is frequency dependent and in proportion to the perforation's size, with the lowest sound frequencies experiencing the greatest losses. Additionally, it fluctuates inversely with the volume of the mastoid and middle ear airways. This could help to explain why perforations that appear to be identical in size and location can result in varying degrees of hearing loss, and how hearing loss can change within a single perforation depending on whether otorrhea is present or not. Otorrhea would reduce the middle ear and mastoid airspace, which would increase hearing loss‖.[11]

Hearing Assessment

Modern otological practices for surgical interventions include a variety of diagnostic tools and methodologies that are vital to guide the decision-making process.

Tuning fork test is a necessary aid to identify hearing loss to differentiate between conductive and sensorineural dysfunctions. In order to assess conductive hearing loss and identify different air-bone gaps, pure tune audiometry is extremely important. ―Ossicular chain erosion (particularly the long process of the incus and occasionally the stapes superstructure), the extent of the tympanic membrane perforation, and the existence of granulation tissue around the ossicular chain that influences its movement, and the occurrence of tympanosclerosis around the ossicular chain area—which becomes critical in situations of inconsistencies—are some of the factors that determine the air-bone gap. One essential method for determining the extent of hearing loss caused by conductivity linked to the underlying condition is pure-tone audiometry. [3]

Table 2. Degree of Hearing Loss Estimated by Rinne Testing. [9]

Rinne Test Result	Estimated Conductive Los
Negative: 256 Hz, Positive: 512 and 1024 Hz	Mild conductive loss of 20–30 dB
Negative: 256 and 512 Hz, Positive: 1024 Hz	Moderate conductive loss of 30–45 dB
Positive: 1024 Hz, Negative: 256, 512, and 1024 Hz	Severe conductive loss of 45–60 dB

—When bone conduction exceeds air conduction, the Rinne test is negative (abnormal).

When air conduction exceeds bone conduction, the Rinne test is positive (normal). The reliability of tuning fork tests in identifying hearing loss, from Miltenburg DM. J. Otolaryngology 23:254, 1994.

Other complications of COM

The documented rates of intracranial and extracranial complication prevalence of Chronic Otitis Media (COM) range between 0.69% and 5% Moreover, complications within the temporal bone can impact the cochlea, labyrinth, and facial nerve, presenting in both extracranial and intracranial forms.

Table 3. Classification of Complications of Acute and Chronic Otitis Media.[9]

EXTRACRANIAL	INTRACRANIAL
Acute mastoiditis	Meningitis
Coalescent mastoiditis	Brain abscess
Chronic mastoiditis	Subdural empyema
Masked mastoiditis	Epidural abscess
Postauricular abscess	Lateral sinus thrombosis
Bezold abscess	Otitic Hydrocephalus
Temporal abscess	
Petrous apicitis	
Labyrinthine fistula	
Facial nerve paralysis	
Acute suppurative labyrinthitis	
Encephalocele and cerebrospinal fluid leakage	

Studies by ―Singh and Maharaj have highlighted the prevalence of squamous epithelial disease as opposed to mucosal disease when considering extracranial and intracranial complications. The onset of pain may potentially indicate the commencement of an acute infection, hinting at a potential accumulation of purulent material beneath pressure in the mastoid or middle ear. Furthermore, it is worth noting that otogenic abscesses have the capability to manifest in ears that have previously undergone mastoidectomy procedures.[9]

―Despite a general decrease in the frequency of otitis media complications, potentially fatal complications can still occur. The alterations in bacterial virulence and susceptibility, the decline in the doctor's experience, and the condition of each patient are the hypothesized causes.[9]

―Personal history of Recurrent acute otitis media, chronic otitis media, and otitis media, Persistent symptoms despite appropriate antibiotic therapy, High fever, Purulent otorrhea, Otalgia, Pain extending beyond the ear, Mastoid tenderness, Infra-auricular pain, Retro-orbital pain, Significant toxicity at presentation, Severe headache, Nausea and vomiting, Vertigo, Mental status changes, Focal neurologic deficits.[10]

Tympanoplasty

It involves removing middle ear illness and rebuilding the hearing system with or without tympanic membrane grafting, or mastoid surgery. This refers to either myringoplasty along with ossicular reconstruction or ossicular reconstruction alone.

—Mastoidectomy accompanied by tympanoplasty. It involves reconstructing the hearing system, either eliminating disease from the middle ear and mastoid cavities, either with or without tympanic membrane transplantation.

A cortical mastoidectomy, referred to preservation of the posterior meatal wall via a straightforward mastoidectomy or Schwartz technique, which involves all exposed mastoid air cells are exenterated.[8]

—The endaural technique is more popular in Europe and can be applied to all types of perforations. It works best when a limited atticotomy is expected in addition to tympanoplasty. This method can be applied with a self-retaining retractor. In the US, the most used method for tympanoplasty is the postauricular technique. Even in the absence of canaloplasty, it provides a better angle of vision of the anterior TM and is applicable to all hole diameters. Self-retaining retractors make it simpler to employ both hands for suctioning and instrumentation.[9]

—Primary goal of a tympanoplasty procedure is to restore sound to create an airtight, air-filled middle ear and reconstruct a connection from a large tympanic membrane to the stapes footplate by an ossicular chain that is either intact or rebuilt. Medial Graft Technique, the transcanal technique elevates the tympanomeatal flap. If performed correctly by a skilled surgeon, the medial approach is most suited for posterior and inferior central perforations, but it can also be utilized to treat complete perforations or in revision instances.[9]

—The lateral approach has significant promise for stimulating vascular ingrowth to support epithelialization and graft healing. It can be especially helpful for revision cases with chronic suppurative otitis media with drum pathology and for severe or extensive perforations involving the anterior TM‖.[9]

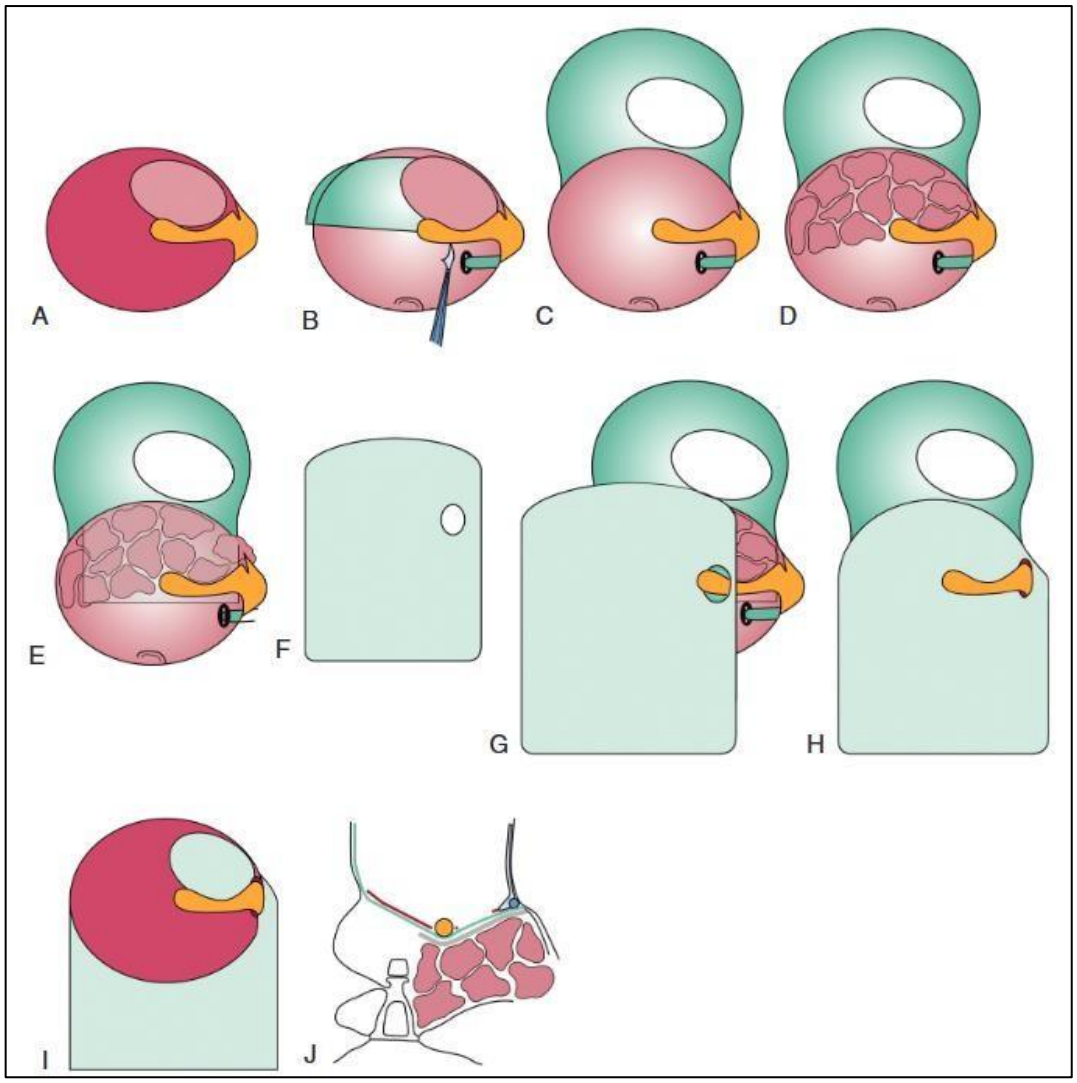


Fig 7. "Medial Graft Technique".[9]

—Technical steps of medial technique tympanoplasty. (A) Anterior tympanic membrane perforation. (B) The reflected tympanomeatal flap is still attached to the malleus; the periosteum is incised along the posterior aspect of the malleus. (C) The tympanomeatal flap is freed from the malleus, dissected forward, and reflected upward onto the anterior canal wall, which shows through the perforation. (D) Gelfoam is placed anteriorty to support the graft. (E) A platform of Gelfilm is placed lateral to the Gelfoam and medial to the malleus and the anterior annulus. (F) Fascial graft with a small hole created in the anterior superior aspect. (G) The umbo is passed through the hole in the graft. (H) The graft is pulled superiorly so that the hole

surrounds the neck of the malleus; the anterior edge of the graft is tucked medial to the anterior annulus and lateral to the Gelfilm platform. (I) The tympanomeatal flap is returned to its position; the graft shows through the perforation. (J) Placement of the Gelfilm platform and graft medial to the anterior annulus and supported by Gelfoam in the anterior tympanum‖.[9]

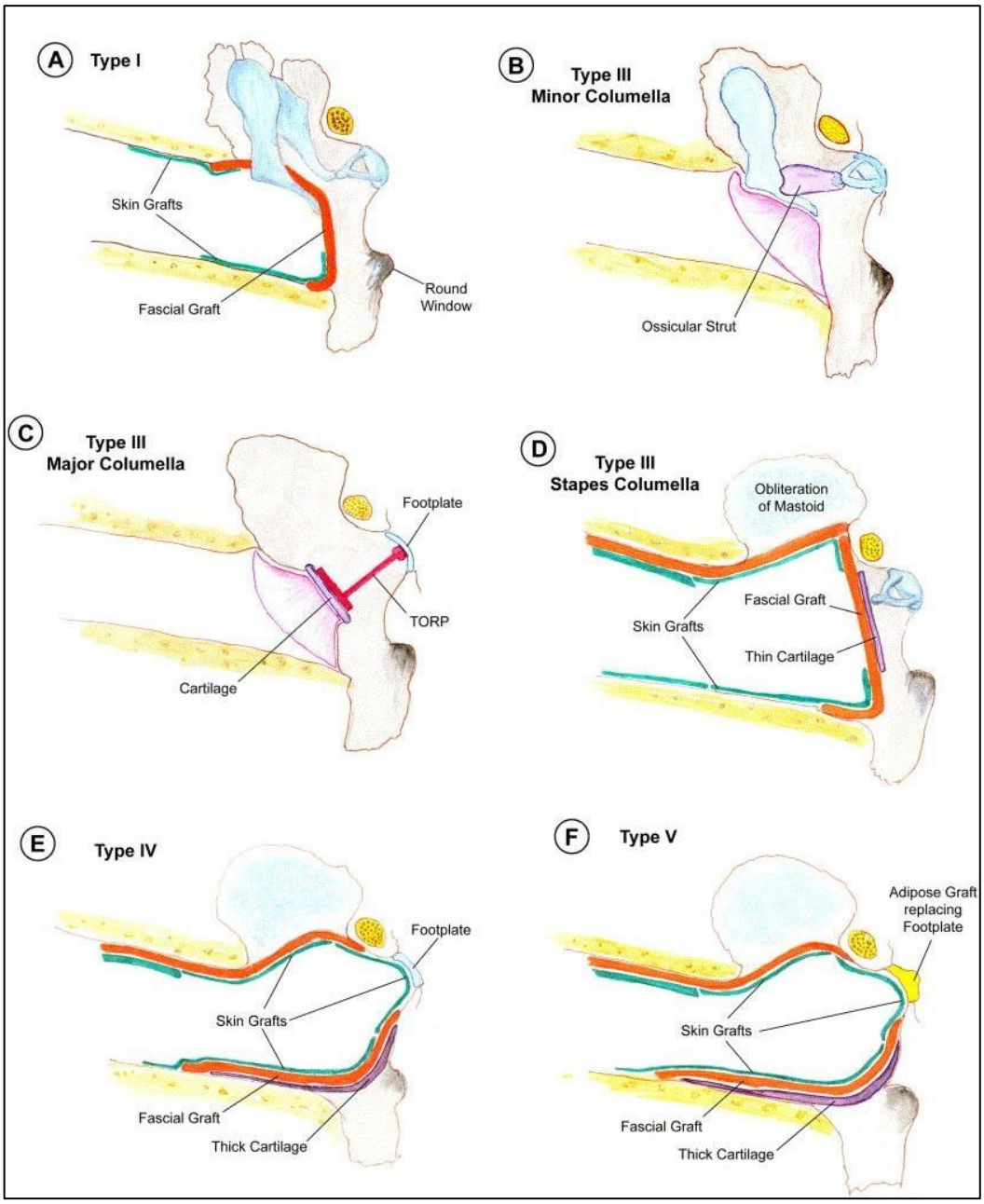


Fig 8. Types of Tympanoplasty.[5]

Types of tympanoplasty. (A) Type I. Repair of tympanic membrane (TM) with temporalis fascia. (B) Type III: minor columella. Ossicular strut or partial ossicular replacement prosthesis (PORP) is placed between stapes head and manubrium/TM. (C) Type III: major columella. Total ossicular replacement prosthesis (TORP) is placed from stapes footplate to the manubrium/TM. (D) Type III: stapes columella. Performed with canal wall-down (CWD) mastoidectomy and obliteration of mastoid. Thin cartilage disk and temporalis fascia are placed on stapes head. (E) Type IV. Round window is acoustically shielded by thick cartilage and temporalis fascia while footplate is covered with thin skin graft. Also performed with CWD mastoidectomy.
(F) Type V. Similar to type IV, except for total stapedectomy and footplate replacement by an adipose graft.[5]

Wullstein proposed a categorization system for tympanoplasty, which relies on the residual of the middle ear following complete eradication of any pathological conditions and a method by which protection of round window is ensured.

Table 4. "Modified Wullstein classification".[9]

Type	Tympanoplasty
Type I	Repair of tympanic membrane without altering the ossicular chain
Type II	Repair of the ossicular chain with restoration of the lever mechanism
Type Ill (minor columella)	Repair of ossicular chain by placing graft from the stapes capitulum to the tympanic membrane or manubrium
Type Ill (major columella)	Repair of ossicular chain using a single graft interposed between mobile footplate and the tympanic membrane or manubrium
Type III (stapes columella)	Repair of ossicular chain by placing a tym panic membrane graft directly onto the capitulum of stapes
Type IV	A mobile stapes footplate remains directly exposed to incoming sound from the ear canal while a tissue graft is placed to acoustically shield the round window membrane from sound
Type Va	Fenestration of the lateral semicircular canal so as to bypass an ankylosed stapes footplate
Type Vb	Identical to type IV, except that the stapes footplate is removed, and the oval window is sealed by a tissue graft

Preoperative Evaluation for successful tympanoplasty

—A history of infections, prior surgery, including pressure-equalization tube placement as well as the course and severity of otologic symptoms. The degree of TM perforation, as well as the state of the middle ear mucosa and ossicular chain. The condition of the surviving membrane, with special attention to the degree of myringosclerosis and atrophic regions.[9]

The expected size of the perforation following the removal of the diseased segments, since repairs of perforations that cover more than 50% of the membrane are less likely to be successful. Additionally, the external canal's size is assessed, and if a prominent anterior canal wall makes it impossible to see the perforation completely, a canaloplasty is planned. The dilatory function of the eustachian tube is crucial for aeration. proper middle ear mucosa and fewer otorrhea episodes could indicate proper eustachian tube function.

Factors Influencing Treatment Options

—To try to stratify the likelihood of success, a number of tympanoplasty prognostic scoring systems have been established, such as MERI (Middle Ear Risk Index) and SPITE (Surgical, Prosthetic, Infection, Tissues, and Eustachian tube [9] .The age of the patient, whether an infection is present, the state of the other ear, the pace of reperforation, and the mastoid, and smoking are additional aspects to consider before undergoing surgery.

—Timing and age

Many children are managed conservatively until after the age of seven, presuming that these patients were largely asymptomatic. Morphological changes in

ET that accompany improvement in function are most noticeable after this age. Problematic perforations, such as those with recurrent infections or significant hearing loss causing developmental delay, may warrant earlier operative intervention. Morphological changes in the ET that accompany improvement in function are most noticeable after the age of 7 years. Many patients are managed conservatively until this age, assuming these patients were relatively asymptomatic.[9]

—Adenoidectomy

There is conflicting evidence about how much adenoidectomy contributes to the outcome of myringoplasty. with most reports indicating that there's no advantage to myringoplasty rates of success from prior adenoidectomy.[9]

—Infection

Regarding the impact potential infection during the procedure on results, there are conflicting views in the literature. It has been demonstrated that up to 20% of both wet and dry perforated ears can harbor infections in culture. and one of the most frequent reasons why myringoplasty fails is infection. According to certain research, potential infection during the procedure has a detrimental impact on results, increasing the likelihood of myringitis, retraction pockets, and unsuccessful perforation closure. However, the bulk of research has demonstrated that the existence of infection has no detrimental effect on surgical results; as a result, most surgeons would not be discouraged from performing surgery while an infection is ongoing.[10]

—The opposing ear

A favourable overall Eustachian tube function is indicated by a normal contralateral ear, and this is a good indicator of the success of tympanoplasty. However, in order to rule out cholesteatoma, abnormalities in the opposite ear should be investigated. Graft uptake has been reported to be less successful when the other ear has problems. The selection of graft material may be impacted by the existence of a bilateral perforation. Due to its presumed superior resilience over temporalis fascia alone and consequently higher closure success rates, cartilage is increasingly being used, especially in this group, subtotal perforations, and revision surgery.[9]

—According to the research, children's success rates range from 35 to 94% and adults from 60 to 99%. Although the majority of studies have brief follow-up times, reperforation can happen years after the initial procedure. According to some estimates, the rate of reperforation in children under the age of 15 is 18%, which is more than twice the rate in adults. Graft failure from infection with graft necrosis or failure of the anterior aspect of the graft—the most precarious area because of its apparent hypovascularity are the primary reasons for most failures that take place in the early post-operative phase, relative to the rest of the tympanic membrane. There are unclear recommendations regarding whether surgical revision is necessary after initial failures and, if so, how long one should wait before reoperating, despite three months.[10]

—Mastoid

There is ongoing discussion on the role of the mastoid air cell system in COM. COM is frequently put at risk by poor mastoid pneumatization and eustachian tube dysfunction. By eliminating any remaining mastoidectomy, a reservoir of aerated

bone to cushion pressure variations in the middle ear, and mucosal illness hidden in the mastoid air cells can enhance the results of non-cholesteatomatous COM surgery. Mastoidectomy is recommended when COM patients don't improve with strict pre-operative medical care or in revision cases, as other investigations have shown the existence of persistent mastoid disease on CT scans of the temporal bones in patients whose graft had failed for simple perforations. A recent assessment of the literature found no advantages in combining mastoidectomy and tympanoplasty. More complex otological conditions, like recurring perforations or active mucosal COM, have poorer results and can benefit from combined mastoidectomy.[10]

—Smoking

It's unclear how smoking affects surgical results. According to certain research, there is no statistically significant impact on the rate of graft take. However, some have pointed out that smoking has detrimental impacts on the Eustachian tube and middle ear on a local, regional, and systemic level. Locally, the blood's capacity to carry oxygen is reduced by carbon monoxide, whereas nicotine promotes cutaneous vasoconstriction and raises the risk of thrombosis. Chemical irritation causes regional blockage of the Eustachian tube, increased mucous viscosity, and decreased mucociliary clearance. The literature has extensively demonstrated smoking's detrimental effects on the body, especially on the respiratory system.[10]

Factors That Affect Surgical Decision

The state of the middle ear mucosa, the magnitude of the bleeding, the likelihood of a cholesteatoma recurrence, and the function of the eustachian tubes in the affected and contralateral ears. The creation of fibrous tissue is likely to heal enlarged, damaged, or partially absent middle ear mucosa. —In addition to impairing

vision and complicating surgery, middle ear haemorrhage raises the possibility of adverse fibrosis. to place a sheet of Silastic, Gelfilm, or Epidisc between the promontory and the TM (transplant) in order to reduce the development of postoperative middle ear fibrous tissue.[9]

Prognostic factors for successful tympanoplasty

"Size of the perforation It is believed that the chances of success are reduced if the perforation is more than 50% of the tympanic membrane.

Condition of the opposite ear Pooling of presumed Eustachian tube malfunction is the cause of the ear issue.[10]

"Condition of the operated ear The ear problem is thought to be caused by a malfunction in the Eustachian tube‖.[10]

Site of perforation marginal perforations, central perforations

and anterior perforations

"Prior adenectomy or adenotonsillectomy Frequent inflammation around the Eustachian tube

Smoking status Smoking has a detrimental effect on one's chances of success [10]

Follow-up period".[10]

Outcomes-Graft uptake rate

When a transcanal method is being used, temporalis fascia can be harvested during tympanoplasty by superior dissection following an endaural or postauricular incision, or by making a small incision posterosuperior to the helix in the hair-bearing

scalp. A success rate of 95% has been reported post tympanoplasty when performed by highly skilled otosurgeons, which underscores and highlights the substantial impact of surgical expertise. On review of 281 myringoplasties by Palva and Ramsay [26], a closure rate of 97% was reported when performed under the skillful supervision of an experienced otosurgeons, compared with 74% among surgeons with limited experience.

In contradiction to the above, assumption related to the high skills and competencies of otosurgeons, Wasson et al's [27] study ―observed that neither the skill level of the surgeon nor the specific type of graft material used had a significant impact on the closure rate or the hearing outcomes. Closure rate is significantly higher for small perforations (74%) compared to larger ones (56%) Additionally, the efficacy of graft survival in revision surgery has been examined in contrast to initial procedures. Halik and Smyth [28] reported a retention rate of only 60% for tympanic membranes after revision surgery, highlighting a significantly reduced success rate compared to what is commonly reported for primary procedures.

Hearing outcomes

―In terms of auditory results, the effective closure of the tympanic membrane generally leads to only a minor enhancement in hearing capability. Achieving a full closure of the air-bone gap in myringoplasty is infrequent, as repairing a perforation in the tympanic membrane does not completely return the ear to its original condition‖.[2]

Failure of Surgery

A number of factors are responsible for tympanoplasty failure, and well- known factors are attributed to reperforation, graft lateralization, atelectasis and postop myringitis.

—Many failures tend to transpire in the early post-operative phase, primarily attributed to graft failure resulting from infections leading to graft necrosis, or the failure of the anterior portion of the graft, which is considered the most vulnerable due to the apparent hypo vascularity in this specific region when compared to the remainder of the tympanic membrane.[6]

Evidence related to success rates of tympanoplasty therefore remains a topic of scientific quest.

—Success rates ranging from 60% to 99% have been documented in the adult population, some studies have proposed a decline in success rates over time, transitioning from an approximate 85% rate at 1 year to 78% at the 10-year mark‖.[6]

—It is important to note that many of the studies have relatively brief follow-up durations and long-term investigations are limited in number.[6]

Middle ear risk index (MERI)

—The Middle Ear Risk Index (MERI) was developed by Kartush in 1994 to help predict the success of tympanoplasty surgery. The MERI is a numerical value that indicates the severity of a middle ear disease and the likelihood of a successful surgical outcome.[11]

—History of MERI [11]

1965-The American Academy of Ophthalmology and Otolaryngology Subcommittee on Conservation of Hearing established a standard classification for chronic middle ear infection surgery.

1971-Austin proposed a system for ossiculoplasty that was later modified by Kartush in 1994.

1994-Kartush introduced the MERI, which combined the Austin-Kartush classification with the Belluci classification of otorrhea.

2001-Kartush updated the MERI to include smoking as a risk factor.

What MERI does

Combines preoperative and intraoperative risk factors with a numerical value

- Helps predict the success of tympanoplasty surgery
- Helps guide case selection for surgery
- Helps predict hearing outcomes of surgery

What the MERI score indicates

- 0: Normal
- 1–3: Mild disease
- 4–6: Moderate disease
- 7–12: Severe disease‖.[11]

—This index generates a numerical indicator of the severity of middle ear disease. The recognized preoperative and intraoperative risk variables for the prognosis of tympanoplasty are combined into a quantitative value by MERI. To

clarify these fundamental facts and divide patients into other prognostic categories, Kartush modified the Austin classification and introduced the middle ear risk index (MERI). They assigned risk value to each of the parameters they monitored, which included otorrhea, eardrum perforation, cholesteatoma, ossicular status, middle ear granulations or effusions, prior surgery, and smoking. Throwing light on the various parameters which determine a successful tympanoplasty, important ones include age, gender, type and site of perforation, middle ear condition, presence or absence of middle ear granulations, cholesteatoma, drainage status of the ear at the time of surgery.[11]

—Removing the pathogenesis and achieving a mucosal-lined middle ear cleft with an intact tympanic membrane are the objectives of a successful tympanoplasty. The creation of a sound conducting mechanism in a middle ear cleft with a mucosal lining and enough airflow is the aim of a successful tympanoplasty [4]. —It also offers the chance for enhanced hearing. The literature has revealed several prognostic factors that could affect the surgical effectiveness of tympanoplasty. While some research finds that some of these criteria are significant, others find the opposite. Adult tympanoplasty surgical success rates have been reported to range from 60% to 99%.[5]

Tympanoplasty prognosis was categorized. Belluci outlined four distinct phases for the tympanoplasty prognosis. According to disease categories, stage categories, and disease descriptors. —Austin suggested a prognostic stratification according to disease categories and disease description. The middle ear risk index (MERI) was created by Kartush‖.[5] —MERI was updated and redesigned by Decvarovski and Kartush in 2001. Another risk to the middle ears is smoking. Moreover, the MERI 2001 risk value for cholesteatoma and granulation tissue or

effusion has been raised.[7] MERI combines preoperative and intraoperative risk variables for the prognosis of tympanoplasty into a numerical number.

Risk factor	Risk value
Otorrhea (Bellucci)	
I-Dry 0	0
II-Occasionally wet	1
III-Persistently wet	2
IV-Wet, cleft palate	3
Perforation	
None	0
Present	1
Cholesteatoma	
None	0
Present	1
Ossicular status (Austin/Kartush)	
0) M+I+S+	0
A) M+S+	1
B) M+S-	2
C) M-S+	3
D) M-S-	4
E) Malleus head fixation	2
F) Stapes fixation	3
Middle ear: granulations or effusion	
No	0
Yes	2
Previous surgery	
None	0
Staged	1
Revision	2
Smoker	
No	0
Yes	2

In 2022, Bothra J. et al. [13] conducted a study. ―Our study comprised 68 cases in total. The age range was 7 years to 70 years, with a mean of 38.46 SD 14.78 years. Successful graft uptake and hearing benefit are two distinct things that have been used to explain the success rate. Based on graft status, the total success rate was 79%. Forty-three (84.31%) of the fifty-one mild MERI patients achieved successful transplant uptake. The success rate was 70% (7 out of 10) in the moderate MERI group and 57.14% (4 out of 7) in the severe MERI group (Table 5). The success rate for mucosal disease was 83.64%, whereas that of squamosal disease was 61.53%.

In the year 2018, a study done by Hayati R, et al,[7] hearing threshold after tympanoplasty was much better in the subjects with no otorrhea, subtotal perforation type, no cholesteatoma and granulation, complete ossicular chain, who had never been operated on and did not smoke. There was a significant negative correlation between MERI Scores as the predictor of hearing threshold which indicated that the lower the MERI Scores were, the better the improvement of hearing threshold after tympanoplasty (p=0.039; r=-0.453) ‖

In the year 2017, a study done by Kalyanasundaram R et al [2] ―The study comprises 19 males and 31 females .29 patients belong to mucosal or tubotympanic type of COM and 21 patients belong to the squamous type or the atticoantral type. The study group comprises 14 patients with mild (1-3) MERI score, 19 patients with moderate (4-6) MERI score and 17 patients with severe (< 7) MERI score. The graft is taken up by 38 patients (72%) and rejected for 12 patients (28%). Thus, the overall success rate of tympanoplasty is 74%. Among those with mild MERI, graft is taken up for 13 patients and rejected only for 1patient. Similarly, among those with severe disease, there is a higher graft rejection rate‖.

In the year 2017, Sarfaraz A et al [4] This study comprised 27 patients with mild (1-3) MERI score, 29 patients with moderate (4-6) MERI score and 2 patients with severe (<7) MERI score. In this study, 29 patients were taken with mild MERI score, in which 27(93.10%) patients were accepted, and 2(6.89%) patients were rejected the graft. 36 patients were taken with moderate MERI score in which 29(80.55%) patients were accepted, and 7(19.44%) patients were rejected the graft. And 35 patients were taken with severe MERI score in which 22(62.85%) patients were accepted, and 13(37.14%) patients were rejected the graft. Hence, graft with mild MERI scores were less chances for rejection, and graft with severe MERI scores

were higher chances for rejection. That means, patients with higher MERI scores have greater chance for rejection of grafts.

―In the developing countries the cost of surgery and absence from work are major restraints for two stage surgical procedures. If we can predict the outcome of the surgical procedure depending upon the pathological condition of the middle ear, the cost effectiveness of the surgery can be improved, and this will also improve the patient's compliance‖.[1] The Middle ear risk indices (MERI) is a concise and developed tool that will guide decision and design of tympanoplasties to provide prognostics for audiological gain. A successful result will also greatly help doctors and patients in having better prognosis and confidence in completing the procedure.

MATERIALS AND METHODS

Methodology

The department of OTORHINOLARYNGOLOGY AND HEAD AND NECK SURGERY at Jawaharlal Nehru Medical College conducted the current study over a period of one year to correlate the Middle Ear Risk Indices (MERI) and hearing gain in the evaluation of post operative outcomes of tympanoplasties. A prospective study done in KLE's Prabhakar Kore Hospital, Belagavi had a total of 65 patient who were confirmed cases of COM, mucosal, squamosal type of disease planned for tympanoplasty with or without cortical mastoidectomy

Study Design: Prospective study

Study Period: 1 year

Study Population

In our study 65 patients suffering from COM with or without cholesteatoma. The age of patients above 18 years of age came to the department of Otolaryngology.

Inclusion Criteria:

Individuals with unilateral or bilateral COM, whether or not they have cholesteatoma; patients who are older than eighteen; and patients who have sufficient cochlear reserve

Exclusion Criteria:

Individuals suffering from sensorineural hearing loss

Patients with systemic conditions such as diabetes mellitus and hypertension

Individuals suffering from nasal polyps, cleft palates, and adenotonsillitis.

Individuals with COM intracranial complications

Sample Size:

The sample size taken was 65

Sampling technique: Simple random selection

Sample Technique

Sample size at 95% confidence interval and 80% power.

$n = (Z1- \alpha/2 + Z1- \beta)2 \times (SD12+SD22) / (x1- x2)2$

Where x1 is the audiological gain in 2 months

and x2 is the audiological gain in 4 months.

For α= 5% (95% confidence) $Z1- \alpha/2 = 1.96 \sim 2$

for β= 20% (1- β= 80 % power), $Z1-\beta = 0.84$

where α- false positive and β-false negative

Statistical analysis

The audiological gain was regarded as a secondary end variable, while graft uptake and well-epithelialized cavities were regarded as the key outcome variables. The main explanatory factor was thought to be the severity of MERI. For quantitative variables, descriptive analysis was done using mean and standard deviation; for

categorical variables, it was done using frequency and proportion. The paired t-test is used to evaluate changes in quantitative parameters. The chi-square test is used to compare categorical results. IBM SPSS version 22 was utilized for statistical analysis, and $P<0.05$ was deemed statistically significant.

Study Setting

Data collection procedure:

— The patients were subjected to detailed history, general as well as systemic examination, which includes clinical examination of the ear, nose, paranasal sinuses, larynx and pharynx. The complete otological evaluation has been done to assess the exact nature and the extent of disease, presence or absence of cholesteatoma, granulation tissue, mucosal polyp and ossicular chain status. Pure tone audiometry was done for audiological evaluation, and readings were taken at 500, 1000, 2000 and 4000 Hz and AB gap was calculated by taking average of above four frequencies.[6]

If necessary, a radiographic evaluation was conducted in addition to a thorough laboratory evaluation. According to their proportion of the overall tympanic membrane area, holes were categorized as small (less than 50%), medium (50–75%), and big (> 75%). The impact of the perforation's size on the surgical result was compared.

Two of the 65 patients in our study had retraction pockets, and 63 of the patients had tympanic membrane perforations. There were 60 cases with central perforation. Twenty-three of the sixty-five patients in our study smoked.

Assessment criteria of Middle Ear Risk index risk score for each patient was based on individual risk factors like otorrhea assessed by Bellucci criteria (I - Dry ear

had a risk value of 0, II - Occasionally wet ear had a risk value of 1, III - persistently wet ear had a risk value of 2, IV- Wet, cleft palate was given a risk value of 3); Perforation (No perforation of tympanic membrane had a risk value of 0, perforated tympanic membrane had a risk value of 1); Cholesteatoma (None - 0, Present - 2); Ossicular status as assessed by Austin/Kartush criteria (Malleus, incus, stapes intact - 0, Malleus and stapes intact - 1, Malleus intact with erosion of stapes - 2, Stapes intact with erosion of malleus - 3, Erosion of malleus and stapes - 4, Malleus head fixed - 2, stapes fixed - 3); Middle ear granulations (None - 0, Present- 2); History of previous surgery (None - 0, Staged - 1, Revision - 2); Smoker (No,- 0, Yes - 2). The middle ear risk index was calculated. MERI score of the patients had mild (0-3), moderate (4-6) and severe (≥7). The type of tympanoplasty and mastoidectomy was decided intraoperatively based on the extent of disease in middle ear and mastoid. Temporalis fascia graft was used for all patients. Graft status was analysed by Otoendocopy. The anatomical and functional outcome of tympanoplasty with or without cortical mastoidectomy was evaluated in terms of tympanic membrane graft uptake at 2 months 4 months of surgery.

RESULTS

Baseline Patient demographics

Baseline characteristics for gender, age and diagnosis at the time of study recruitment are reported

Gender

In the study, 50.77 % participants were male (33), conversely 49.23 % were females (32). Total number of samples was 65. Table 1 provides a summary of all gender distribution.

Age

Among 65 patients, majority of the patients were in the range of 21- 30 years, around 40 %, followed by 31- 40 years around 26.15 %, the least were 20 years of age around 6.15 %, followed by > 51 years of age around 13.85%. The mean age 34.88 with SD 12.30. Table 2 provides a summary of all age groups recruited for the study.

Graphs 1: Age wise distribution of patients

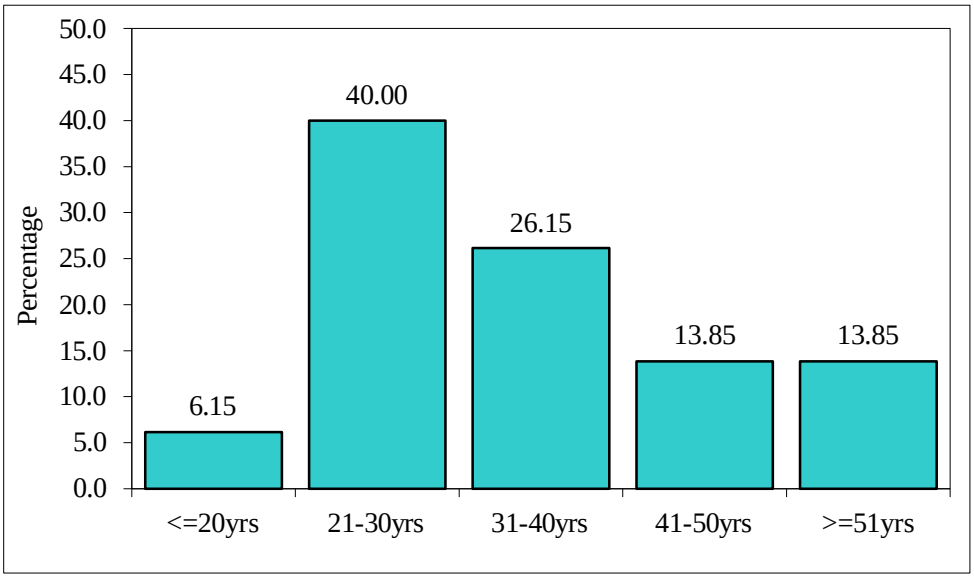


Table 5: Gender wise distribution of patients

Gender	Number of patients	Percentage of patients
Male	33	50.77
Female	32	49.23
Total	65	100.00

Graphs 2: Gender wise distribution of patients

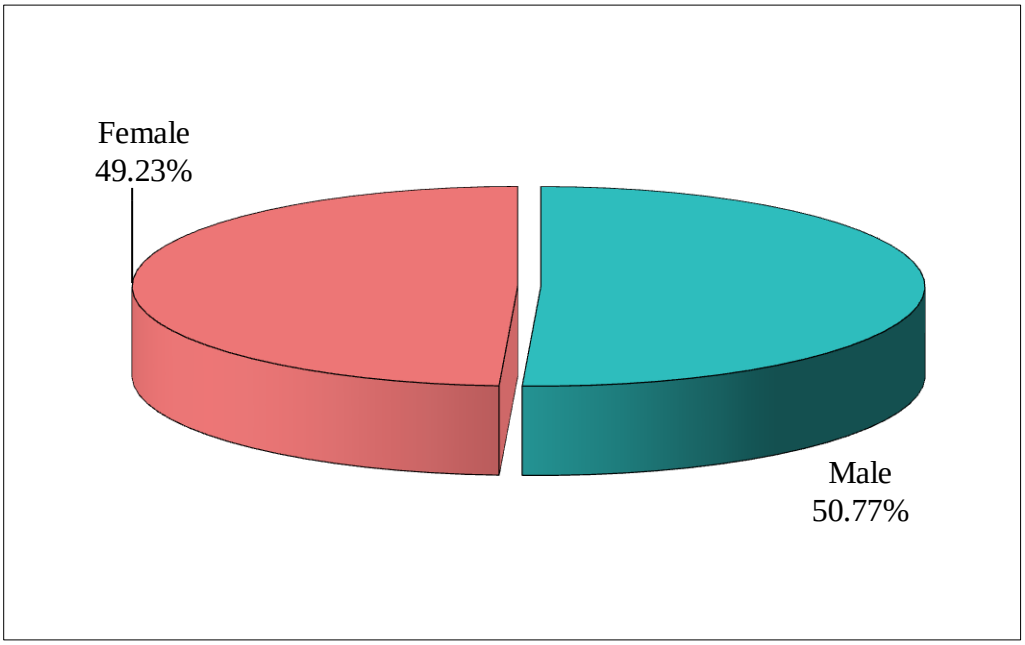


Table 6: Age wise distribution of patients

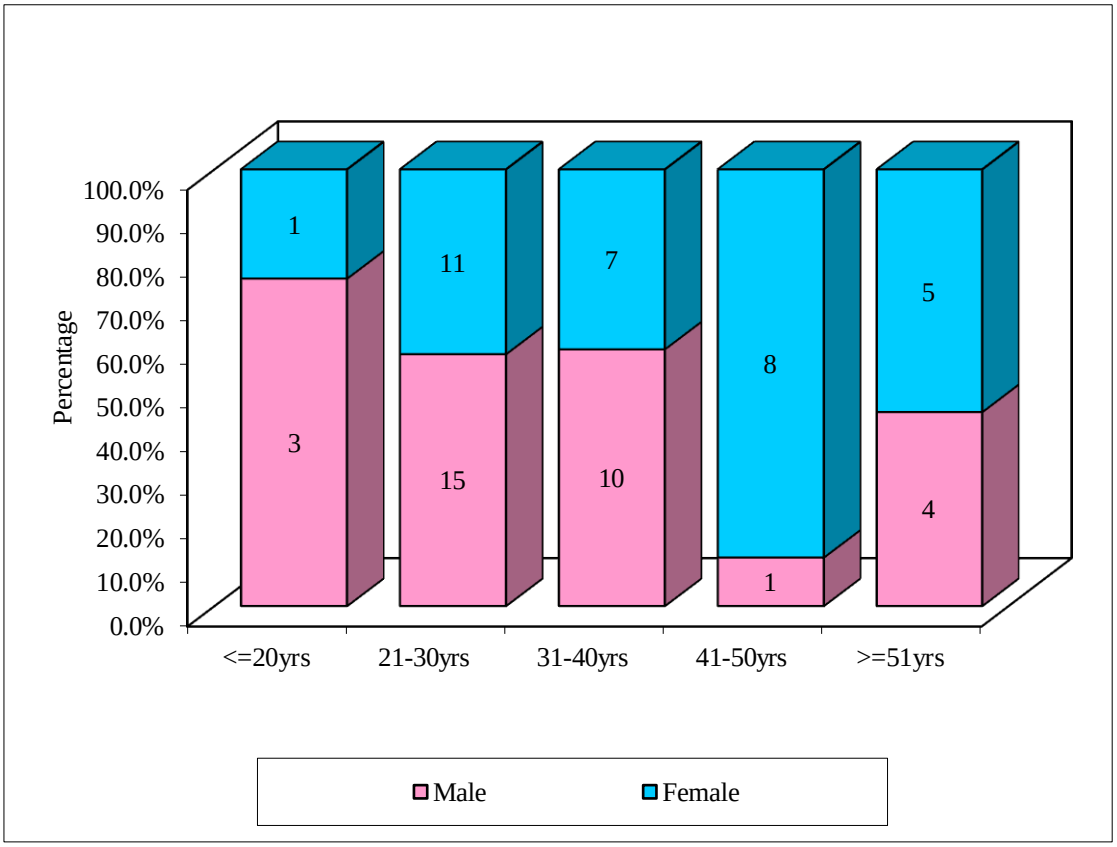
Age groups	Number of patients	Percentage of patients
<=20yrs	4	6.15
21-30yrs	26	40.00
31-40yrs	17	26.15
41-50yrs	9	13.85
>=51yrs	9	13.85
Total	65	100.00
Mean	34.88	
SD	12.30	

Table 7: Age by gender wise distribution of patients

Age groups	Male	Percentage	Female	%	Total
<=20yrs	3	75.00	1	25.00	4
21-30yrs	15	57.69	11	42.31	26
31-40yrs	10	58.82	7	41.18	17
41-50yrs	1	11.11	8	88.89	9
>=51yrs	4	44.44	5	55.56	9
Total	33	50.77	32	49.23	65
Mean	32.55		37.28		34.88
SD	12.15		12.17		12.30

Table 6 provides a detailed age by gender wise description recruitment for the study. Showing <=20yrs: 3 males (75.00%), 1 female (25.00%), Total = 4 , 21-30yrs: 15 males (57.69%), 11 females (42.31%), Total = 26, 31-40yrs: 10 males (58.82%), 7 females (41.18%), Total = 17, 41-50yrs: 1 male (11.11%), 8 females (88.89%), Total = 9, >=51yrs: 4 males (44.44%), 5 females (55.56%), Total = 9. The mean age in male 32.55 (SD 12.15) while mean age in female 37.28 (SD 12.17). Figure below shows the age by gender distribution of patients.

Graphs 3: Age by gender wise distribution of patients



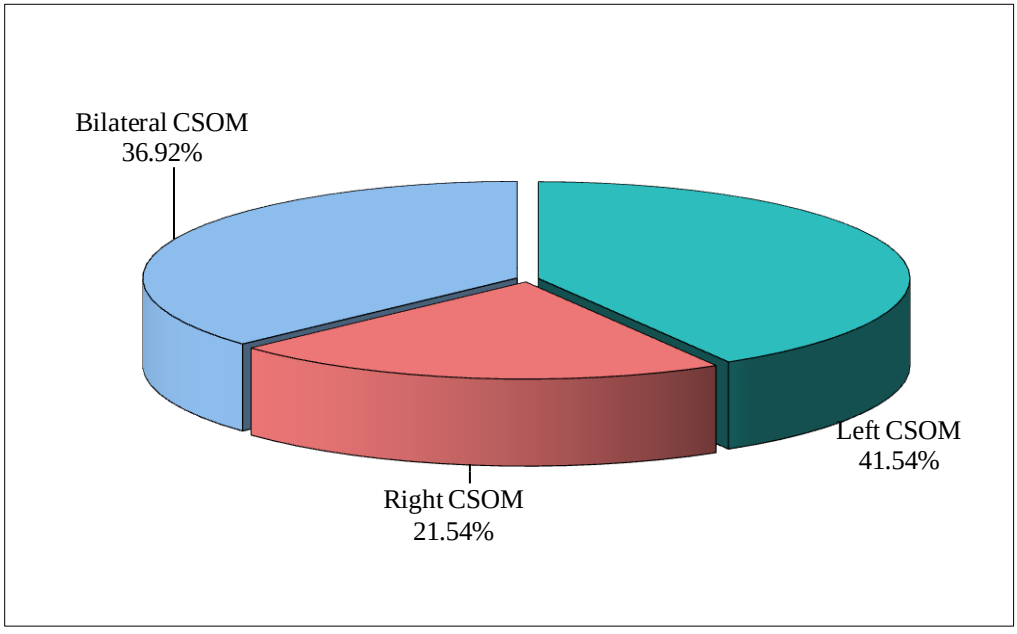
Baseline diagnosis

COM diagnosis was done based on otoendoscopy, which showed Left CSOM is the most common diagnosis (41.54% of cases). Right COM affects fewer patients (21.54%). Bilateral COM (both ears) affects 36.92% of patients. As described on table 7

Table 8: Diagnosis wise distribution of patients

Diagnosis	Number of patients	Percentage of patients
Left CSOM	27	41.54
Right CSOM	14	21.54
Bilateral CSOM	24	36.92
Total	65	100.00

Graphs 4: Diagnosis wise distribution of patients



Tympanic membrane perforation

LCP, MCP and SCP were not using a otoendoscopy. LCP (Large Central Perforation) is the most common type (50.77% of cases). MCP (Medium Central Perforation) follows closely (36.92%). SCP (Small Central Perforation) is less frequent (7.69%). Only 3 patients (4.62%) had no perforation. As described in table 8.

Table 9: Perforation wise distribution of patients

Perforation	Number of patients	Percentage of patients
Nil	3	4.62
LCP	33	50.77
MCP	24	36.92
SCP	5	7.69
Total	65	100.00

Graphs 5: Perforation wise distribution of patients

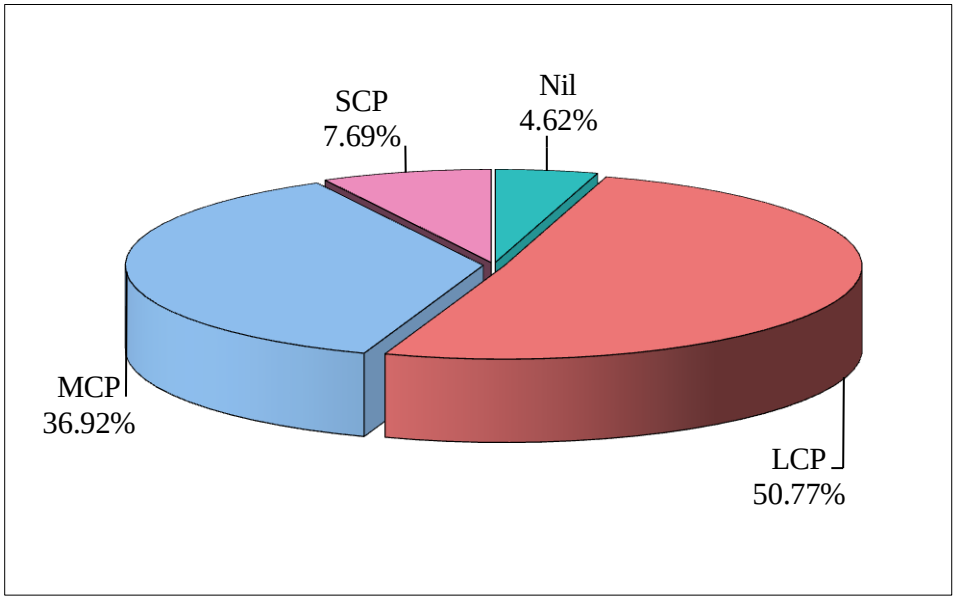


Table 10: Procedure wise distribution of patients

Procedure	Number of patients	Percentage of patients
Left cortical mastoidectomy	1	1.54
Left tympanoplasty	35	53.85
Right cortical mastoidectomy	2	3.08
Right tympanoplasty	27	41.54
Total	65	100.00

Baseline diagnosis

After Chronic Suppurative Otitis Media (CSOM), diagnosis was confirmed at baseline and surgical intervention planned, left the most frequent procedure, tympanoplasty, is carried out on 53.85% of patients. Right tympanoplasty follows, accounting for 41.54%. Cortical mastoidectomy (both left and right) is rare, with only 3 patients (1.54% + 3.08%) undergoing this procedure. Described in the figure below, and in table 9.

Graphs 6: Procedure wise distribution of patients

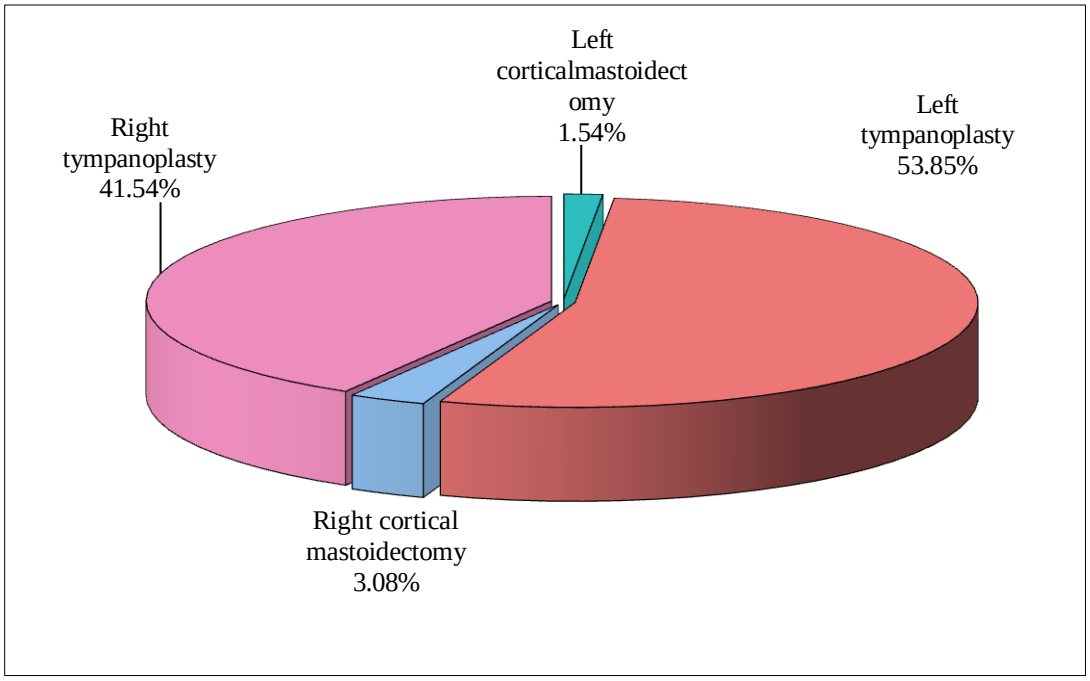


Table 11: Severity of MERI group wise distribution of patients

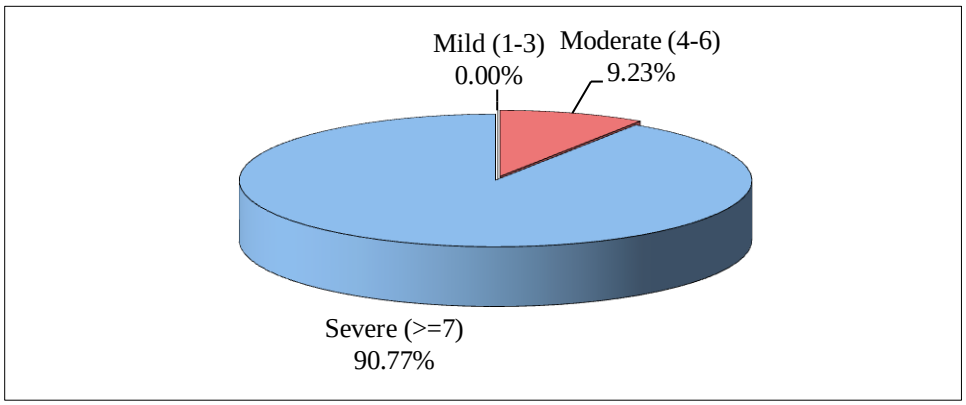
Severity of MERI	Number of patients	Percentage of patients
Mild (1-3)	0	0.00
Moderate (4-6)	6	9.23
Severe (>=7)	59	90.77
Total	65	100.00

The Middle Ear Risk Indices

―MERI is determined by assigning a specific value for each risk factor, and these values are added to get the MERI score. The risk factors include degree of otorrhea, Smoking, cholesteatoma and granulation tissue, ossicular status, presence of perforation, effusion and history of previous surgery‖ [2]. Table 10 describes only 6 patients (9.23%) had moderate MERI scores (4-6). The majority of the patients (59 out of 65, or 90.77%) had severe MERI scores (≥7).

This indicates that most patients had a high middle ear risk index, suggesting a more severe form of the condition.

Graphs 7: Severity of MERI group wise distribution of patients



Pure Tone Audiometry

Pre and Post operative Pure Tone Audiometry was assessed for all patient

Preoperative Pure Tone Audiometry mean for 65 patients measured (49.23). From Pre-Op (49.23) to 2 months mean Pure Tone Audiometry (40.45), there is an improvement of 8.78 points. T-value of 17.83 and a p- value of 0.0001.

From Pre-Op Mean PTA (49.23) to 4 months Mean PTA (28.95), there is a much larger improvement of 20.28 points. T- value 18.57, p-value 0.0001

There was improvement from 2 months mean PTA (40.45) to 4 months mean PTA (28.95), the improvement is 11.50 points. T-value 11.6, p-value 0.0001

All p-values are 0.0001, indicating highly significant results ($p<0.05$). % Effect shows that the most improvement occurs between Pre-Op and 4 months (41.2%). Hence significant improvement in PTA scores over time. This finding is depicted in table 11 and the figure below

Graphs 8: Comparison of preoperative, 2 months and 4 months treatment time points with PTA scores

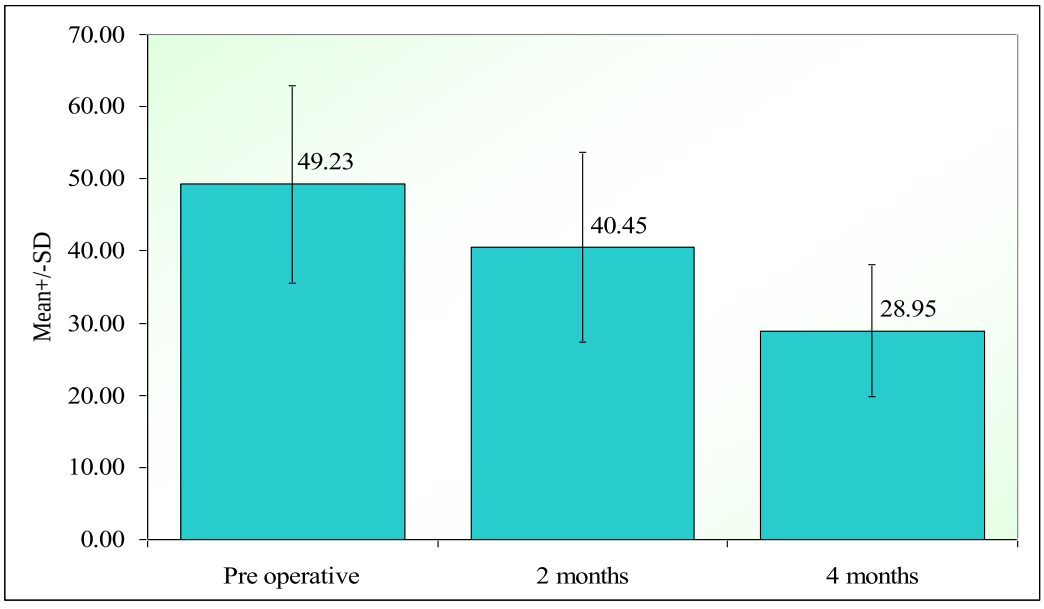


Table 12: Association between Severity of MERI and graft uptake

Pre-op MERI	Failed Graft uptake	%	Successful Graft uptake	%	Total
Moderate (4-6)	2	33.33	4	66.67	6
Severe (>=7)	13	22.03	46	77.97	59
Total	15	23.08	50	76.92	65

Graft uptake

Surgical outcomes and results for the graft uptake rate were analyzed in both moderate and sever groups and successful surgical outcomes were reported. Table 8 showed Moderate (4-6) MERI Group: 2 cases (33.33%) failed Graft Uptake, and 4 cases (66.67%) had Graft Uptake

In Severe (≥7) MERI Group: 13 cases (22.03%) failed Graft Uptake; 46 cases (77.97%) had graft uptake. Overall Total (All Patients): 15 cases (23.08%) had failed graft uptake, and 50 cases (76.92%) had successful graft uptake.

Graphs 9: Association between Severity of MERI and graft uptake

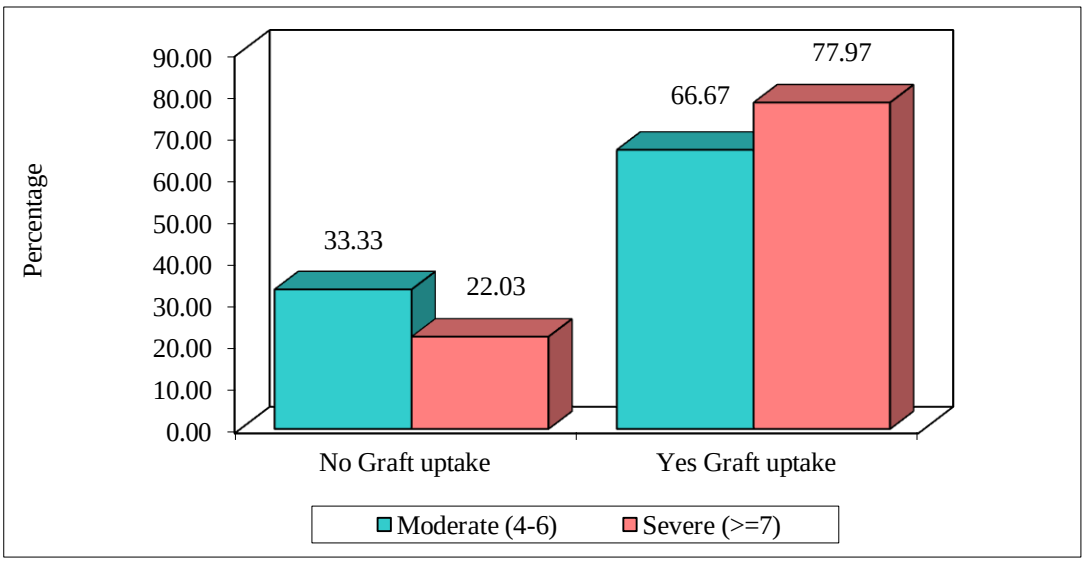


Table 13: Association between Graft Uptake and status of smoking

Smoking	Graft Uptake				Total	%	Chi-square	p-value
	Failed Graft uptake	%	Successful Graft uptake	%				
No	0	0.00	43	100.00	43	66.15	38.1140	0.0001*
Yes	15	68.18	7	31.82	22	33.85		
Total	15	23.08	50	76.92	65	100.0		

*p<0.05

Tablet 12 shows association between Graft Uptake and status of smoking. 43 patients were Non-Smokers and all 43 patients (100.00%) graft uptake, while 23 patients were smokers ,15 cases (68.18%) had failed graft uptake, 7 cases (31.82%) had successful graft uptake. P-value = 0.0001 (Statistically significant, p < 0.05). All 43 non-smokers (100%) had successful graft uptake. 15 out of 22 smokers (68.18%) had graft failure. Overall, Graft Uptake Rate 76.92% of patients had successful graft uptake, However, smokers are at a significantly higher risk of failure

Graphs 10: Association between Graft Uptake and Status of smoking

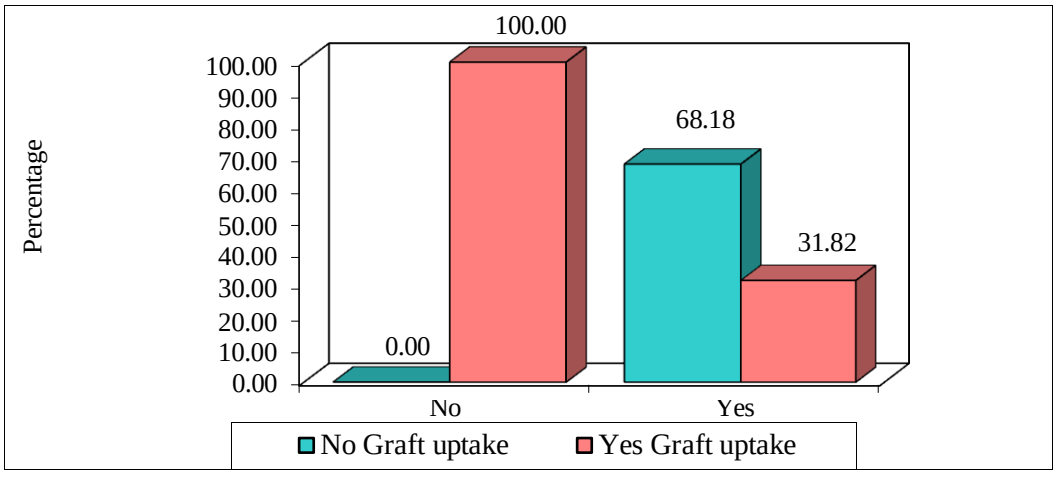


Table 14: Association between Graft Uptake and status of Otorrhea

Otorrhea	Graft uptake				Total	%	Chi-square	p-value
	Failed Graft uptake	%	Successful Graft uptake	%				
Dry	2	6.90	27	93.10	29	44.62	26.6119	0.0001*
Occasional	0	0.00	15	100.00	15	23.08		
Persistent	13	61.90	8	38.10	21	32.31		
Total	15	23.08	50	76.92	65	100.00		

$p<0.05$

The acceptance rate of graft uptake proved effective in 93.10% of cases of dry ear (no otorrhea), while graft failure occurred in only 6.90% of cases. On the other hand, 100% of cases of occasional otorrhea had effective graft uptake and 0% failure rate. Graft uptake was successful in 38.10% of cases of persistent otorrhea, while graft failure occurred in 61.90%. p-value = 0.0001* ($p < 0.05$, extremely significant), there was significant association exists between otorrhea status and graft uptake, as the p- value (0.0001) is much lower than 0.05. Persistent otorrhea is strongly linked to graft failure, while dry and occasional otorrhea show much higher graft success rates. Table 13 suggests that the presence of chronic ear discharge negatively impacts graft uptake success

Table 15: Association between Graft Uptake and status of Middle ear granulation

Middle ear granulation	Graft Uptake				Total	%	Chi-square	p-value
	Failed Graft uptake	%	Successful Graft uptake	%				
Healthy	0	0.00	25	100.00	25	38.46	12.1880	0.0001*
Unhealthy	15	37.50	25	62.50	40	61.54		
Total	15	23.08	50	76.92	65	100.00		

*p<0.05

Granulations tissue plays an integral part in graft uptake in Table 14, Healthy Middle Ear Granulation had 25 cases (100.00%) with successful graft uptake. While 40 cases (61.54%)

Had unhealthy Middle Ear Granulation, in which 25 cases (62.50%) had successful graft uptake, and 15 cases (37.50%) had failed graft uptake. P-value = 0.0001 (Statistically significant, $p < 0.05$). Overall, Graft Uptake Rate: 76.92% Graft uptake was successful for a number of patients. However, patients with unhealthy middle-ear granulation are at a significantly higher risk of failure

Graphs 11: Association between Graft Uptake and status of Middle ear granulation

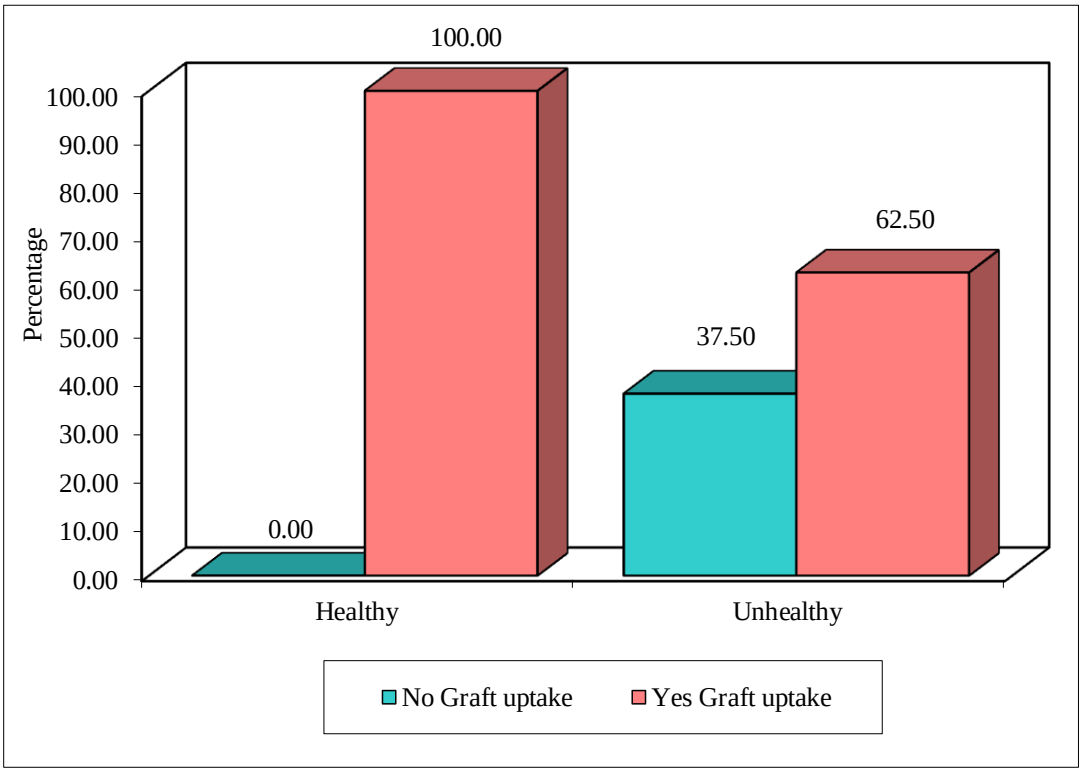


Table 16: Association between Graft Uptake and status of Cholesteatoma

Cholesteatoma	Graft uptake				Total	%	Chi-square	p-value
	Failed Graft uptake	%	Successful Graft uptake	%				
No	1	2.22	44	97.78	45	69.23	35.8320	0.0001*
Yes	14	70.00	6	30.00	20	30.77		
Total	15	23.08	50	76.92	65	100.00		

*p<0.05

Patients Without Cholesteatoma were around 45 (69.23%), in which 44 cases (97.78%) had successful graft uptake, 1 case (2.22%) had failed graft uptake. Patient with cholesteatoma were 20 cases (30.77%) in which 14 cases (70.00%) had failure of graft, and 6 cases (30.00%) had successful graft uptake. P-value = 0.0001 (Statistically significant, $p < 0.05$), this indicates a strong and statistically significant association between cholesteatoma presence and graft uptake success. Patients Without Cholesteatoma Have a High Graft uptake Success Rate, however, patients with cholesteatoma are at a significantly higher risk of graft failure. Table 15.

Graphs 12: Association between Graft Uptake and status of Cholesteatoma

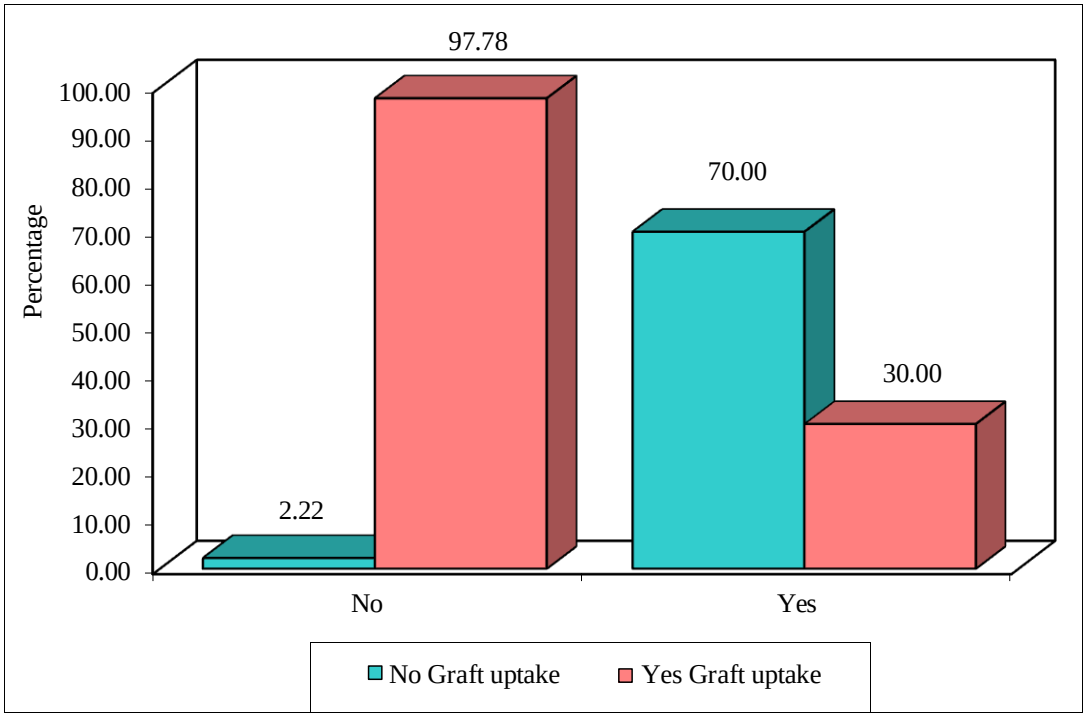


Table 17: Association between Graft Uptake and status of incus

Incus	Graft uptake				Total	%	Chi-square	p-value
	Failed Graft uptake	%	Successful Graft uptake	%				
Intact	2	20.00	8	80.00	10	15.38	0.0630	0.8030
Necrosed	13	23.64	42	76.36	55	84.62		
Total	15	23.08	50	76.92	65	100.00		

Table 18: Association between Graft Uptake and status of stapes

Stapes	Graft Uptake				Total	%	Chi-square	p-value
	Failed Graft uptake	%	Successful Graft uptake	%				
Intact	5	15.15	28	84.85	33	50.77	2.3072	0.1240
Necrosed	10	31.25	22	68.75	32	49.23		
Total	15	23.08	50	76.92	65	100.0		

Table 19: Association between Graft Uptake and status of malleus

Malleus	Graft Uptake				Total	%	Chi-square	p-value
	Failed Graft uptake	Percentage	Successful, Graft uptake	Percentage				
Intact	2	5.88	32	94.12	34	52.31	11.8730	0.0001*
Necrosed	13	41.94	18	58.06	31	47.69		
Total	15	23.08	50	76.92	65	100.00		

*p<0.05

Tables 17,18,19 discuss the association between Graft Uptake and status of ossicles

Incus, stapes, malleus respectively. Intact Incus there were 2 cases (20%) had no graft uptake, and 8 cases (80%) had successful graft uptake. In total: 10 cases (15.38% of the total). While necrosed Incus were 13 cases (23.64%) had no graft uptake, and 42 cases (76.36%) had successful graft uptake in total: 55 cases (84.62% of the total).

Statistically Chi-square value: 0.0630 and p-value: 0.8030. Since p-value > 0.05, the result is not statistically significant, meaning the status of the incus does not have a significant effect on graft uptake.

Intact Stapes were 5 cases (15.15%) had no graft uptake, and 28 cases (84.85%) had successful graft uptake in a total: 33 cases (50.77% of the total). Necrosed Stapes were 10 cases (31.25%) had no graft uptake, and 22 cases (68.75%) had successful graft uptake, in total: 32 cases (49.23% of the total). Statistical Analysis Chi-square value: 2.3072 and p-value: 0.1240. Since p-value > 0.05, the result is not statistically significant, meaning the status of the stapes does not have a significant effect on graft uptake.

2 cases (5.88%) had no graft uptake with intact malleus, while 32 cases (94.1%) with intact malleus had successful graft uptake. A total of 34 cases (52.31% of the total).

13 cases (41.94%) had no graft uptake had necrosed malleus while 18 cases with necrosed malleus (58.06%) had successful graft uptake. A total of 31 cases (47.69% of the total). Statistically Chi-square value: 11.8730 and p-value: 0.0001* (significant at $p < 0.05$).

The malleus condition has a significant impact on graft uptake. The p-value (0.0001) is statistically significant, indicating that graft uptake success is strongly associated with the status of the malleus. Intact malleus shows significantly higher graft uptake (94.1%) compared to necrosed malleus (58.06%), suggesting that preservation of the malleus may play an important role in graft success.

Table 20: Association between Severity of MERI and audio logical gain after 2 months

Gain after 2 months	Severity of MERI						p-value
	Moderate (4-6)	Percentage	Severe (>=7)	Percentage	Total	Percentage	
No improvement (<10dB)	4	9.30	39	90.70	43	66.15	1.0000
Improvement (10-20dB)	2	9.09	20	90.91	22	33.85	
Successful (>20dB)	0	0.00	0	0.00	0	0.00	
Total	6	9.23	59	90.77	65	100.00	

Table 19 describes association between Severity of MERI and audio logical gain after postoperative 2 months. It was categorized into three heading No Improvement (<10 dB gain), Improvement (10-20 dB gain) and Successful (>20 dB gain).

Under No Improvement (<10 dB gain), 4 cases (9.30%) had Moderate MERI (4-6) and Severe MERI (≥7): 39 cases (90.70%) a Total: 43 cases (66.15%)

2 cases (9.09%) Moderate MERI (4-6), and 20 cases (90.91%) Severe MERI (≥7) had Improvement (10-20 dB gain) a total: 22 cases (33.85%)

There was no patient who had a Successful hearing gain (>20 dB gain) by the end of post operative 2 months. Statistically P-value = 1.0000, suggesting that there is no statistically significant association between MERI severity and audiological gain after 2 months.

Graphs 13: Association between Severity of MERI and audio logical gain after 2 months

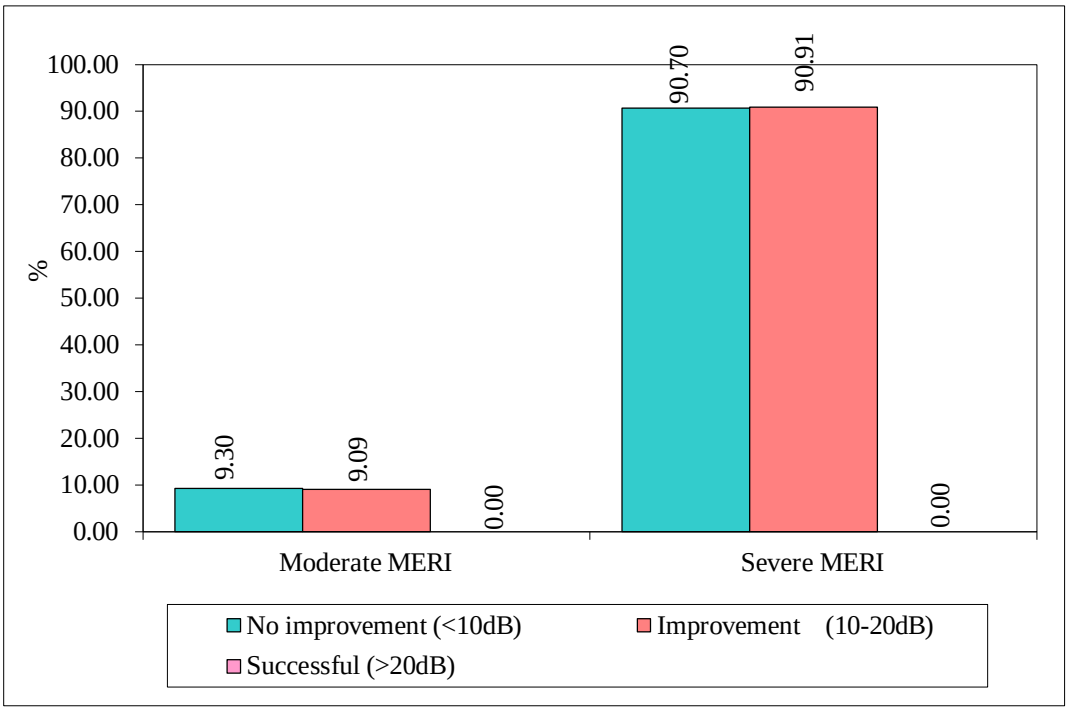


Table 21: Association between Severity of MERI and audio logical gain after 4 months

Gain after 4 months	Severity of MERI						p-value
	Moderate (4-6)	Percentage	Severe (>=7)	Percentage	Total	Percentage	
No improvement (<10dB)	2	22.22	7	77.78	9	13.85	0.2680
Improvement (10-20dB)	1	4.00	24	96.00	25	38.46	
Successful (>20dB)	3	9.68	28	90.32	31	47.69	
Total	6	9.23	59	90.77	65	100.00	

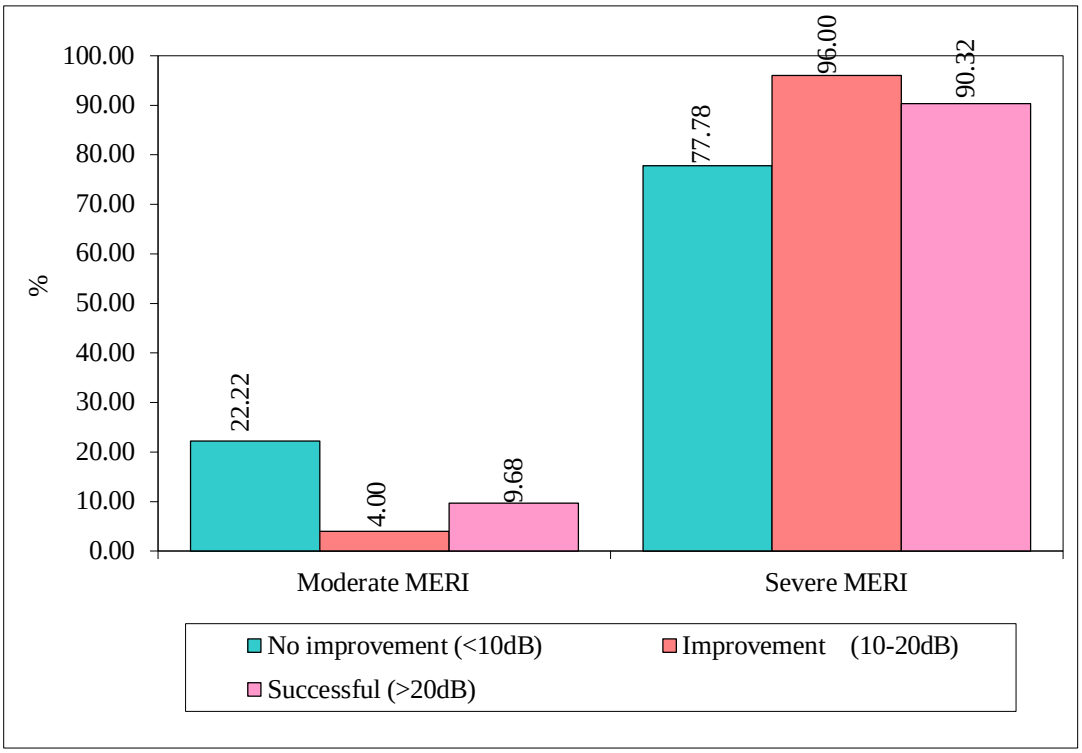
Table 20 describes association between Severity of MERI and audio logical gain after postoperative 4 months. It was categorized into three heading No Improvement (<10 dB gain), Improvement (10-20 dB gain) and Successful (>20 dB gain).

Under No Improvement (<10 dB gain), 2 cases (22.22%) had Moderate MERI (4-6) and Severe MERI (≥7): 7 cases (77.78%) a Total: 9 cases (13.85%)

1 case (4.00%) Moderate MERI (4-6), and 24 cases (96.00%), 24 cases (96.00%) under Severe MERI (≥7) had Improvement (10-20 dB gain) a total: 22 cases (33.85%)

3 cases (9.68%) Moderate MERI (4-6), and 28 cases (90.32%), under Severe MERI (≥7) had a Successful hearing gain (>20 dB gain) by the end of post operative 4 months. Statistically P-value = 0.2680, indicating that the degree of MERI is not statistically correlated with and audiological gain after 4 months.

Graphs 14: Association between Severity of MERI and audio logical gain after 4 months



DISCUSSION

—The principle of management of chronic otitis media is removal of diseased mucosa from the middle ear cleft and an attempt at restoration of hearing. The present study was conducted to assess the prognostic value of the various pathological and the technical factors associated with the COM on the outcome of the surgery. As stated earlier, the cost of surgery and absence from work are major constraints for the staged surgical procedure in the developing countries. The staging of the surgical procedure according to the pathological condition of the middle ear will improve the outcome of the surgery and the compliance of the patients.[1]

—Middle Ear Risk Index [MERI] is a numerical grading system to stratify the severity of the disease in the patients suffering from the COM. MERI can be used to decide the staging of the surgical procedure according to the severity of the disease.[2]

—MERI score was calculated for each patient. Mild, moderate and severe MERI groups were compared for the outcome of surgery. MERI was found to be a predictor of outcome in the ear surgeries.[3] The factors analyzed in the present study include perforation size, presence of tympanosclerosis, cholesteatoma, granulation tissue, ossicular necrosis, primary or revision surgery in COM patients. COM is a very common Otorhinolaryngology problem worldwide, especially in developing countries. Around 7.8% of the Indians suffer from this infection according to WHO report, 2004‖.[5] We still can't achieve 100% success in tympanoplasty terms of improvement of hearing and graft uptake, despite the availability of a wide variety of antibiotics, improved surgical procedures, and newly created prosthetic materials.

This is because the outcome is impacted by the degree of middle ear and mastoid disease.

Thus, the Middle ear risk indices (MERI), a numerical value that has been summarized and assigned, is useful in determining the severity of the disease and, consequently, in forecasting the outcome of surgery. While some of the elements were the extra factors examined, others were components of the MERI. ―These factors were studied in COM patients undergoing tympanoplasty for their effect on anatomical and functional outcome of the surgery, evaluated in terms of tympanic membrane graft uptake and audiological gain. We will discuss the effect of various factors studied on the outcome of surgery and after that we will discuss the effect of MERI in predicting the outcome of surgery.

Age is one of the prognostic factors. In general, the success of pediatric tympanoplasty is slightly lower than in adults [10] This has been traditionally attributed to the fact that children have a higher incidence of eustachian tube dysfunction. On the other hand, some authors 12-14 concluded that patient age did not influence the surgical success of tympanoplasty. A similar study was conducted by Redkar et al. in 2024, wherein they performed Type 1 Tympanoplasty in patients of different age groups discovered that the hearing gain and graft absorption rate peaked in the 18–35 age range and then gradually declined as the patient's age rose. Thus, concluding that ‗age of the patient ‘s impacts the outcomes of tympanoplasty in adult population‖.[22] The majority of patients in this study 48, or 71.7%—are from rural areas, whereas 17 (or 28.3%) come from metropolitan areas. About 40% of patients are between the ages of 21 and 30. Perhaps the most socially engaged and health- conscious age group is that of people aged 21 to 30. ―Another reason for the early presentation may be due to increased awareness of health issues and difficulty in

hearing affecting work efficiency, leading patients and parents to seek early medical intervention [13]. **—Lasisi AO et al.5** observed majority of patients were in age group of 21-34 years, which was in accordance with the result of present study. Study done by Kaur Met et al. also found similar results. [14, 15]

—Studies by Mudhol et al and Islam et al had reported a higher preponderance of chronic suppurative otitis media in patients from rural areas than urban area‖.[12] In the study done by Somashekara et al —age was 17 years, and maximum age was 49 years with mean age of 31years‖.[35] —In our study, decreased hearing was the presenting symptom in all the patients (100%) and in addition history of ear discharge as presenting symptom was present in 58 patients (i.e. 95%) which is in accordance with the studies‖ done by Shetty et al [31] and Somashekara et al.[35] —Olowookere et al [32] in their study had reported 3% incidence of traumatic perforation_traumatic perforation was present in 3 (5%) of our subjects‖.[18] —History of profuse ear discharge was present in 80.18% of our subjects, moderate ear discharge was present in 15.78% subjects while scanty discharge was observed in 14.04% subjects. A similar pattern of ear discharge has been reported‖ in a study by Mondal et al. [33]

When the middle ear transformer mechanism is not further damaged, a tympanic membrane rupture has two distinct consequences on hearing.

—First, there is the diminished surface area of tympanic membrane on which sound pressure is exerted, resulting in dampened ossicular chain excursions. The larger the perforation, the greater the loss of surface area on which sound pressure can act. In addition, the site of the perforation influences the degree of hearing loss: posterior perforations produce more severe hearing losses [15] —A second effect of a simple perforation on hearing results from sound reaching the round window directly

without the dampening and phase-changing effect of an intact tympanic membrane. Moreover, as the size of the tympanic membrane remnant decreases, the hydraulic advantage produced by a large tympanic membrane on a small oval window disappears, so that sound reaches both windows with more nearly equal force and at nearly the same time. The resultant cancellation of vibratory movement of the cochlear fluid column produces the maximum hearing loss observed in simple perforation, as much as 45 dB for the speech frequencies.[18, 19] —The tympanic membrane perforation in the study subjects was sized in accordance with study by Sarker et al [37] with medium sized perforations being present in 24 (36.92%) patients, large size perforation present in 33 (50.77%) patients while small size perforation was present in 5 (7.69%). 3 (4.62) patients had retraction pockets. In terms of type of perforation 62 (95.38%) had central perforation, 3 (4.62) patients had retraction pocket‖

—The location and size of the perforation have been frequently examined in the literature. Technically anterior perforations are more difficult to access and place grafts. Previous studies reported that the location of the perforation had no effect on the surgical or hearing result. Conversely, we found that the graft success rate for central perforations was higher compared with posterior and anterior perforations.[21]

—With respect to size, for perforations less than 50% showed a noticeably greater success rate. Additionally, we discovered a strong correlation between smaller perforation and graft success. Recent investigations, however, did not find a statistically significant correlation between effective tympanoplasty and the extent of the perforation.[19]

Of the cases in our study, 63.08% had unilateral disease and 36.92% had bilateral disease. Bilateral CSOM also showed a higher prevalence of illness in investigations conducted by earlier authors. Of the cases, 87.5% had dry ears and 12.5% had active ear drainage. 1.5% had a history of trauma but no ear drainage. Less than three months was the duration of inactivity for 47% of cases, followed by four to six months for 23.5% of cases, and more than six months for 15.5% of cases.

—Numerous factors, such as maintaining dry ear protection, personal hygiene, crowding, allergies, and recurring upper respiratory tract infections, affect how long a person is inactive. Middle ear mucosa was healthy in 38.46% of patients and unhealthy in 61.54% of cases.

—After four months of follow-up, the graft success rate in this study was 76.92%, whereas the graft failure rate was 23.08%. Graft success rates of 85% , were reported in studies conducted by different authors like Kalyanasundram R et al [2]

The Middle Ear Risk Indices (MERI) v/s success rate of Tympanoplasty

The success percentage of middle ear reconstruction procedures is predicted using a tool called the Middle Ear Risk Indices (MERI). The condition of the middle ear and its ossicles must be determined in order to forecast the surgical outcome with precision. There were 0.00% of patients overall with a score of 1-3 (mild disease), 9.23% with a score of 4-6 (moderate disease), and 90.77% with a score of 7-12 (severe disease). Graft acceptability was 66.67% for patients with a MERI score of 4- 6 and 77.97% for those with a score of 7 and above. 28.6% of patients with MERI scores 4-6 and 72.4% of patients with MERI scores above 7 had hearing loss >40 dB

prior to surgery. Following surgery, 12.2% and 33.3% of patients with MERI 4-6 and 7-12, respectively, had hearing loss more than 40 dB.

—Nishant et al.'s study found that 72% of patients had MERI scores between 1 and 3, followed by 24% with scores between 4 and 6, and 4% with scores between 7 and 12. He discovered that 86% of ears graded into MERI scores 1-3, or mild illness, receive grafts. and MERI 7–12, which are considered to have a severe illness, have a 100% probability of having their graft rejected‖.[12]

Middle Ear Risk Index

— The mean audiological gain at two months postoperatively showed no statistically significant prognostic difference between individuals with moderate, and severe MERI, Consistent to the findings of Khalid A. et al., this observation was in contrast with the findings of Gulati A. et al [21] where the difference between the mild, moderate, and severe MERI groups was further determined using post hoc Tukey's Honest Significant Difference test. With a p-value of (P=0.01), it was shown that there was a statistically significant difference between patients with mild and severe MERI. Therefore, a severe MERI can be employed as an unfavorable prognostic sign more efficiently than a mild MERI.[23]

— Using a one-way ANOVA, our study's p-value for mean audiological gain in the group of patients with moderate and severe MERI four months post-surgery was (P=0.268), indicating a statistically not significant difference which was consistent to the findings of Khalid A. et al.,[24] this observation was in contrast with the findings of Gulati A. et al. where the difference between the mild, moderate, and severe MERI groups was determined using the post hoc Tukey's Honest Significant Difference test. A p-value of (P=0.04) indicated a statistically significant difference between patients

with mild and severe MERI.[25]

The aforementioned findings unequivocally highlight the predictive importance of MERI in forecasting the functional result of COM surgery. The prognosis is better for patients with mild to moderate MERI, and the prognosis for surgery gets worse as the MERI gets worse. When choosing a surgical technique to maximize the results, these criteria can be applied efficiently.

Audiological Gain

At 2 and 4 months following surgery, for patients with minor, moderate, and large perforations, the post-operative mean audiological gain had p-values of (P=0.80) and (P=0.74), respectively. Despite the fact that patients with bigger perforations experienced greater hearing gain following surgery, no statistically significant difference was found. This was probably brought on by the underlay technique used in tympanoplasty. fixes any kind of membrane defect, no matter the size of perforation.

In our investigation, the mean audiological gain in the groups of patients with and without cholesteatoma was statistically significant, with p-values of (P=0.0001). The p-values for the mean audiological gain in the groups of patients with and without granulation tissue were (P=0.006) and (P=0.0001), respectively, with the difference being statistically significant in our research of 65 patients.

—There has been some debate in the literature regarding the ossicular chain's role in determining hearing outcomes. The middle ear ossicles' undamaged state was determined to be audiologically noteworthy in the current investigation. Forty-two participants in our study exhibited incus necrosis. Between two and four months following surgery, the mean audiological gain in groups of patients with necrosed and intact incus had p-values of (P=0.8) and (P=0.7), respectively; the difference was not statistically significant. 18 participants in our study exhibited malleus necrosis. At two- and four-months following surgery, the mean audiological gain in the group of patients with necrosed and intact malleus revealed a statistically significant difference, with p-values of (P=0.001) and (P=0.001), respectively. In our study, 22 patients experienced stapes necrosis. At two- and four-months following surgery, the mean audiological gain in the group of patients with necrosed and intact stapes had p-values of (P=0.12) and (P=0.15), respectively, with no statistically significant difference.

The preoperative mean AB gap on PTA was 49.23đB (SD 13.63) when compared to the 2- and 4-month follow-up in type 1 tympanoplasty. At 2 and 4 months postoperatively, the mean AB gap was 40.45 dB (SD 13.16) and 28.95 dB (SD 9.09), with a p value of <0.00l at 2 and 4 months, which is statistically significant.

Graft Uptake by Tympanic Membrane

One measure of graft uptake was the size of the TM perforation. Statistical analysis revealed no significant difference in surgical success rates across the different perforation size groups, despite the fact that patients with bigger tympanic membrane perforations had lower success rates. —According to this study, the size of the perforation was neither a predictor nor a determinant of a successful tympanoplasty. Our assumption is that any membrane defect, no matter how big or tiny, may be

covered by the underlay approach of tympanoplasty with a suitable graft size. Yung MW, et al, [38] Vartiainen E, et al. [40], Wasson JD, et al.,[27] and Pignataro L, et al. [41] have all reached identical conclusions and offered no convincing justification. In our investigation, 20 patients had cholesteatoma. Graft uptake success after cortical mastoidectomy with tympanoplasty was 30.7% for cholesteatoma patients and 69.23% for non-cholesteatoma patients; the difference was statistically significant (p=0.0001). Cholesteatoma is therefore indicative of the outcome of cortical mastoidectomy with tympanoplasty, according to this study.

Forty patients had granulation tissue. Graft uptake success after cortical mastoidectomy with tympanoplasty was statistically significant, with 62.50% of patients with granulation tissue and 38.46% of patients without granulation tissue achieving this outcome. (p=0.0001).

The uptake of grafts in tympanoplasty reparative surgery is also significantly influenced by osseous necrosis. Malleus necrosis was present in 18 of the participants in our research. Between patient groups with necrosed and intact malleus, there was a statistically significant difference in graft uptake (p=0.001). 42 of the participants in our research exhibited incus necrosis. There was no statistically significant variation in graft absorption between the necrosed patient groups and intact malleus (p=0.8). Stapes necrosis affected 22 of the participants in our study. There was a statistically significant difference in graft uptake between the patient groups with intact and necrosed stapes. (p = 0.12).

Out of the 65 patients in our study, 17 had revision surgery and 48 had tympanoplasty surgery for the first time. Graft uptake success after original surgery was 78.2%, however it was 41.6% after revision surgery, there was a statistically

significant difference. (p = 0.008) Lesinskas E. et al.'s[42] study ―which found no statistically significant difference in graft uptake between primary and revision tympanoplasty, did not support the results‖.

93.10% of individuals with dry ears successful graft uptake. Among individuals with continuously wet ears, 61.90% had transplant failure, whereas 0% of people with occasionally wet ears experienced graft rejection. ―Overall, the Bellucci categorization was not statistically significant, according to John L. Dornhoffer's analysis‖.[11] ―However, Bellucci classes 1, 2, and 3 showed a definite tendency toward worse outcomes. Because other middle ear issues can affect the outcome, otorrhea alone might not be relevant. But the worse the otorrhea, the worse the result. Therefore, in order to lessen the ear discharge, the right antibiotics should be given based on culture and sensitivity data. Research indicates that as compared to situations where surgery was performed at an infected site, the success rate of surgery rises to about 30% if there is a minimum of three months without otorrhea‖.[6]

―Therefore, in order to have the greatest outcomes, it is better to dry the ear before surgery‖.[7]

―Smoking's effects on the middle ear can be categorized as systemic (caused by immunosuppression), regional (caused by constriction of the Eustachian tube), or local (caused by effects on the mucociliary apparatus)‖.[8] ―According to a study reviewing the impact of smoking on tympanoplasty success rates, smoking was linked to a threefold higher risk of long-term graft failure‖.[14] This study led to the revision of MERI to add smoking as a risk factor. Forty-three (100%) of the nonsmokers in our study successfully absorbed the graft. In this group, no failure cases were noted. 31.82% of patients had successful transplant uptake, and 15 out of 22 smokers (68.18%) experienced graft failure. As a result, smokers are much more likely to fail.

—Following the placement of the harvested graft using underlay methods, a new tympanic membrane forms. Graft serves as a scaffold for the proliferation and epithelium migration of freshened central perforation edges until physiologically stable epithelization has place. A thin layer of epithelial sheet forms by the end of two weeks. Neo tympanum would have developed by about one month. Graft may or may not be seen in the tissues of the middle ear cleft. Remaining central perforation could be the outcome if the graft rejection happens‖.[9] —Following surgery, a healthy neo tympanum forms and inflammation subsides when the middle ear cavity is sufficiently ventilated. The tympanic membrane grows 1 mm per day. Following tympanoplasty, the granulation tissue begins to form 36 hours after the procedure, and the tympanic membrane begins to heal 12 hours later. The graft serves as a scaffold to support the squamous epithelium on the lateral side and the regenerated mucosa as the medial aspect of the ear drum. The neo tympanum's connective tissue is made up of the graft‖.[12]

According to this study, there were notable differences in hearing thresholds before and after tympanoplasty. This conclusion was influenced by the following factors: the patients' complete ossicle status, subtotal type perforation, otorrhea, lack of prior middle ear surgical history, and nonsmoking status. In addition, the difference in hearing threshold between COM patients before and after tympanoplasty was negatively impacted by cholesteatoma and middle ear granulation.

Comparable to the studies conducted by Lima et al. and Vignadutt et al, [6] —who found overall hearing improvement in 72% of cases and 84% of cases, respectively, our study showed an overall hearing benefit in 76.92% of patients‖.[6] Nonetheless, most patients (90.77) in our study were in the severe MERI category, which included 42.8% of participants. The variation in the percentage of the AB gap

between 2 months and 4 months was not statistically significant (p=0.268), suggesting hearing benefit were more in mild to moderate MERI group. ―This significant association may be explained by the following: 1) smoking is one of the MERI's parameters; smoking has detrimental local, regional, and systemic effects on the middle ear mucosa; 2) severe MERI indicates the presence of cholesteatoma, ossicular discontinuity, and middle ear pathology; and 3) these patients also require more extensive surgery. [23]

As a limitation of our study, it lacked Eustachian tube function tests which along with Middle ear risk index would provide for better results. It also did not include other mucosal polyps and other middle ear pathologies, and no single surgeon performed all of the procedures.

CONCLUSION

The goal of surgically treating COM is to remove the ailment and ensure the ear is dry and safe. Tympanoplasty can be used to restore hearing to a level that can be used for everyday activities. The surgeon's assessment of the surgical operation may benefit from a deeper understanding of the predictive functions of different elements. We find that the following parameters influence the morphological and functional result of tympanoplasty, assessed by mean audiological gain and graft uptake, with or without cortical mastoidectomy.

The size of the tympanic membrane perforation has no bearing on the outcome. Tympanic membrane graft uptake is influenced by the presence or absence of cholesteatoma, granulation tissue, ossicular necrosis, Eustachian tube patency, mastoidectomy technique (canal wall up or canal wall down), and surgical attempt (primary or revision).

The study here one can infer higher indices of (MERI) and lower age group had superior hearing gain and graft absorption rate when compared to older age groups. The patient of COM could be given accurate information about the chances of surgical success, the potential benefits to their hearing, and the choice of tympanoplasty type. To improve tympanoplasty outcomes by reducing middle ear disorders (granulation, smoking, and otorrhea) before surgery

SUMMARY

This study aims to forecast the post-operative outcomes of tympanoplasties by examining the correlation between MERI and hearing gain in terms of mean audiological gain and graft uptake.

MERI is a numerical indicator of the risk of getting a middle ear infection scale to quantify the severity of disease. There is limited data about the pathologic condition of middle ear as a predictor of the outcomes of tympanoplasties. Predicting the results increases patient understanding and the surgery's cost effectiveness.

The study conducted in our department over a period of one year, which comprised 65 patients. These patients comprised patients with TM perforation and 2 with retraction pockets; in the ages 21 and above; nearly equal distribution of male and females. MERI values ranged from 4 and above, with most having high MERI values (moderate and severe)

The post operative mean audiological gain at 2 months and 4 months compared to that at preoperative state, was significantly different for severity of MERI, factors of cholesteatoma, granulation tissue, intact state of middle ear ossicles and mean AB gap tm perforation size had no discernible effect on graft absorption, although it was strongly impacted by factors such as smoking, persistent otorrhea, unhealthy middle ear granulation, high cholesteatoma, ossicular necrosis, mastoidectomy technique and attempt of surgery (primary/revised).

This study excluded eustachian tube function tests, mucosal polyp study and surgeries performed by multiple surgeons.

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ANNEXURES

ANNEXURE – I - INFORMED CONSENT FORM

KAHER, JNMC, BELAGAVI

CORRELATION OF MIDDLE EAR RISK INDICES SCORES AND HEARING GAIN AFTER TYMPANOPLASTIES IN PATIENT WITH CHRONIC SUPPURATIVE OTITIS MEDIA - A 1 YEAR PROSPECTIVE STUDY

Name of Student/Principal Investigator:

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Junior resident,

Department of Otorhinolaryngology and Head and Neck surgery

JNMC, KAHER, BELAGAVI

Name of Guide/Co Investigators:

Objective: The objective of this study is to correlate Middle Ear Risk Index and hearing gain in the evaluation of post operative outcomes of tympanoplasties.

Introduction:

Chronic Otitis Media is defined as a chronic inflammation of the middle ear and mastoid cavity which presents with recurrent ear discharge or Otorrhea through a tympanic membrane perforation. Mortality and disability due to Otitis Media are primarily related to the complications. MERI is a concise and developed tool that will

guide decision and design of tympanoplasties to provide prognostics for audiological gain. With increasing numbers of tympanoplasty procedures being performed nowadays, it is important to predict the outcome of surgery and give proper counselling for the patient.

Explanation of procedure:

Withdrawal from participation in the study: Participation in this study is voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will not get any benefits by participating in this study. The data gathered will help the population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person to identify you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study. Cost of investigations done during the course of study will be paid by the principal investigator.

Authorization for publication of aggregated data: Results obtained after processing the aggregated data will be published for scientific purposes and or presented to scientific groups. However, your identity will never be revealed.

Questions: In case of any questions about this study, you are free to contact: ―Name of student/PI, mobile number, email ID‖. If you have any questions or complaints with regard to your right as study participant you may contact Dr Harsha Hegde, Chairperson, Ethical committee of JNMC, 0831-2473777 Extension 4052.

Legal rights: By signing this consent form, we are not waving any of your legal rights.

CONSENT STATEMENT

I am making a voluntary decision to participate in the study, **CORRELATION OF MIDDLE EAR RISK INDICES SCORES AND HEARING GAIN AFTER TYMPANOPLASTIES IN PARTIENT WITH CHRONIC SUPPURATIVE OTITIS MEDIA - A 1 YEAR PROSPECTIVE**

STUDY My signature below indicates that I have decided to participate, and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions, and they were answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant: Name of the witness:

Name of the witness:

Signature or left thumb impression of the witness: Name of the investigator:

Signature of the investigator

ANNEXURE-II

PROFORMA FOR DATA COLLECTION

PROFORMA

CORRELATION OF MIDDLE EAR RISK INDICES SCORES AND HEARING GAIN AFTER TYMPANOPLASTIES IN PARTIENT WITH CHRONIC SUPPURATIVE OTITIS MEDIA - A 1-YEAR PROSPECTIVE STUDY

Date:

O.P. No: IP No:

Name: Age:

Sex: Occupation:

Address: Phone No:

D.O.A D.O.D

CLINICAL PROFILE:

Chief Complaint:

History of Present Illness

Past History:

Personal History:

Family History

Physical Examination:

I) General Physical Examination -

Vital signs:

Pulse: Blood Pressure: Respiratory rate :

Pallor- Icterus - clubbing – cyanosis - Lymphadenopathy -

Oedema –

II) ENT Examination

1) EAR EXAMINATION- Right ear Left ear

Pinna

Preauricular area

Post auricular area

External auditory canal

Tympanic membrane

Tuning Fork Test: Right ear Left ear

Rinne‘s test:

256hz

512hz

1024hz

Weber‘s test:

Absolute Bone Conduction test:

FACIAL NERVE EXAMINATION

2) NOSE EXAMINATION

External appearance

Root Bridge Dorsum Alae Tip columella

Cold spatula test

Cottle‘s test

Anterior Rhinoscopy

Posterior Rhinoscopy

Paranasal Sinus Examination

3) THROAT EXAMINATION -

ORAL CAVITY and OROPHARYNX:

INDIRECT LARYNGOSCOPY-

4) NECK EXAMINATION

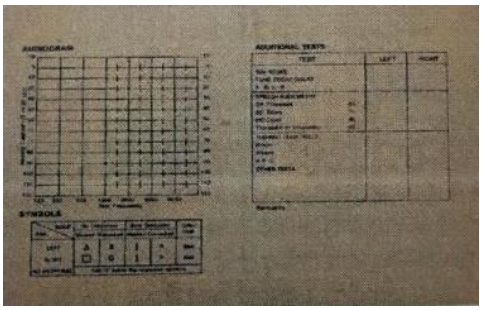
DIAGNOSIS

PURE TONE AUDIOMETRY

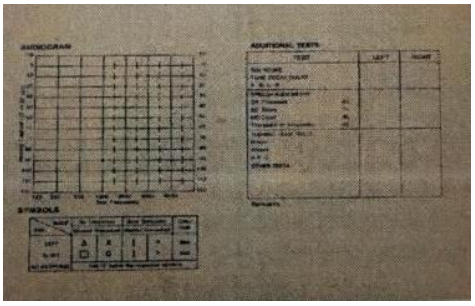
PREOP RIGHT - RIGHT LEFT

POST OP - 2 MONTHS RIGHT LEFT

POST OP – 4 MONTHS RIGHT LEFT



Pre op PTA



Post op PTA

ANNEXURE III

CLINIAL PHOTOGRAPHS

PREOP OTOENDOSCOPIC FINDING

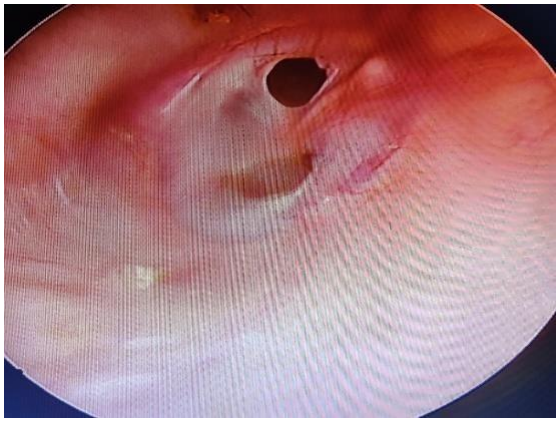


Photo 1 Medium central perforation

Photo 2 Large central perforation

INTRA OP FINDING

Photo 3 Granulation Tissue

Photo 4 Middle ear cholesteatoma

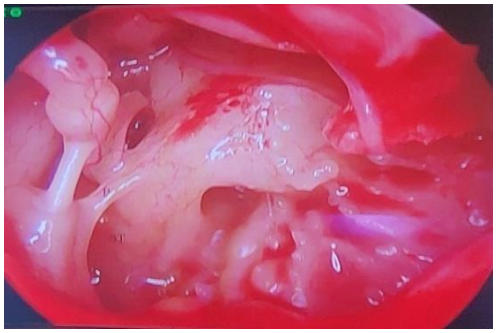


Photo 5 Ossicular status

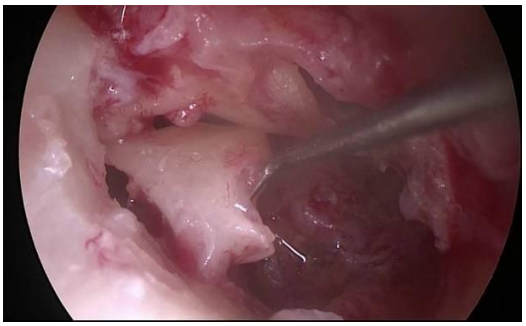


Photo 6 Eroded long process of incus

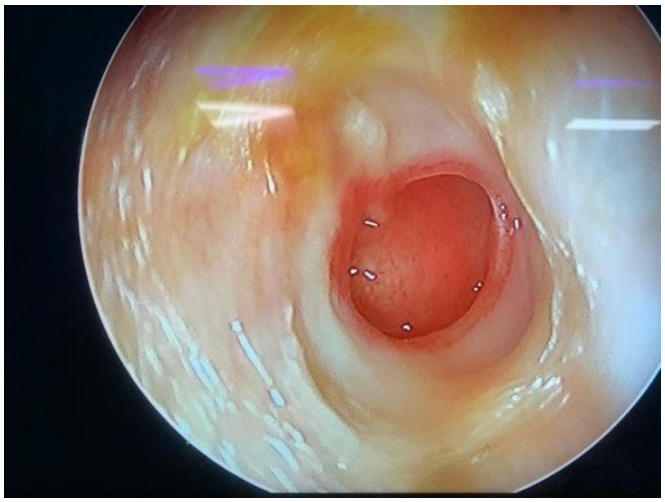
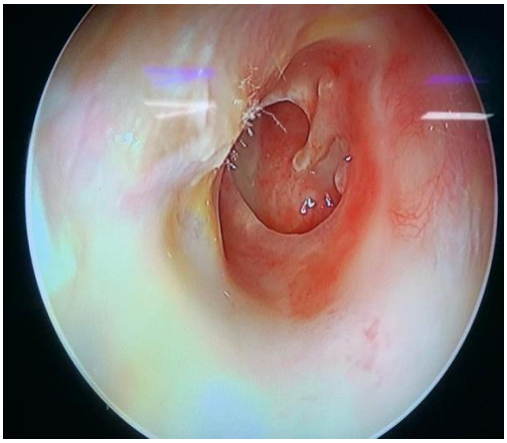
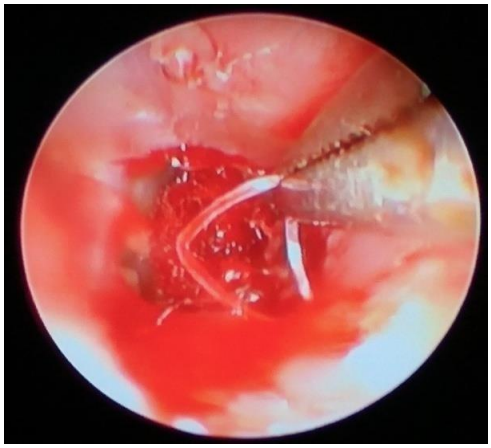


Photo 7 otorrhea

Photo 8 Step of tympanoplasty

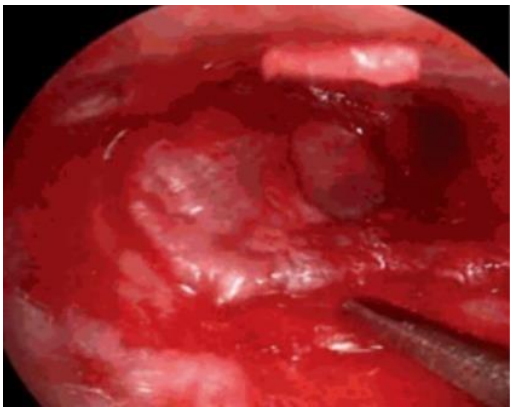


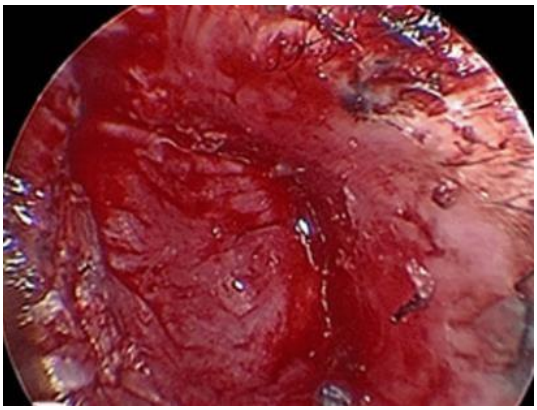


Margins freshening

Transcanal incision given (Right ear) from 6 o'clock to 12 o'clock poison

Raising tympanomeatal flap Ossicular status checked with round window reflex





Placement of graft by underlay technique and repositioning of tympanomeatal flap

Postoperative graft 2 months

Postoperative graft 4 months

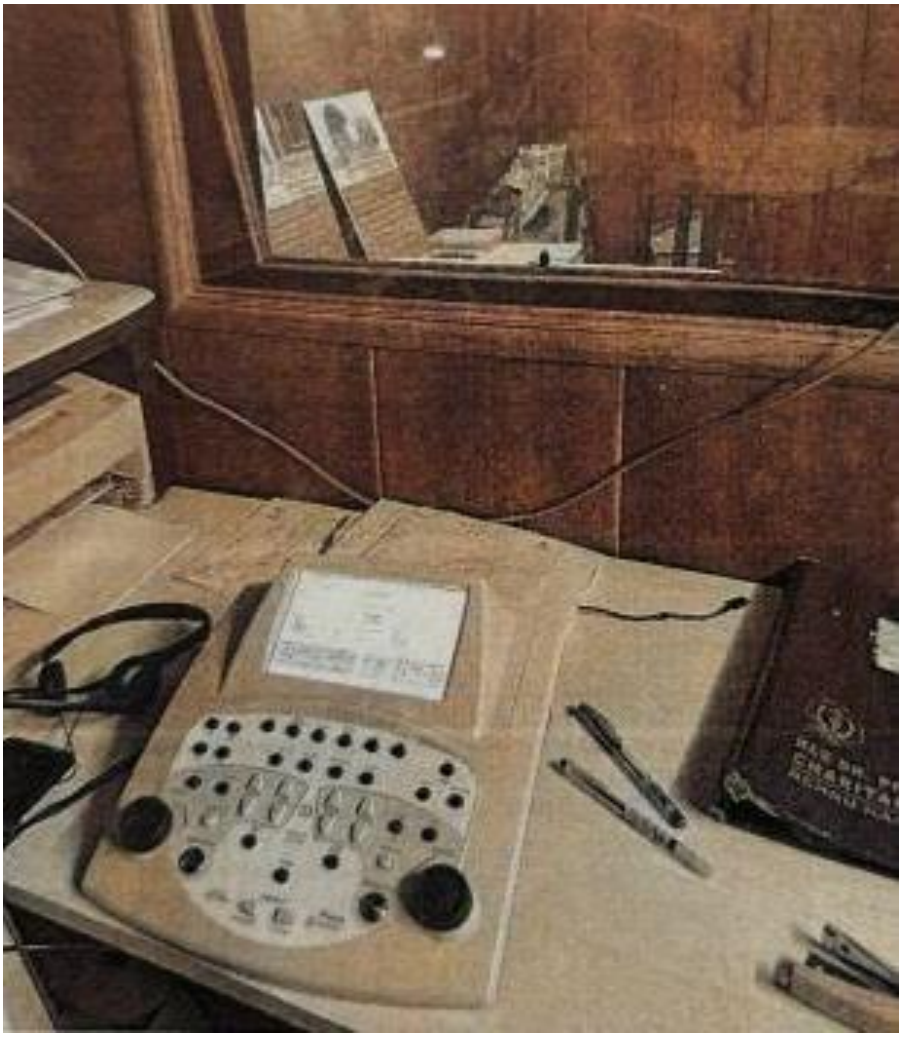


Photo 9 PTA machine

ANNEXURE IV MASTER CHART

Sl No	IP No	Sex/Age	Diagnosis	Procedure	Perforation	Pre-Op PTA	Cholesteatoma	Middle ear granulation	malleus	incus	stapes	Otorrhea	smoking	Pre -Op MERI	Post-Op PTA 2 months	Post-Op PTA 4 months	Graft Uptake
1	10098450	30/F	B/L CSOM	LEFT TYMPANOPLASTY	MCP	45dbhl	no	unhealth	necrosed	necrosed	necrosed	dry	no	14	35dbhl	28dbhl	YES
2	7383414	55/F	B/L CSOM	RIGHT TYMPANOPLASTY	LCP	53.33dbhl	no	health	intact	intact	intact	dry	no	8	40dbhl	25dbhl	YES
3	10053420	28/M	RIGHT CSOM	RIGHT TYMPANOPLASTY	MCP	18.33dbhl	no	unhealth	intact	necrosed	necrosed	dry	no	12	15dbhl	15dbhl	YES
4	10053442	39/M	RIGHT CSOM	RIGHT TYMPANOPLASTY	MCP	31dbhl	yes	unhealth	necrosed	necrosed	necrosed	persistent	yes	14	23dbhl	22dbhl	YES
5	10044217	26/F	B/L CSOM	RIGHT TYMPANOPLASTY	MCP	38.33dbhl	no	health	intact	necrosed	intact	dry	no	8	29.34dbhl	25dbhl	YES
6	10044489	41/M	LEFT CSOM	LEFT TYMPANOPLASTY	MCP	31.66dbhl	no	unhealth	necrosed	necrosed	necrosed	dry	no	11	29dbhl	22.33dbhl	YES
7	10041156	18/M	RIGHT CSOM	RIGHT TYMPANOPLASTY	SCP	26.66dbhl	no	unhealth	necrosed	necrosed	necrosed	dry	no	11	20dbhl	20.33dbhl	YES
8	10030721	26/M	B/L CSOM	RIGHT TYMPANOPLASTY	MCP	38.33dbhl	no	health	intact	intact	intact	dry	no	8	31.33dbhl	22sbhl	YES
9	7355693	19/M	LEFT CSOM	LEFT TYMPANOPLASTY	SCP	28.3dbhl	yes	unhealth	necrosed	necrosed	necrosed	persistent	yes	14	16.33dbhl	15.3dbhl	YES
10	10041556	23/M	LEFT CSOM	LEFT TYMPANOPLASTY	MCP	48.33dbhl	no	unhealth	intact	necrosed	necrosed	occasional	no	11	34dbhl	26.66dbhl	YES
11	10032676	39/M	B/L CSOM	RIGHT TYMPANOPLASTY	LCP	50dbhl	no	unhealth	intact	necrosed	necrosed	occasional	no	11	43.44dbhl	33dbhl	YES
12	10040466	35/F	B/L CSOM	RIGHT TYMPANOPLASTY	MCP	48.33dbhl	no	health	intact	necrosed	intact	occasional	no	8	40dbhl	33.66dbhl	YES
13	10040488	59/F	RIGHT CSOM	RIGHT TYMPANOPLASTY	LCP	46.66dbhl	no	health	intact	intact	intact	dry	no	5	41dbhl	24dbhl	YES
14	10039058	37/F	LEFT CSOM	LEFT TYMPANOPLASTY	MCP	30dbhl	no	health	intact	intact	intact	dry	no	4	25dbhl	21dbhl	YES
15	10038114	33/M	RIGHT CSOM	RIGHT TYMPANOPLASTY	LCP	55dbhl	no	health	intact	intact	intact	dry	no	4	48.44dbhl	30.3dbhl	YES
16	10038185	48/F	B/L CSOM	LEFT TYMPANOPLASTY	MCP	47dbhl	no	health	necrosed	necrosed	intact	occasional	no	8	40dbhl	28dbhl	YES
17	10032908	22/M	RIGHT CSOM	RIGHT CORTICAL MASTOIDECTOMY	nil	46.66dbhl	no	unhealth	necrosed	necrosed	necrosed	persistent	yes	12	38.66dbhl	21dbhl	YES
18	7200242	24/F	B/L CSOM	RIGHT TYMPANOPLASTY	LCP	56.66dbhl	no	unhealth	intact	necrosed	intact	occasional	no	10	45.33dbhl	23.55dbhl	YES
19	1153994	36/M	B/L CSOM	RIGHT TYMPANOPLASTY	LCP	51.66dbhl	no	unhealth	intact	intact	intact	occasional	no	10	44.3dbhl	22dbhl	YES
20	1194965	35/F	B/L CSOM	LEFT TYMPANOPLASTY	lcp	61.66dbhl	yes	unhealth	necrosed	necrosed	intact	persistent	yes	13	49.3dbhl	30dbhl	NO
21	1194424	50/F	RIGHT CSOM	RIGHT TYMPANOPLASTY	LCP	36.66dbhl	no	health	intact	intact	intact	dry	no	4	23.34dbhl	22dbhl	YES
22	1193649	40/F	RIGHT CSOM	RIGHT TYMPANOPLASTY	LCP	43 dbhl	no	unhealth	intact	necrosed	intact	occasional	no	10	36.44dbhl	24dbhl	YES
23	1192849	26/M	LEFT CSOM	LEFT TYMPANOPLASTY	LCP	73.33dbhl	yes	unhealth	necrosed	necrosed	necrosed	occasional	no	14	68.3dbhl	44.3dbhl	YES
24	1191489	41/F	LEFT CSOM	LEFT TYMPANOPLASTY	LCP	41.66dbhl	no	unhealth	intact	necrosed	necrosed	dry	no	11	33dbhl	26.33dbhl	YES
25	1190754	28/F	LEFT CSOM	LEFT TYMPANOPLASTY	SCP	23.33dbhl	no	health	intact	necrosed	intact	dry	no	9	18.3dbhl	15dbhl	YES
26	1191351	28/M	LEFT CSOM	LEFT TYMPANOPLASTY	MCP	60dbhl	no	unhealth	necrosed	necrosed	necrosed	occasional	no	11	54dbhl	36dbhl	YES
27	1189476	33?M	B/L CSOM	RIGHT TYMPANOPLASTY	LCP	66dbhl	no	unhealth	necrosed	necrosed	necrosed	persistent	no	15	46dbhl	25.33dbhl	YES
28	1188702	19/F	B/L CSOM	RIGHT TYMPANOPLASTY	LCP	56.66dbhl	no	health	intact	necrosed	necrosed	occasional	no	9	53.33dbhl	28dbhl	YES

29	1188811	27/M	RIGHT CSOM	RIGHT TYMPANOPLASTY	MCP	48.33dbhl	no	unhealth	necrosed	necrosed	intact	dry	no	11	36dbhl	22dbhl	YES
30	1186920	50/F	RIGHT CSOM	RIGHT TYMPANOPLASTY	MCP	33.3dbhl	no	unhealth	intact	necrosed	intact	dry	no	10	26.66dbhl	20dbhl	YES
31	1187625	42/F	RIGHT CSOM	RIGHT TYMPANOPLASTY	LCP	55dbhl	yes	health	necrosed	necrosed	necrosed	dry	no	14	44dbhl	31dbhl	YES
32	10057694	59/M	LEFT CSOM	LEFT TYMPANOPLASTY	LCP	61dbhl	yes	unhealth	necrosed	necrosed	necrosed	persistent	yes	13	55dbhl	40.33dbhl	NO
33	10058637	70/M	LEFT CSOM	LEFT TYMPANOPLASTY	LCP	57.66dbhl	no	unhealth	necrosed	necrosed	necrosed	dry	no	13	40dbhl	22.66dbhl	YES
34	10059559	21/F	B/L CSOM	LEFT TYMPANOPLASTY	LCP	58.33dbhl	no	health	intact	necrosed	necrosed	occasional	no	11	44.44dbhl	27.66dbhl	YES
35	10061194	59/F	B/L CSOM	LEFT TYMPANOPLASTY	LCP	51.66dbhl	no	unhealth	intact	necrosed	intact	occasional	no	10	44dbl	36dbhl	YES
36	10066102	35/F	B/L CSOM	RIGHT TYMPANOPLASTY	LCP	50dbhl	yes	unhealth	necrosed	necrosed	necrosed	dry	yes	14	43.33dbhl	34.34dbhl	NO
37	10067564	36/M	LEFT CSOM	LEFT TYMPANOPLASTY	LCP	55dbhl	no	health	intact	necrosed	intact	persistent	no	9	46dbhl	24dbhl	YES
38	7130545	34/M	LEFT CSOM	LEFT TYMPANOPLASTY	LCP	50dbhl	no	unhealth	necrosed	necrosed	necrosed	persistent	yes	12	38dbhl	25dbhl	NO
39	10070086	18/M	LEFT CSOM	LEFT TYMPANOPLASTY	LCP	61.66dbhl	yes	unhealth	necrosed	necrosed	necrosed	persistent	yes	11	55dbhl	38.33dbhl	NO
40	10026452	23/F	B/L CSOM	LEFT TYMPANOPLASTY	LCP	63.33dbhl	yes	health	intact	necrosed	intact	dry	no	9	58dbhl	44dbhl	YES
41	10071504	38/M	LEFT CSOM	LEFT TYMPANOPLASTY	LCP	66.66dbhl	no	unhealth	necrosed	necrosed	necrosed	occasional	yes	14	48dbhl	26.66dbhl	YES
42	10071840	27/M	LEFT CSOM	LEFT TYMPANOPLASTY	MCP	28.3dbhl	no	health	intact	necrosed	intact	dry	no	10	20.3dbhl	18dbhl	YES
43	10072764	24/F	LEFT CSOM	LEFT TYMPANOPLASTY	SCP	58.33dbhl	no	unhealth	necrosed	necrosed	necrosed	persistent	no	11	41dbhl	34dbhl	YES
44	10077100	36/F	LEFT CSOM	LEFT TYMPANOPLASTY	LCP	60dbhl	yes	unhealth	intact	intact	intact	persistent	yes	6	53dbhl	30.66dbhl	NO
45	10079029	22/M	LEFT CSOM	LEFT TYMPANOPLASTY	LCP	60dbhl	no	health	intact	necrosed	intact	dry	no	8	45dbhl	24dbhl	YES
46	10080574	28/M	LEFT CSOM	LEFT TYMPANOPLASTY	MCP	68.33dbhl	no	unhealth	necrosed	necrosed	necrosed	persistent	yes	14	60dbhl	44dbhl	YES
47	10080910	24/F	RIGHT CSOM	RIGHT TYMPANOPLASTY	LCP	51.66dbhl	yes	unhealth	necrosed	necrosed	intact	persistent	yes	11	48dbhl	22dbhl	NO
48	10062478	26/M	RIGHT CSOM	RIGHT CORTICAL MASTOIDECTOMY	nil	53.33dbhl	yes	unhealth	necrosed	necrosed	intact	persistent	yes	12	48.3dbhl	26.66dbhl	NO
49	7286242	21/M	LEFT CSOM	LEFT CORTICALMASTOIDECTOMY	NIL	23.3dbhl	yes	unhealth	necrosed	necrosed	necrosed	persistent	yes	14	18dbhl	18dbhl	NO
50	10038114	23/F	B/L CSOM	RIGHT TYMPANOPLASTY	MCP	48.35dbhl	no	unhealth	intact	intact	intact	dry	yes	8	40.66dbhl	33.6dbhl	YES
51	7355693	44/F	B/L CSOM	RIGHT TYMPANOPLASTY	MCP	38.33dbhl	no	health	intact	necrosed	intact	occasional	no	9	30dbhl	22dbhl	YES
52	10042556	37/M	B/L CSOM	RIGHT TYMPANOPLASTY	LCP	60dbhl	yes	unhealth	necrosed	necrosed	necrosed	persistent	yes	12	55dbhl	28.33dbhl	NO
53	10044251	53/F	LEFT CSOM	LEFT TYMPANOPLASTY	MCP	46.66dbhl	no	health	necrosed	necrosed	intact	occasional	no	11	40.33dbhl	32dbhl	YES
54	10044267	35/M	B/L CSOM	LEFT TYMPANOPLASTY	LCP	70dbhl	no	health	intact	necrosed	intact	dry	no	7	56dbhl	53dbhl	YES
55	10044268	21/F	LEFT CSOM	LEFT TYMPANOPLASTY	MCP	60dbhl	no	health	intact	necrosed	intact	dry	no	10	46.33dbhl	40dbhl	YES
56	10041156	46/F	B/L CSOM	LEFT TYMPANOPLASTY	LCP	73dbhl	yes	unhealth	necrosed	necrosed	necrosed	persistent	yes	14	68dbhl	55dbhl	NO
57	10044217	52/F	LEFT CSOM	LEFT TYMPANOPLASTY	MCP	51.66dbhl	yes	unhealth	necrosed	necrosed	necrosed	persistent	yes	12	47dbhl	33.6dbhl	NO
58	10044476	56/M	B/L CSOM	LEFT TYMPANOPLASTY	MCP	60dbhl	yes	unhealth	necrosed	necrosed	necrosed	dry	yes	12	46.66dbhl	38.33dbhl	NO
59	10045772	47/F	LEFT CSOM	LEFT TYMPANOPLASTY	LCP	61.66dbhl	no	health	intact	necrosed	intact	dry	no	9	56dbhl	40dbhl	YES
60	10045914	28/F	B/L CSOM	RIGHT TYMPANOPLASTY	LCP	72dbhl	yes	unhealth	necrosed	necrosed	necrosed	persistent	yes	14	68dbhl	50dbhl	YES
61	10045900	38/F	LEFT CSOM	LEFT TYMPANOPLASTY	MCP	30dbhl	no	health	intact	necrosed	intact	dry	no	9	20dbhl	20.33dbhl	YES
62	10045772	25/M	RIGHT CSOM	RIGHT TYMPANOPLASTY	SCP	31dbhl	no	health	intact	necrosed	necrosed	dry	no	10	25dbhl	20dbhl	YES
63	10043890	28/M	LEFT CSOM	LEFT TYMPANOPLASTY	MCP	30dbhl	yes	unhealth	intact	intact	intact	persistent	yes	6	20dbhl	28dbhl	NO
64	10048464	52/M	B/L CSOM	RIGHT TYMPANOPLASTY	LCP	58.33dbhl	yes	unhealth	necrosed	necrosed	necrosed	persistent	yes	13	44.66dbhl	43dbhl	NO
65	10049847	24/M	LEFT CSOM	LEFT TYMPANOPLASTY	MCP	40dbhl	no	health	intact	necrosed	intact	dry	no	10	32.33dbhl	26dbhl	YES
							20 yes	40 unhealth					23 yes`				