A STUDY ON OUTCOME OF OSSICULOPLASTIES IN SURGERIES OF CHRONIC SUPPURATIVE OTITIS MEDIA WITH OSSICULAREROSION

A Dissertation submitted to the Tamilnadu DR.M.G.R Medical University Chennai

In partial fulfilment of the Regulations for the award of Degree of

M.S.BRANCH IV

(OTORHINOLARYNGOLOGY)

Reg No: 221714103

DEPARTMENT OF ENT

MADURAI MEDICAL COLLEGE MADURAI,

MAY 2020

CERTIFICATE - I

This is to certify that the dissertation entitled **"A STUDY ON OUTCOME OF OSSICULOPLASTIES IN SURGERIES OF CHRONIC SUPPURATIVE OTITIS MEDIA WITH OSSICULAR EROSION"** is a bonafide record of work done by **Dr.N.MURUGAN** in the Department of Otorhinolaryngology, Madurai medical college and Govt. Rajaji hospital, Madurai in partial fulfilment of the requirements for the award of the degree of M.S. Branch IV (Otorhinolaryngology), under my guidance and supervision during the academic period 2017-20.

I have great pleasure in forwarding the dissertation to The Tamil Nadu Dr. M.G.R. medical university

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CERTIFICATE – II

This is to certify that this dissertation work titled **"A STUDY ON OUTCOME OF OSSICULOPLASTIES IN SURGERIES OF CHRONIC SUPPURATIVE OTITIS MEDIA WITH OSSICULAR EROSION"** of the candidate **Dr.N.MURUGAN** with registration Number 221714103 for the award of degree of **M.S.** Branch IV in the branch of **Otorhinolaryngology**.

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I, **Dr.N.MURUGAN** solemnly declare that the dissertation entitled **"A STUDY ON OUTCOME OF OSSICULOPLASTIES IN SURGERIES OF CHRONIC SUPPURATIVE OTITIS MEDIA WITH OSSICULAR EROSION"** is a bonafide record of work done by me during the period of September 2017 – September 2019 at Madurai medical college and Govt. Rajaji hospital, Madurai.

This dissertation is submitted to the Tamil Nadu Dr.M.G.R. Medical University for the examinations to be held in May 2020 in partial fulfilments of the requirements for the award of M.S.Branch IV (Otorhinolaryngology).I have not submitted this dissertation work previously for the award of any degree or diploma from any other University.

Place: Madurai

Date: **Dr.N.MURUGAN**

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INTRODUCTION

60-80% of middle ear disease occurs due to chronic otitis media in developing countries. Improperly treated chronic otitis media will affect the quality of life. In developing countries the most common cause of hearing impairment is chronic otitis media.

Ossicular disruption is the most common cause of hearing impairment in CSOM patients making this as a major cause for hearing disability .This is managed commonly with surgeries in two sittings earlier, but in our study with single sitting surgery both the disease clearance and good hearing improvement is achieved .

Previously most popular treatment was radical mastoidectomy which give good disease eradication but hearing function was sacrificed. Initially in surgeries of CSOM whether it is safe or unsafe ear, most widely used procedure was Intact canal wall tympanoplasty. But recently it was partially replaced by Canal wall down procedure with tympanoplasty in unsafe ear. Ossicular reconstruction and its long term stability will give good hearing outcome but it is a challenging one. Numerous new materials are available to reconstruct the ossicles. Of these remodelled ossicles, cartilage and cortical bone are autologous materials. First choice in ossiculoplasty was autologous materials. Various synthetic prosthesis can be used in the absence of autologous material. Those synthetic prosthesis could be Teflon, plastipore, hydroxyapatite, gold, titanium[1].

The aim of the study is to evaluate hearing outcome in patients of chronic otitis media with ossicular erosion intervened by surgeries with use of autologous materials or synthetic prosthesis (partial ossicular replacement prosthesis/total ossicular replacement prosthesis). Thus to bring back near normal hearing in our patients treated with single stage procedure, also making this procedure both cost effective and disability reduction.

REVIEW OF LITERATURE

Tympanoplasty term was first used by Wullstein in 1953 to describe surgical reconstruction of the middle ear hearing mechanism due to middle ear disease. This surgery which has improved the hearing in various middle ear disease replaced the radical mastoidectomy surgery. Tympanoplasty is the final procedure done prior to reconstruction of the tympanic membrane.

Stapes mobilisation was the first procedure done by Kessel in 1878. Plastic repair of tympanic membrane was done by Berthold in the same year. In 1883, Kiesslbach's attempted to correct the congenital meatal atresia. These studies were the base for development of further reconstructive surgeries on conductive hearing loss.

Wullstein and Zolliner were the first who used incus as an interposition between the stapes head and malleus. Yet Hall and Rytzner described the procedure clearly. It is now the most favoured method used today by many surgeons.

Since 1960, homograft ossicles are the most popular method used in reconstructing the hearing mechanics. Now on further development of reconstructing the hearing mechanics are total ossicular prosthesis(TORP) which produce columella from the tympanic membrane to oval window and

partial ossicular replacement prosthesis(PORP) which produce columella from tympanic membrane to stapes head.

Zoll first tried reconstructing the hearing mechanics by using plastic prosthesis and later who himself abandoned the method due to failure and adverse effects. Ossiculoplasty was first attempted by Matte in 1901.Wullestein used the vinyl acrylic as ossicular reconstructing prosthesis in 1951. Now to reconstruct the middle ear hearing mechanics various materials are used, which are biologic (autograft and homograft) and alloplastic.

Bell first used the malleus to reconstruct hearing mechanics in 1958. Ossicular defect and interposition technique was initially described by Austin. Hildyard (1967) and Hough (1970) also described the same technique in detail. Austin`s malleus/stapes assembly was later modified and improved by Pennington (1973) and Wehers (1974). Goodman (1980), Smyth(1980) and Macgee(1979) recommended the different types of reconstructing technique.

Hough(1958) used outer mastoid cortex, bony external auditory canal as autologus graft to reconstruct the hearing mechanics. Similarly auricular cartilage was used by Utech(1960).

Jansen(1963) described the use of tragal and septal cartilage to reconstruct hearing mechanics.

As Autograft materials are not readily available and in ossicles microscopic epithelium is not suitable for reuse (because of Recurrence) Homografts techniques came in action in 1960`s. Incus as an allograft was first introduced by House, Patterson and Linthicum(1966) which are now being used by many surgeons .

Notched incus autograft technique was introduced by Wehrs in 1974. House, Glasscock and Sheehy in 1969 introduced a new technique of alcohol preserved en bloc composite allograft, consisting of tympanic membrane with ossicles. However Homograft materials are rarely used due to risk of disease transmission (Creutzfeldt Jackob disease and HIV) and chance of resorption is high in cartilage and bone.

Since there is risk in using homograft materials and disadvantages of autograft materials, Biometric scientists and surgeons invented different types of alloplastic materials for implantation. At the end, three porous plastic materials namely Proplast, Plastipore and Polycel with ceramic material were developed for ossiculoplasty. These plastic materials are classified as bioinert, bioactive, biocompatible. Biocompatible materials such as Proplast, Teflon and Polyethylene were used in the late 1950 and 1960s.

High density Polyethylene sponge (HDPS), a non reactive material was developed in the late 1970. Plastipore is a original form and Polycel is a more versatile form of HDPS which can be combined with other materials such as

stainless steel thus lending itself to a wide variety of prosthetic designs. Extrusion rate was high when either plastipore or polycel placed in contact with tympanic membrane. Extrusion rate was considerably reduced by placing a cartilage between the plastipore or polycel prosthesis and tympanic membrane[2].

In the 1970s, prototype bioinert material(dense aluminium oxide, ceramic) was popular in Germany and Japan. In the same year bioactive implant (bioglass & ceravital) was introduced. Use of bioactive materials are limited nowadays because of instability in infective environment and difficulty in trimming the implant. Currently one of the alloplastic material bone cement (Hydroxyl apatite) was used commonly for ossicular reconstruction. Other biocompatible materials used for ossicular reconstruction are gold, titanium, stainless steel and sialastic. Titanium has gained popularity because of

1. Lighter than other materials
2. More stable in middle ear
3. Used in MRI

TYMPANIC MEMBRANE

It forms lateral wall of tympanic cavity. It lies at the medial end of external auditory meatus. It is slightly oval in shape, Pearly white in colour, broader above than below. It was obliquely set in the tympanic annulus.

- Height – 9 to 10mm
- Width- 8 to 9 mm
- Thickness – 0.1mm.

It is divided into 2 parts by anterior and posterior malleolar fold. Part above the malleolar fold is PARS FLACCIDA. Part below the malleolar fold is PARS TENSA. Thickened peripheral part of Pars tensa is Annulus which fits into the tympanic sulcus.

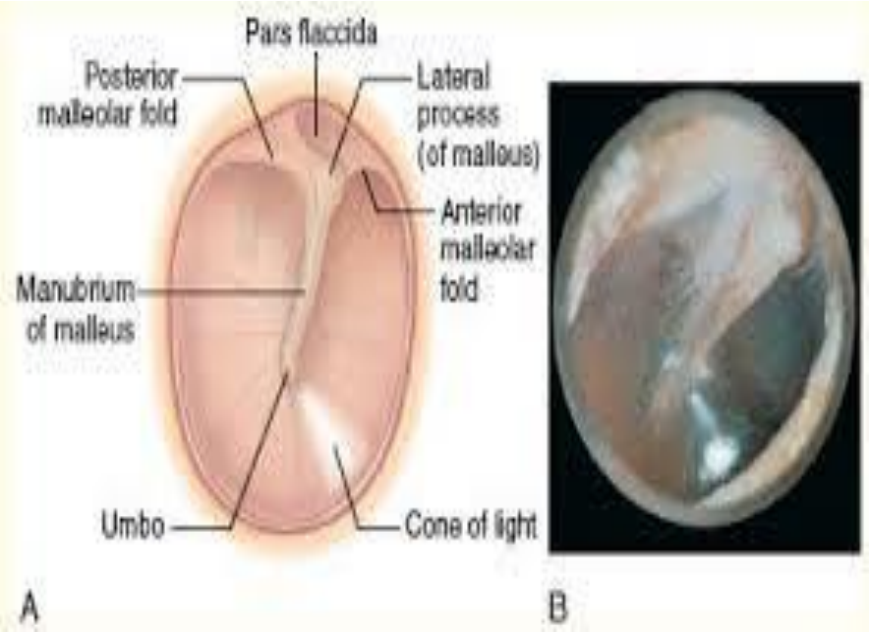


FIGURE:1 TYMPANIC MEMBRANE

UMBO:

The most depressed part in the concave tympanic membrane formed by firm attachment of handle of malleus to the tympanic membrane.

PARS FLACCIDA:

Also known as Sharpnel's membrane situated above the lateral process of malleus between anterior and posterior malleolar fold and notch of Rivinus. It is devoid of middle fibrous layer and is loosely attached with tympanic sulcus.

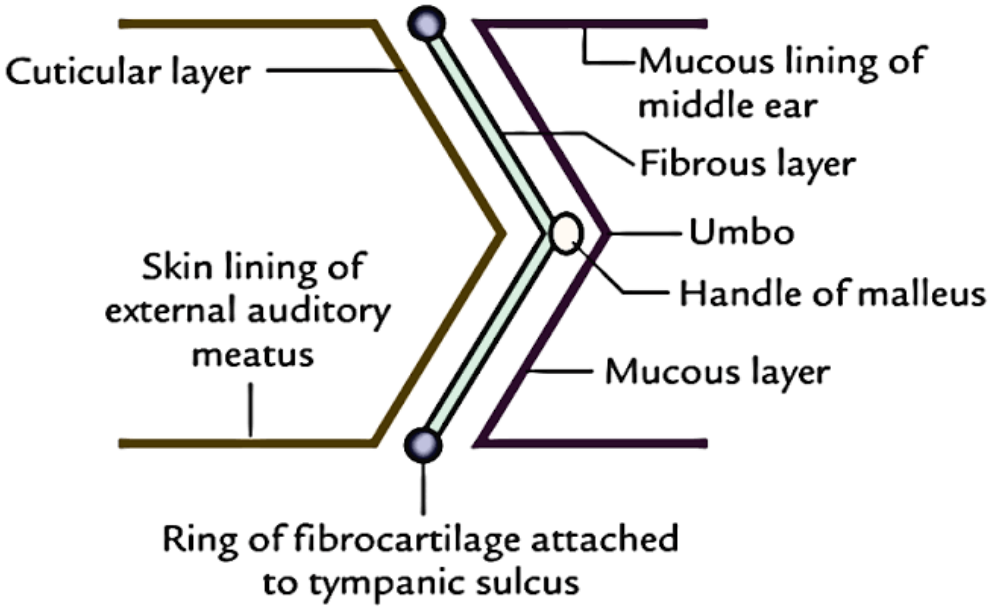


FIGURE:2 LAYERS IN TYMAPANIC MEMBRANE

It contains 3 layers

1. Inner mucosal layer – continuous with mucosa of the tympanic cavity
2. Middle fibrous layer / Lamina propria- it has 3 types of fibres
    - inner circular
    - Outer radial
    - Parabolic

    It also encloses the handle of malleus
3. Outer Epithelial layer -continuous with skin of EAC.

This complex arrangement of layers in tympanic membrane is responsible for displacement during sound stimulation.

Tympanic membrane develops from all the 3 germinal layers –

- Ectoderm
- Endoderm
- Mesoderm

Between the mucosal and fibrous layer, chorda tympani nerve passes. Tympanic membrane makes 55 degree angle with floor of External auditory canal.

PLICA MALLEARIS :

Thin mucosal fold connecting the tympanic membrane to the malleus from lateral process to tip.

BLOOD SUPPLY OF TYMPANIC MEMBRANE:

- Maxillary artery- Epidermal vessels from deep auricular branch.
- Maxillary artery- Mucosal vessels from anterior tympanic artery
- Posterior auricular artery- Stylomastoid branch
- Branches from middle meningeal artery

These arteries forms extensive anastomosis within Lamina propria.

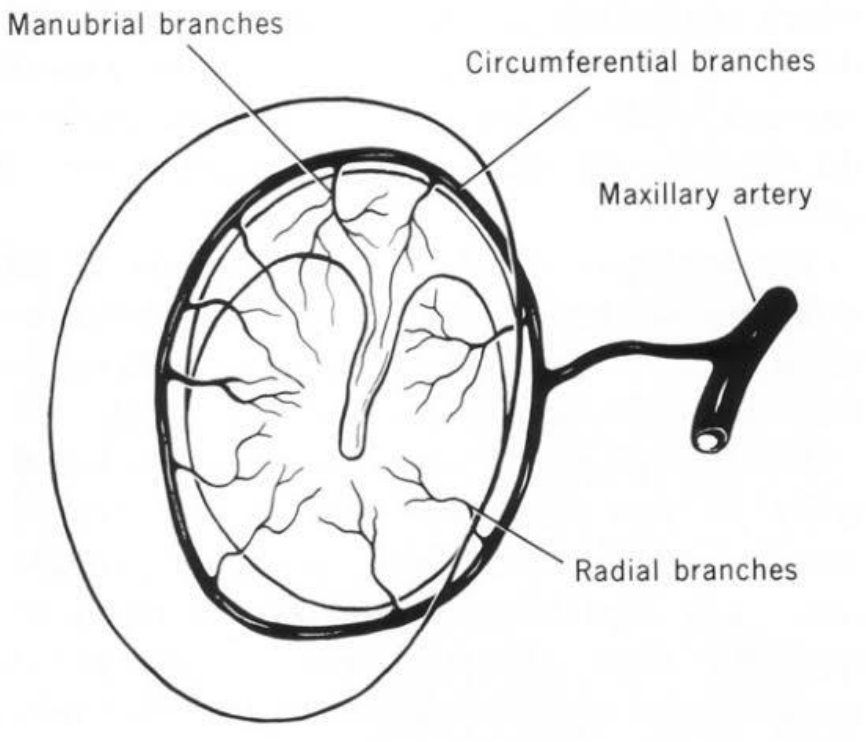


FIGURE:3 BLOOD SUPPLY OF TYMPANIC MEMBRANE

NERVE SUPPLY OF TYMPANIC MEMBRANE:

Lateral surface of Tympanic membrane

- Anterior half – Auriculotemporal nerve
- Posterior half – Arnold's nerve

Inner surface of Tympanic membrane

- Tympanic plexus

In the tympanic cavity there are 3 Ossicles and 2 Muscles which are important for hearing mechanisms.

OSSICLES

1. MALLEUS

2. INCUS

3. STAPES

MALLEUS:

It is the largest ossicle (9mm). It has head, neck, handle of malleus. Tympanic membrane is loosely attached with malleus from the lateral process to the tip. Without perforating the tympanic membrane that portion can be opened surgically to create a slit and to allow the prosthesis to be crimped around the handle of malleus in certain type of ossicular reconstruction.

Tensor tympani muscle is attached to the handle of malleus in its medial surface, near its upper end.

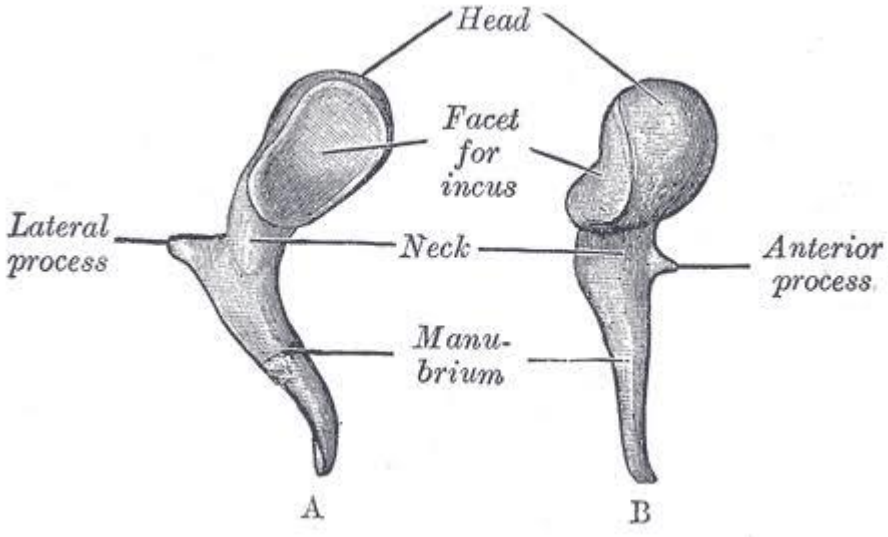


FIGURE:4 MALLEUS

INCUS:

- It has a body, Long process, Short process and Lenticular process
- Lenticular process is also known as 4th Ossicle due to its incomplete fusion with long process.
- Lenticular process articulates with Stapes.
- In chronic otitis media, Long process of Incus is more susceptible to osteitic resorption.

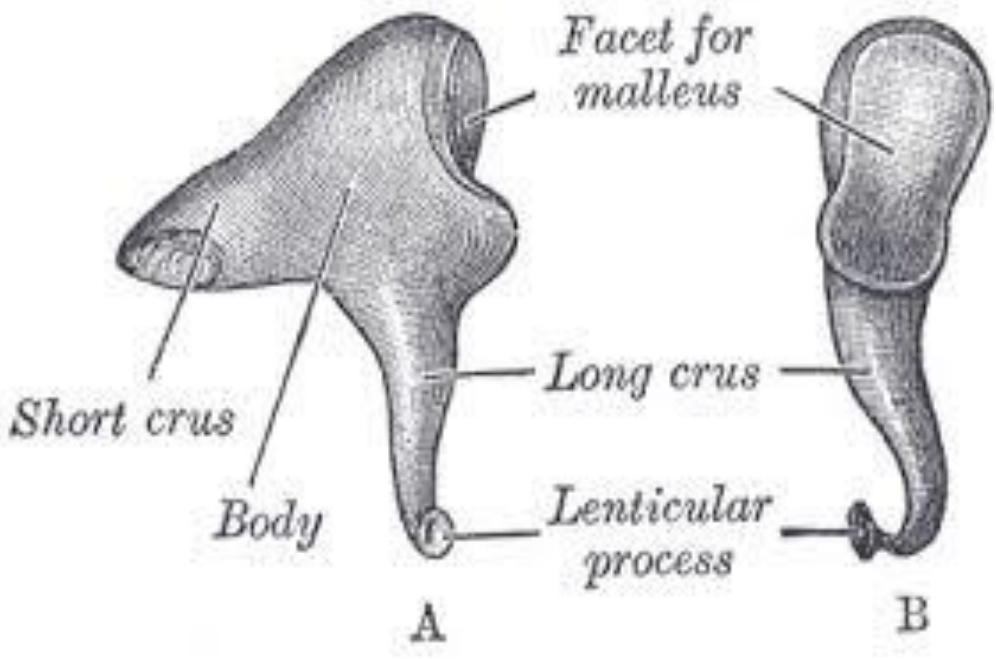


Figure 5: Incus

STAPES:

- Stirrup shaped
- It has head, neck, anterior and posterior crura and foot plate
- Stapedial tendon inserted into the upper portion of the posterior crus and posterior part of the neck.
- Posterior crura is more thicker and more curved than the anterior crura.
- The dimension of foot plate is averagely 3x1.4
- Long axis of foot plate is almost horizontal.

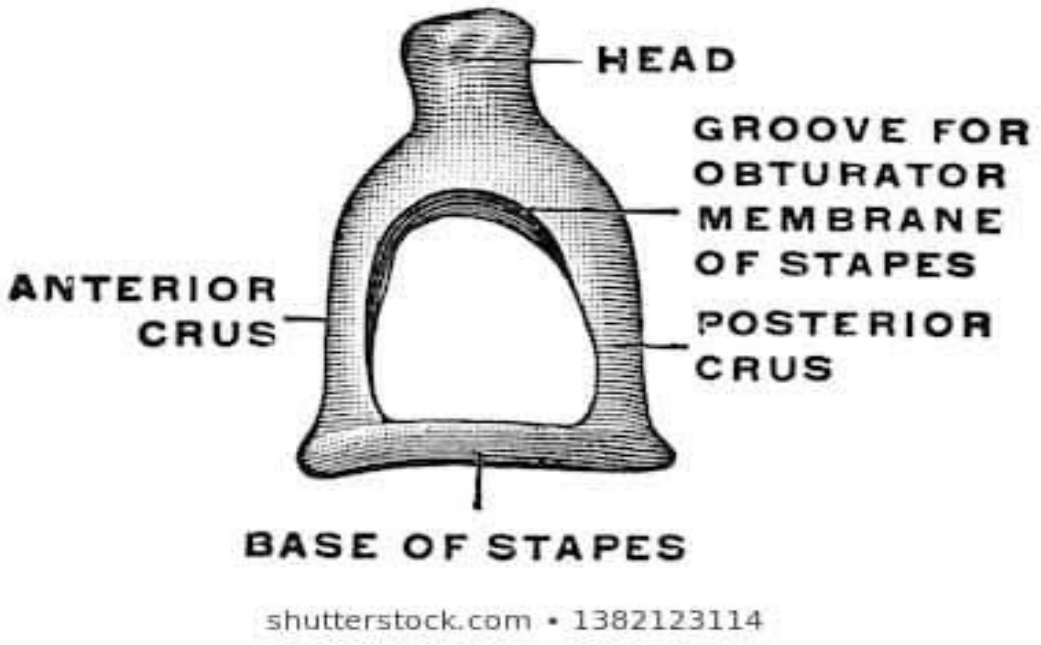


Figure 6: Stapes

STAPEDIUS MUSCLE:

Origin: Apex of pyramid

Insertion: Upper portion of the posterior

crus and posterior part neck.

Nerve supply: Nerve to stapedius branch of Facial nerve

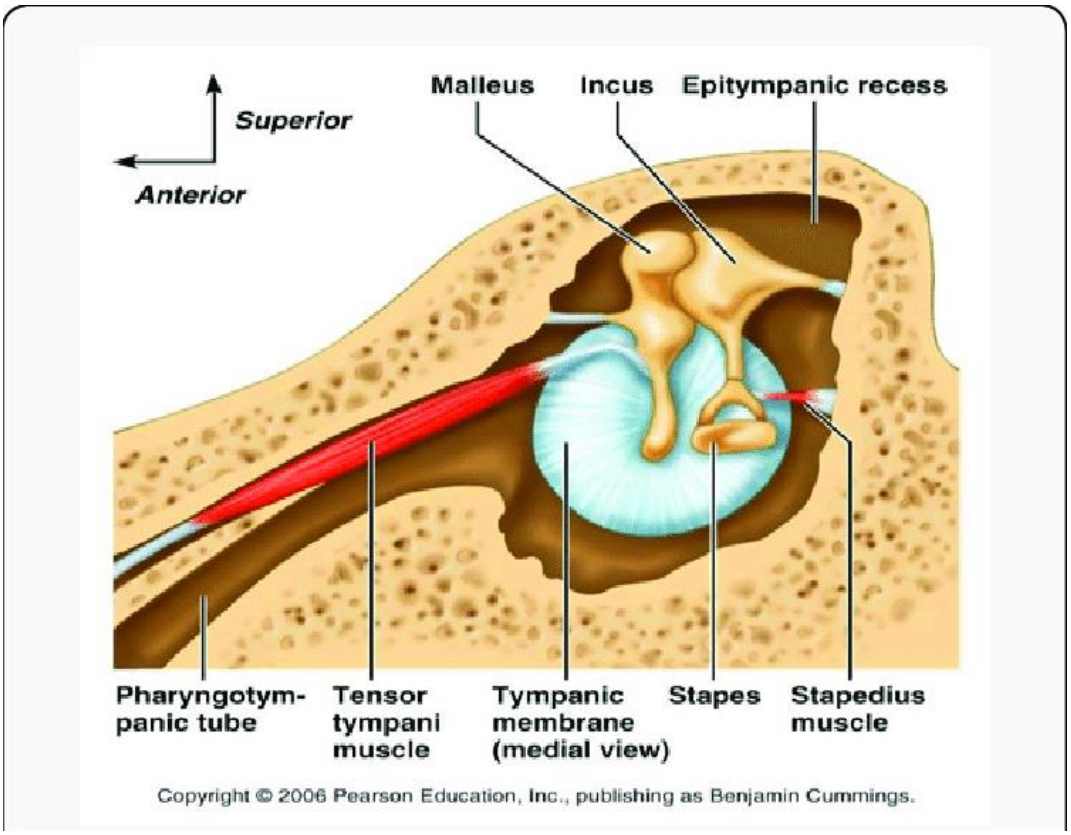


Figure 7: Tensor tympani and stapedius muscle

TENSOR TYMPANI MUSCLE:

Origin: Bony canal of Eustachian tube, part

of the muscle also arises from the

cartilagenous part of eustachian tube

and greater wing of sphenoid

Insertion: Medial aspect of the upper end of

handle of malleus.

Nerve supply: Mandibular nerve via Medial

pterygoid.

ANATOMY OF MIDDLE EAR:

Shape: Cuboid

Lateral wall - Tympanic membrane

Medial wall- it is a common wall between middle and inner ear

The following important structures are present in the medial wall:

- Promontary formed by basal turn of cochlea
- Processes cochleariformis – it has 2 significance
    1) Tensor tympani muscle winds around it.
    2) It is a landmark for 1st genu
- Bulge of the lateral semi-circular canal
- Oval or round window

Posterior wall- It forms the common wall between the middle ear and mastoid. The following structures are present in the posterior wall

- Aditus
- Pyramid
- Facial nerve
- Sinus tympani/ Infra pyramidal recess
- Fossa incudes
- Facial recess/ Supra pyramidal recess

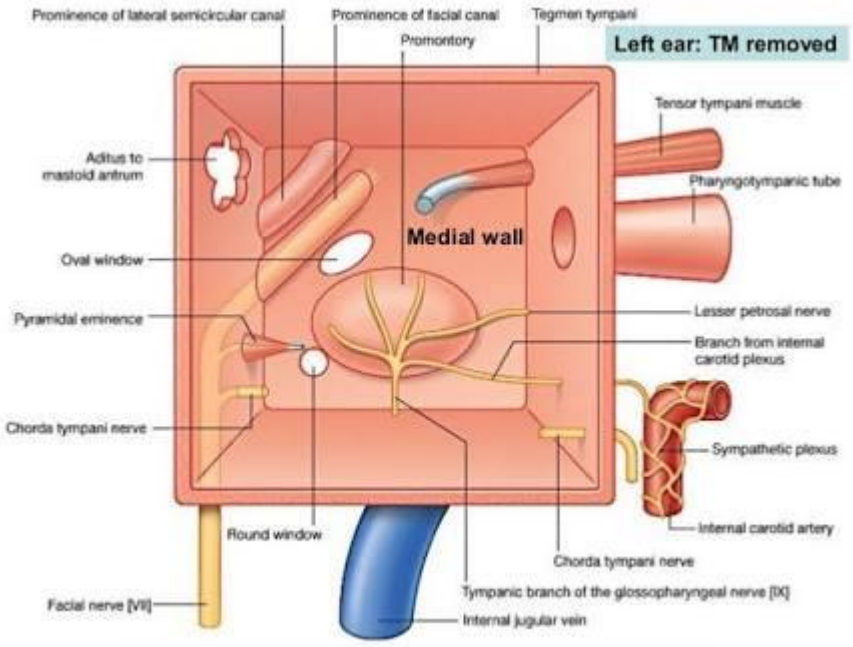


Figure 8: Anatomy of middle ear

Anterior wall – It separates the middle ear cavity from the internal carotid artery. The following structures are present in the anterior wall

- Opening of Eustachian tube
- Tensor tympani canal
- Canal of Huguier
- Petrotympanic fissure

Roof- Tegmen tympani (thin plate of bone)

Floor - Thin plate of bone separating the middle ear from jugular bulb.

ANATOMY OF INNER EAR:

Cochlear duct is a coiled tube and is coiled around the bony axis known as Modiolus. In cross section it is triangular in shape. It is bounded by Basilar membrane (Organ of corti rests), Reissner membrane and stria vascularis.

Structure of Organ of Corti:

Two types of hair cells in organ of corti

- Inner hair cell
- Outer hair cells

Both hair cells project into a membrane called Tectorial membrane.

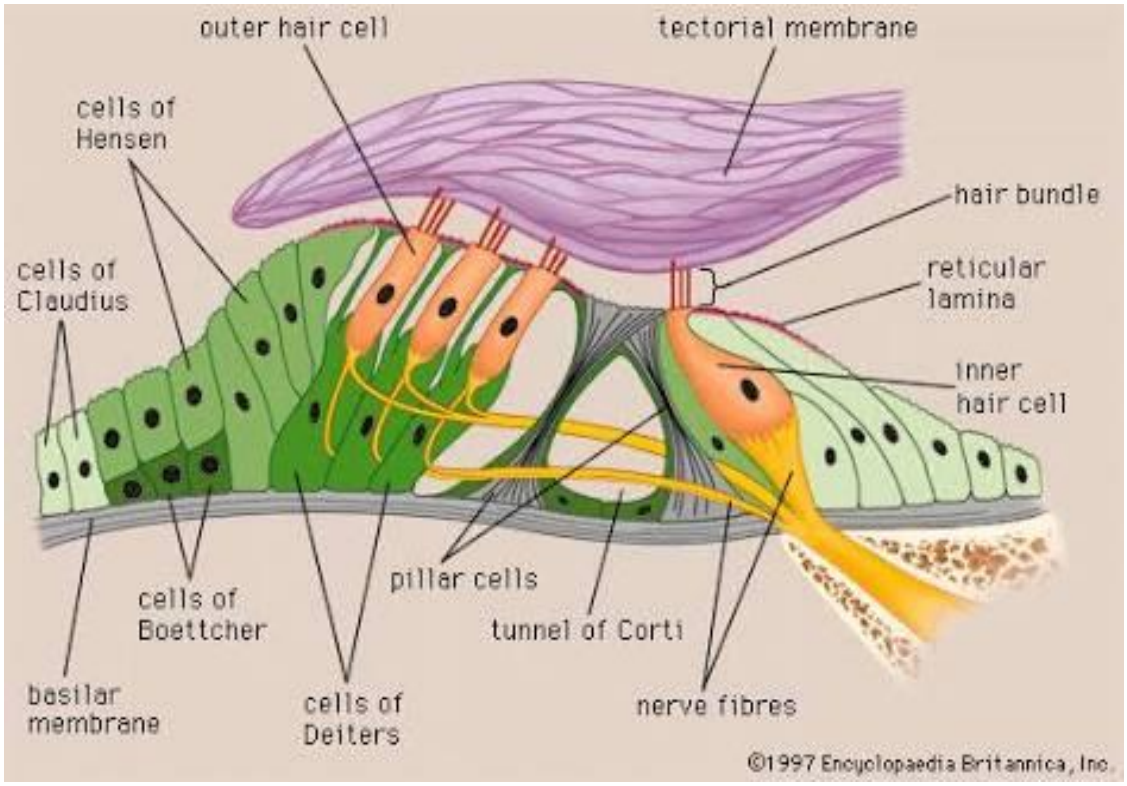


Figure 9 : Organ of Corti

Supporting cells:

It supports the outer hair cells, they are named as cells of Dieters, Claudius, Hensen cells

Tunnel of Corti:

It is formed by inner and outer rods and it contains fluid called cortilymph.

Auditory pathways :

Inner hair cells – Afferent nerve fuses to form cochlear nerve- Spiral ganglion- Cochlear nerve exits through the internal acoustic meatus- Dorsal and

ventral cochlear nuclei- Ipsilateral and contralateral superior olivary complex- Lateral lemniscus- Inferior colliculus- Medial geniculate body- Through the posterior limb of internal capsule- Transverse temporal gyrus Broadmans area 41[3].

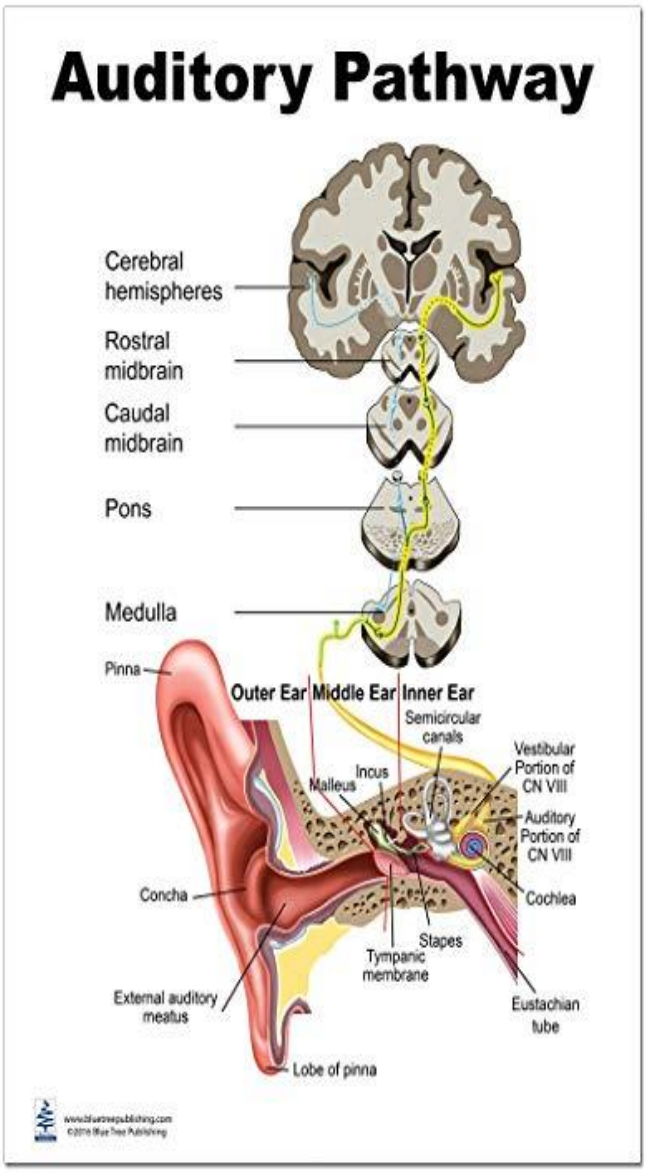


Figure 10: Auditory pathway

BLOOD SUPPLY OF MIDDLE EAR:

Parent artery	Branch	Region supplied
Posterior auricular	Stylomastoid	Posterior part of tympanic cavity and stapedius muscle
Middle meningeal	Superior tympanic artery	Malleus, Incus, Tensor tympani
Ascending pharyngeal	Inferior tympanic artery	Mesotympanum
Internal carotid artery	Tympanic branch	Hypotympanum and Mesotympanum
Maxillary artery	Anterior tympanic artery	Anterior part of tympanic cavity, Incus, Malleus and tympanic membrane
Middle meningeal artery	Petrosal artery	Roof of mastoid and roof of epitympanum
Stylomastoid artery	Mastoid artery	Mastoid air cells

Table 1

PHYSIOLOGY OF MIDDLE EAR

From the external environment the acoustic signals are transmitted to the fluid filled inner ear. Finally sound pressure increased at the foot plate relative to tympanic membrane. For this mechanism middle ear act as a transformer. Stapes volume velocity decreases relative to tympanic membrane volume velocity.

Transformation mechanism of middle ear is divided into 3 stages which is provided by

1. The drum
2. The ossicles
3. The area difference between the drum and stapes foot plate.

CANTENARY LEVER ACTION:

Cantenary lever action is mainly due to the concavity of the drum and it exerts greater force upon its point of attachment. The fibrous annulus part of the tympanic membrane is immobile, the sound energy amplified at the central attachment, the Malleus.

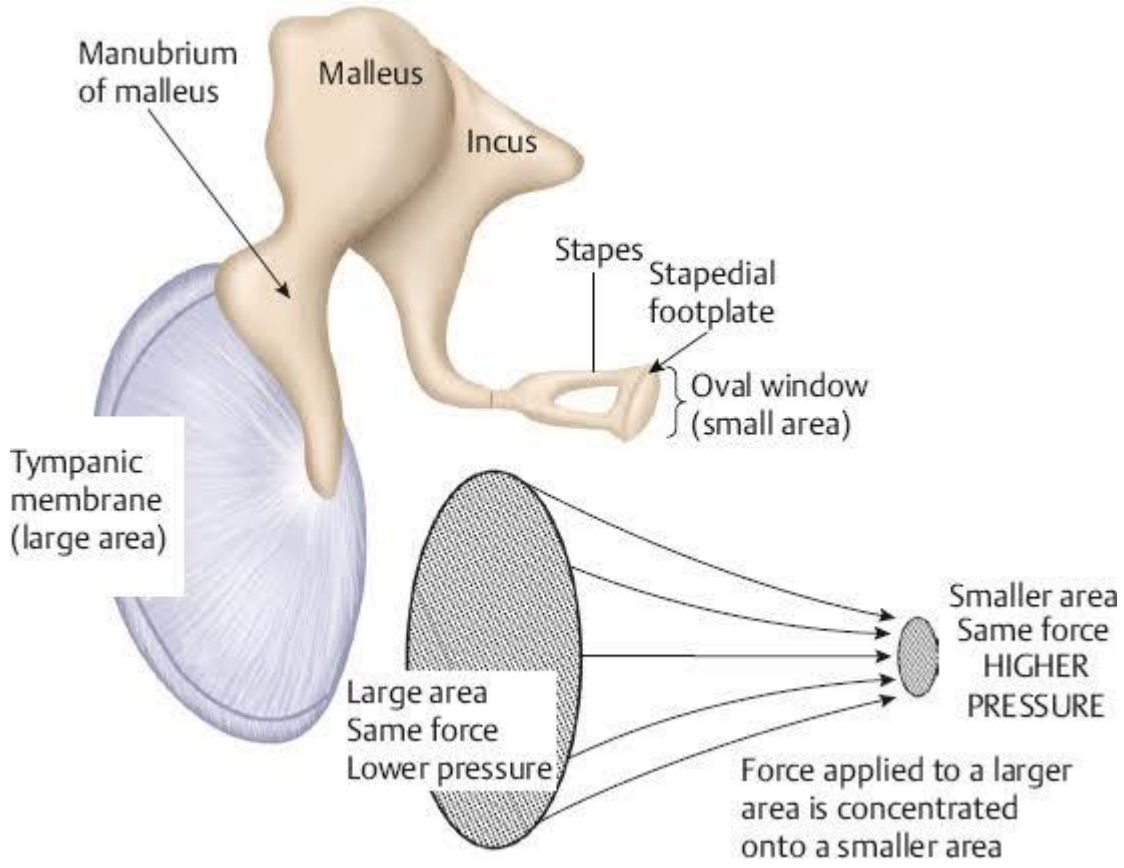


Figure 11 : Lever action of ossicles

OSSICULAR LEVER ACTION:

The ossicular lever action is mainly due to the

1. Differing length of manubrium
2. Long process of Incus
3. Axis of rotation of the ossicles

An imaginary line joining the anterior malleal ligament to the incudal ligament, that anchors the short process of incus is called as the axis of rotation.

Pressure gain can be quantified and measured using the ratio of sound pressure in the vestibule to the sound pressure in the ear canal. Foot plate receives increased sound pressure due to the difference in the surface area of tympanic membrane and foot plate.

Ossicular lever	Force acting on the Malleus / Force acting on the Stapes	1.15
Cantenary lever	Force acting on the TM/ Force acting on the Malleus	2.0
Area ratio	Area of TM/ Area of foot plate	21
Total lever advantage	Force acting on the Foot plate/ Force acting on the TM	48.3

Table 2

Theoretical middle ear gain is 28 decibel, measured middle ear gain is 20 decibel. Middle ear sound pressure depends on the frequency with a maximum gain of only about 20 decibels near 1000 hertz.

BONE CONDUCTION:

In bone conduction the inertial component is due to the lag of conduction apparatus which is followed by Relative movement of stapes on the oval window due to the vibration of the skull. This movement is important between 500 and 2000 hertz. This type of energy transfer gives falsely decreased scores in bone conduction test if ossicular chain is fixed or interrupted[4].

PATHOLOGY OF CHRONIC OTITIS MEDIA

It is a multi factorial disease, recurrent episodes of acute otitis media will cause chronic suppurative otitis media

Following are risk factors for CSOM

1. Age
2. Race
3. Recurrent respiratory tract infection
4. Poor hygiene and nutrition
5. Bottle feeding
6. Exposure to passive smoking
7. Family history

Eustachian tube anatomy and function is the major cause for chronic otitis media

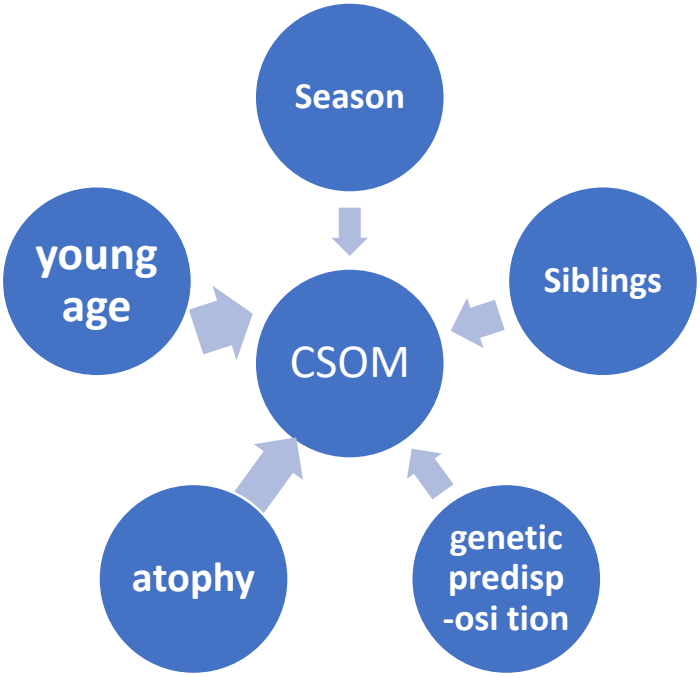


Figure 12: Risk factors for chronic otitis media

Middle ear mucosa does not have property to produce own immunocompetent cells. In AOM, antibodies detected in the middle ear is due to serum transudation and reflux nasal secretions containing antibodies, until we have no evidence for independent local antibody production.

Systemic immune deficiency, poor mastoid pneumatization, Eustachian tube dysfunction and mucosal immune system deficiency, these are associated features with CSOM.

Early childhood infection leads to mastoid hypopneumatization and it produces sclerosis in already pneumatized mastoid and destruction of three

layers of tympanic membrane which leads to Perforation of tympanic membrane. Yet heals spontaneously. Healing is determined by proliferation of connective tissue and squamous epithelium at the margin of defect .

CSOM is mainly due to failure of healing of tympanic membrane and Eustachian tube dysfunction. Multiple factors which is responsible for failure of healing are Eustachian tube dysfunction, persistence of infection, large size perforation, formation of granulation tissue and polyp[5].

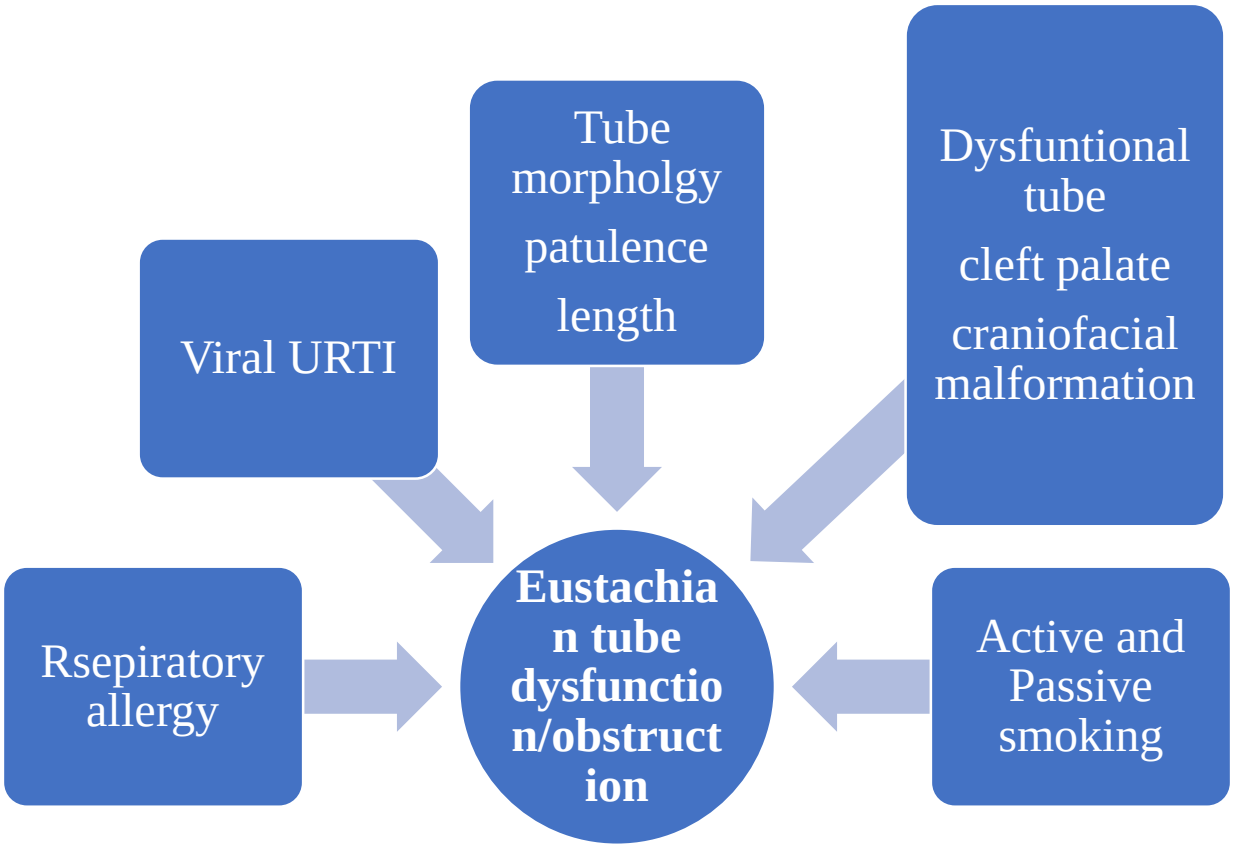


Figure 13: Factors Responsible For Eustachian Tube Dysfunction

HYPOXIA AND INFLAMMATION IN CSOM:

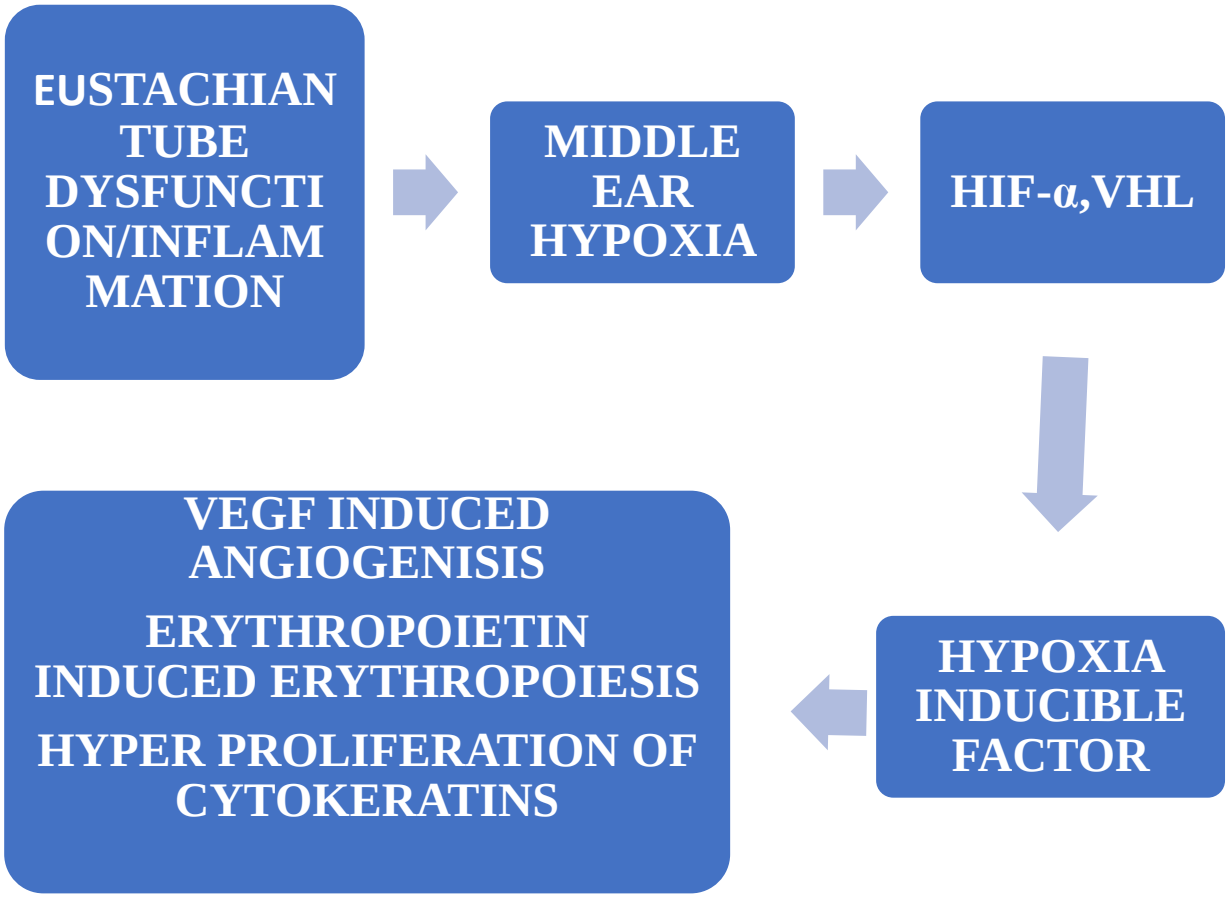


Figure 14: Hypoxia and inflammation in CSOM

MOLECULAR BIOLOGY OF CSOM

Inflammatory mediators induced by bacterial endotoxins, the inflammatory mediators are responsible to produce tumour necrosis factor-alpha and interleukines-1. These mediators are also produced by infiltrating immune cells such as Monocytes, Neutrophils and Lymphocytes. It has the property to fight against infections and also damage the host cells leading to

chronic otitis media. The other cytokines such as IL-6, IL-8, IFN-γ responsive for chronicity of disease.

IgG AND IgA:

In CSOM major factor responsible for defence against mucosal inflammation are immunoglobulin IgA and IgG. By **Coating** mechanism, IgG and IgA are adherent to the bacterial cell wall and act as a defence against bacterial infection.

SECRETORY IgA:

Bacterial Colonization and attachment prevented by secretory IgA. Secretary IgA synthesized and transported to middle ear from nasopharyngeal secretion.

IgG :

Phagocytosis mechanism facilitated directly or through complement activation by IgG's intense coating of bacteria and also by IgA when bacteria coming from nasopharynx like Moraxella, Streptococcus. Yet pseudomonas infection coating was absent as it is transmitted from external auditory canal to middle ear. This explains why pseudomonas could not be eradicated from middle ear[6].

MICROBIOLOGY OF CSOM

Most common cause for CSOM is Pseudomonas aeruginosa, Proteus and Staphylococcus aureus (gram positive). Less commonly found organism are Streptococcus pneumoniae, Diptheroids, Klebsiella and Bacteroides (anaerobic).

MECHANISIM OF HEARING LOSS IN TYMPANIC MEMBRANE PEFORATION :

Middle ear sound transmission mainly depends upon the sound pressure difference across the tympanic membrane. When tympanic membrane is perforated, sound pressure difference across the tympanic membrane is reduced that leads to hearing loss.

In tympanic membrane perforation sound volume velocity travels through perforation and not through ossicular chain. It is the most common mechanism for hearing loss in tympanic membrane perforation. This mechanism proved by Voss et al: Reduction in sound pressure occurs when tympanic membrane perforation is large. Thus hearing loss mainly depends upon the size of perforation.

When tympanic membrane is perforated, hearing loss is inversely proportional to volume of middle ear and mastoid. Middle ear and mastoid volume may vary from 1cc to 20 cc with average of 6cc. In perforated tympanic

membrane air- bone gap mainly depends upon the middle ear and mastoid volume. This explains why the degree of hearing loss is different in individuals even when the size and location of perforation are same[7].

PATHOLOGY OF CHOLESTEATOMA

Based on disease pathogenesis there are two types of Cholesteatoma. They are congenital and acquired. Acquired again classified into primary acquired and secondary acquired cholesteatoma.

CONGENITAL CHOLESTEATOMA:

Congenital cholesteatoma simply defined by epithelial inclusion behind the tympanic membrane. Many theories are developed to explain congenital cholesteatoma.

Theories are

1. Epidermal rest theory
2. Inclusion theory

EPIDERMAL REST THEORY:

This theory explains nonkeratinizing squamous epithelial cell rests are present in the lateral wall of eustachian tube and also surrounding tympanic ring. These cell rests are later developed into congenital cholesteatoma.

Antero superior quadrant is the most common site of congenital cholesteatoma (Teed Michael`s) which is supported by above theory.

INCLUSION THEORY:

This theory explains, through minor injuries in the tympanic membrane epithelial cells are migrated into tympanic cavity. Any inflammation in tympanic membrane will lead to micro perforation, through which epithelial cells migrates into middle ear. Tympanic membrane seems to be intact macroscopically but has perforation microscopically.

In acquired inclusion theory, formation of inclusion cholesteatoma after healing of tympanic membrane is due to residual tears in tympanic membrane.

ACQUIRED CHOLESTEATOMA:

Pathogenesis of epidermal theory was first explained by Haberman in 1888 and confirmed in the 1970s. To explain the pathogenesis of acquired cholesteatoma historically four theories have been proposed

1. Invagination theory
2. Immigration theory
3. Squamous metaplasia
4. Basal cell hyperplasia

INVAGINATION THEORY:

Tympanic membrane retraction pockets are the precursor for acquired cholesteatoma which are caused by dysventilation syndrome of middle ear compartment. Retraction pocket of tympanic membrane is a passive process but formation of cholesteatoma from retraction pocket is a dynamic biologic process. Epithelial hyperplasia and defective skin migration is the major histological factor for cholesteatoma but is not present in retraction pocket. Persistence of inflammation of middle ear leads to loss of self cleaning mechanism and increased epithelial proliferation to form cholesteatoma.

MIGRATION THEORY:

Recurrent ear infection will alter the external auditory canal skin migration. Normal migration of epithelial cells is towards the external auditory meatus. In recurrent ear infection, epithelial migration is altered towards Middle ear leading to cholesteatoma formation.

Epithelium in the outer layer of Tympanic membrane or in the external auditory canal may migrate into middle ear through perforation in the tympanic membrane. Perforation may be due to traumatic and iatrogenic.

SQUAMOUS METAPLASIA THEORY:

It explains persistence of middle ear inflammation which leads to squamous metaplasia of middle ear epithelium. But this theory was not accepted nowadays.

BASAL CELL HYPERPLASIA THEORY:

This theory explains the basal cell hyperplasia in the basale layer of pars flaccida which later combine with keratin filled microcytes, buds and pseudopods forming cholesteatoma[8].

MOLECULAR BIOLOGY OF CHOLESTEATOMA

Internal molecular dysregulation and some external stimuli(bacterial toxins, growth factors and inflammatory cytokines) leads to cholesteatoma formation and also imbalance in vicious cycle of proliferation, differentiation, maturation, prolonged apoptosis and defective self cleaning mechanism leading to formation of cholesteatoma

In proliferative activity of cholesteatoma langerhan cells play a important role. Langerhan cells have positive trophism towards keratinising squamous epithelium and it maintains this role because of activation of surrounding inflammation produced by lymphocytic activation and secretion of osteolytic mediators.

CHOLESTEATOMA – IMMUNOHISTOCHEMISTRY:

Immune histochemical analysis revealed the association between the progression of cholesteatoma and host immune response to persisting inflammation .Excessive release of growth factor in the matrix and prematrix due to inflammatory reactions leads to uncontrolled proliferation of keratinocytes and there by leading to cholesteatoma

Main difference between the cholesteatoma and normal skin is a loss of growth inhibition by cell to cell contact. In this loss of growth control mechanism following factor is involved in cholesteatoma formation.

1)The middle ear environment doesn't favour to produce cell to cell contact inhibition making cholesteatoma (skin in the wrong place) to further proliferate[8].

CHOLESTEATOMA GROWTH PATHWAY:

Age distribution	Location	Site in the tympanic cavity
Frequently in children	Pars tensa / posterior mesotympanum	In pars tensa postero superior quadrant
Frequently in adults	Posterior epitympanum/attic	Pars flaccida
Mostly in children	Anterior epitympanum	Anteriorly and cranialy to the malleus head
Includes also two routes of cholesteatoma	Unclassified	Not clearly defined

Table 3

PATHOLOGY OF OSSICULAR EROSION

Osteolytic process in middle ear cholesteotoma is mainly due to 2 predominant mechanism

1. Enzymatic resorption of bone
2. Pressure induced bone resorption

Steinbrugge in 1879 and Walsh in 1951 described the pressure necrosis initially. Chole and co workers in 1985 described the direct bone resorption mechanism. Only in last two decades we have studied the enzymatic and cytokine induced bone destruction.

Family of zinc metalloenzymes, matrix metalloproteinase that degrades unmineralized extracellular matrix in suprabasal epithelial layers of cholesteatoma two enzymes were exposed that are

1. MMP 2 (72 KD collagenase)
2. MMP 9 (92 KD collagenase)

Analytical study was done by Schnidt and coworkers shows In vivo significance of MMP 9 activity in relation to the production of cytokines, interleukins and tumour factor alpha, Transforming growth factor beta and Epidermal growth factor in tissue homogenates of cholesteatoma and nine external ear skin specimen. Significant elevation of interleukin 1a was found in this study. No correlation between the MMP 9 activity and cytokine production

found in this study. Osteolytic activities of interleukin 1a was seen in cultured cholesteatoma cells with normal external auditory canal skin[9].

A study conducted by Yan and coauthors found that invitro stimulating monocytes, able to produce multinucleated cells with osteoclastic activity. In this study osteoclastic activity mainly induced by an enzyme, Acid phosphatase. By adding osteoblast to the tumour necrosis factor alpha treated osteoclasts containing medium, the amount of osteolysis was increased. In addition to this process, collagenase production by macrophages and osteoblasts was increased.

A analytical study in which tissue samples collected from 22 patients from cholesteatoma and 15 patients from chronic otitis media without cholesteatoma and performing the enzyme linked immunosorbent assay on collected tissue samples shows the interleukin 1a, tumour necrosis factor alpha and epidermal growth factor alpha was significantly increased in patients with cholesteatoma sample.

Temporal bone of 2 patients with ruptured cholesteatoma sac shows histopathological evidence of local inflammation and osteolysis. Small abscess formation were seen associated with these changes and marked inflammatory cellular infiltrate seen surrounding the ruptured sac with evidence of epithelial proliferation at the perforated site.

Nitric oxide is an important mediator of osteoclastic function described by Jung and coworkers. Murine studied the gene expression of nitric oxide synthase and the effect of aminoguanidine (an inhibitor of cytokine mediated nitrate production). In this study they compared the nitric oxide synthase 1 and 3 with nitric oxide synthase 2. The result of this study showed Selective upregulation of inducible nitric oxide synthase and nitric oxide synthase 2 is seen. This study was based on usage of L-Penicillamine, S-nitro-N-acetyl-D, Sodium nitroprusside which is a low concentration of nitric oxide donor and usage of dose dependent stimulation of osteoclastic activity.

Only interferon which can generate nitrite invitro is interferon gamma. Invitro by addition of aminoguanidine the nitrite production was blocked and synergistically enhanced in the presence of tumour necrosis factor alpha, interleukin b and interferon gamma.

This study showed the conclusion of additional cytokine activity in osteoclastogenesis and bone resorption. This disproved the previous study made by Hamzei and coauthors study. Hamzei study showed increase in osteoclast precursor cell number in cholesteatoma whereas Jung study showed increase in osteoclastic activity alone without osteoclast number hike. Thus the osteolytic mechanism in cholesteatoma is high lightened significantly.

Ossicular chain defects classification proposed by Austin's:

1. M+ S+ (Malleus present, Stapes suprastructure present)
2. M- S+ (Malleus absent, Stapes suprastructure absent)
3. M+ S- (Malleus present, Stapes suprastructure absent)
4. M- S- (Malleus absent, Stapes suprastructure absent)

Some rare defects

1. Stapes fixed, Malleus handle absent
2. Stapes fixed, Malleus handle present
3. Loss of Stapes alone
4. Loss of handle of malleus alone

In unsafe CSOM ossicular erosion is much more common than insafe CSOM. In safe CSOM only 14% of patients have ossicular erosion. The duration of inflammatory process determines the erosion of ossicles[10].

INCUS NECROSIS:

In CSOM, Incus is the most common ossicle which is involved in ossicular erosion. The most common site is Lenticular process followed by Long process. The least involved site is Body of incus.

Reason for Long process of Incus erosion:

1. In case of posterior perforation of TM ,exposure of TM to external Environment
2. Weak blood supply

These factors are responsible for Long process of incus erosion. In safe ears 8% of cases reported with long process of incus erosion. Ossicular erosion is not common in Malleus due to its strong attachment with tympanic membrane and tremendous blood flow.

These factors diminishes the risk of Malleus necrosis. In safe type CSOM, only 2% patients were reported with Malleus necrosis. It is due to the decreased blood supply to Malleus because of presence of subtotal and total perforation and also exposure of malleus to the external environment[11].

PURE TONE AUDIOMETRY :

Whenever object vibrate in elastic medium(air) sound gets generated. Vibrating object produce number of similar waves in a second which is known as frequency of that particular sound. Frequency is measured by hertz.

In single fixed frequency the vibrating object produces sound waves like sinusoidal pattern, it is called as sine wave or pure tone of sound.

Uses of pure tone audiometry

1. Patient having definite hearing loss or not
2. The hearing loss is sensory neural or conductive
3. If the hearing loss is sensory neural whether it is cochlear or retro cochlear
4. Degree of hearing dysfunction

By using pure tone audiometry we could not make out exact pathology of disease. But we can classify the hearing loss into three categories

Hearing loss is

- Conductive
- Sensory neural
- Mixed

Frequency range in this test is 125- 8000hz. Single frequency is used in pure tone audiogram as it is easily generated, calibrated and easily measured

In x axis frequency is plotted 125- 8000hz

In y axis sound decibel is plotted -10 to 120 db

While doing pure tone audiometry

- First properly instruct the patient about the procedure
- To start with air conduction test, middle ear and external auditory canal should be normal
- Intially start with 1kHz then later increased to 2kHz, 4kHz, 8kHz
- If patient is normal start with 30 db, if patient had hearing loss start with 70 db
- While doing pure tone audiogram modified hugson west lake procedure is followed, it is otherwise known as ascending or decending procedure i.e when the patient hears, drop down to 10db & when patient does not hear increase with 5db
- Right ear plotted with red colour and left ear plotted with blue colour
- Always test the better ear first for air conduction then test the bone conduction
- Only upto 4kHz access the hearing because above 4kHz more distortion occurs
- By using air conduction test we can access the patient hearing and degree of impairment
- By using bone conduction test we can access the inner ear status and type of deafness

PURE TONE AVERAGE:

It is average of three frequencies 500Hz,1kHz,2kHz

AIR BONE GAP:

Gap between the air conduction and bone conduction is called as air bone gap[12].

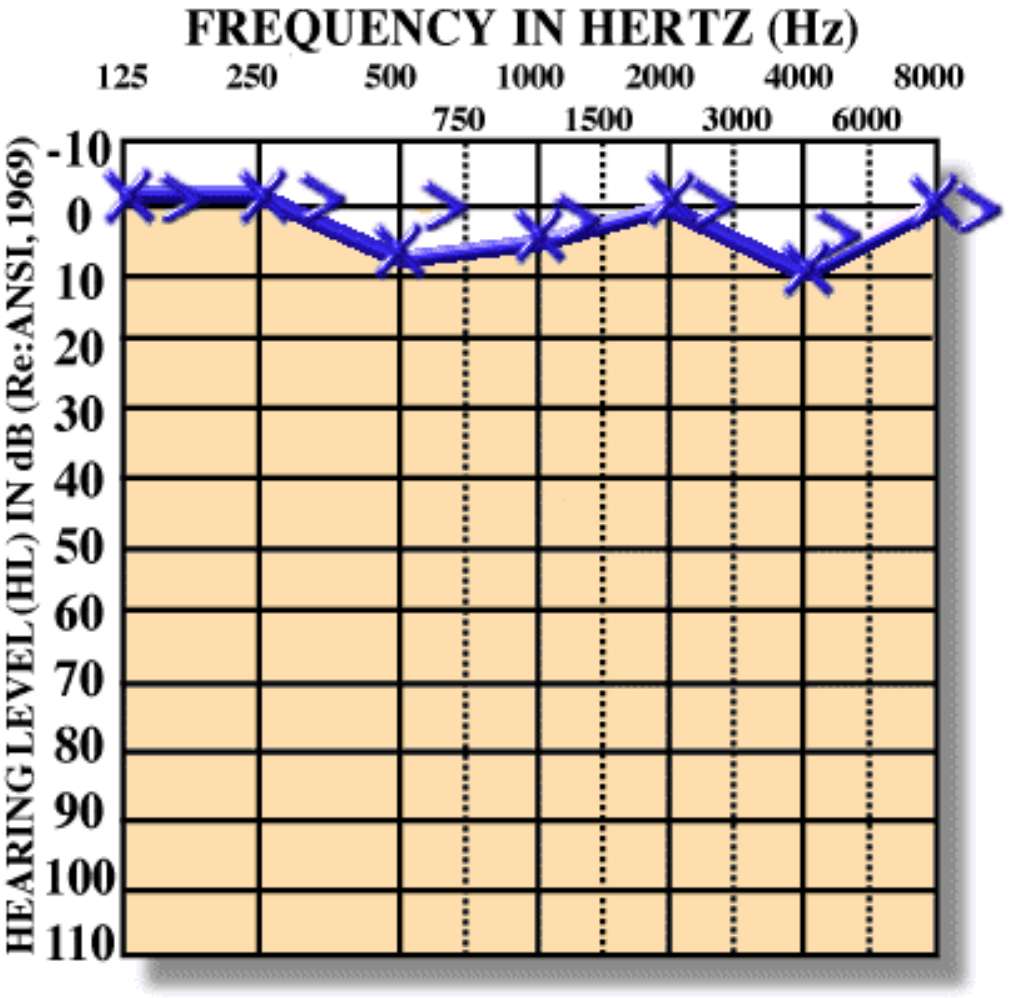


Figure 15: Normal Puretone Andiogram

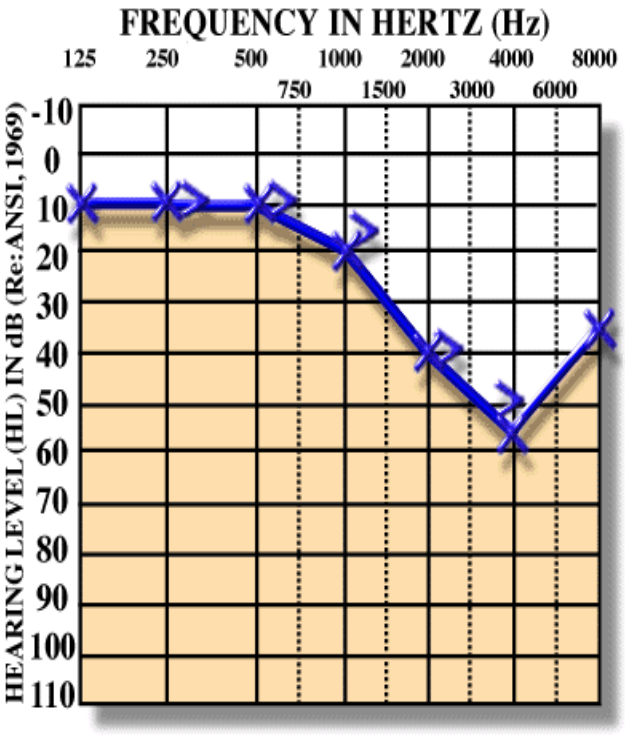


Figure 16:**Sensory neural hearing loss**

Figure17 : Conductive hearing loss

Figure 18: Mixed hearing loss

Normally air conduction curve is lower than the bone conduction curve In some condition where the bone conduction is lower than the air conduction are

- ambient noise in test room
- irregular mastoid
- not well calibrated equipment
- malingering

MASKING:

Masking done to prevent cross hearing and head shadow effect. When difference between the air conduction of test ear and air conduction of non test ear is equal or more then 40 db we have to mask air conduction.

When difference between air bone gap of test ear is more then 10 db we have to mask bone conduction.

DEAFNESS CLASSIFICATION:

By using hearing thresholds deafness was classified according to World Health Organisation, normal hearing is less then 25db, hearing loss is mild when patient has 26db to 40db, moderate when it is 41db to 60db , severe when it is 61 to 80db, profound when it is more then 81db[12].

OSSICULOPLASTY

It is the procedure by which we reconstruct the ossicles by using various materials. By this we can improve the hearing mechanism. Failure of ossicular transmission function leads to more then 50db loss. Incus is the most common ossicle involved in CSOM followed by stapes supra structure.

AUTO GRAFT:

The patient own tissues are used for reconstruction such as cartilage, cortical bone, remodelled ossicles. Interposition of incus is the most commonly used procedure.

Advantage :

- Excellent biocompatibility
- Extrusion rate is very low
- Low cost

Disadvantage:

- Displacement and resorption rate are high with Cartilage
- To sculpture incus, more time is required and more technical skill is needed
- In cholesteatoma risk of residual disease transmission

HOMOGRAFT:

Materials taken from human donor tissue

Advantage:

- They are harvested correctly
- Risk of residual disease (cholesteatoma) is less

Disadvantages :

- Major fear in using the homograft material potential risk of disease transmission like viral infection, Creutzfeldt-jakob disease.

ALLOPLASTIC MATERIALS

Alloplastic materials can be solid plastic (polytetrafluroethylene, polyethylene, solid metals (gold, titanium, stainless steel), porous sponge like plastics (proplast, plastipore), ceramics (aluminium oxide, hydroxyapatite) prosthesis is said to be ideal as prosthesis is having properties of stablity, compatiblity, readily available, easily insertable and having capacity to transmit sound properly.

SURGICAL TREATMENT FOR CSOM

In CSOM ideal goal of surgery is to get disease clearance and reconstitute the good hearing function in a single stage procedure

Surgical technique:

All patients with CSOM are operated via post aural approach. In CSOM safe type, cortical mastoidectomy with tympanoplasty is done. In CSOM attico antral type, canal wall down mastoidectomy with tympanoplsty is done. Using underlay technique tympanic membrane was reconstructed.

Retrospective study was conducted by E De corso, M R Marchese, B sergi between January 1995 and December 2002 where142 no of patients affected by cholesteatoma underwent canal wall down procedure with tympanoplasty with ossicular reconstruction[13].

In that study they observed the air bone gap was significantly reduced from a preoperative value of 28.83 db to post operative value of 13.94 db. This study also explains that after surgery, closure of air bone gap PTAs was found to be 20db or less in two third of patients, where four frequencies (0.5kHz, 1,2, 4kHz)were used and also surgery done in a single stage Procedure.

Berenholz et al., studied series of patients who underwent staged canal wall down tympanoplasty with ossiculoplasty procedures and he reported post operative air bone gap average of 17.8db Babighian and cook et al., studied in a series of patients who underwent canal wall down mastoidectomy with tympanoplasty as a single stage procedure and out come of this study showed post operative air bone gap average of 25.4db.

A prospective study conducted by Nicola quaranta, Stefania zizzi and Antonio quarnta, where they took 57 patients who had cholesteatoma who underwent second stage ossiculoplasty by using titanium prosthesis.

This above study showed results in PORP group average post operative gain as 13.6 dbhl & TORP group gain as 17.9 dbhl. The mean air bone gap after ossicular reconstruction was 24.1dbhl in PORP group & In TORP group 27.2dbhl. After ossiculoplasty the difference between the mean air bone gap was not significant in their study[14].

A prospective study of ossiculoplasty in CSOM using different types of prothesis conducted on 25 patients by Dr. Parthapratim laha, col B.k.Prasad. Among those 25 patients conchal cartilage, tragal cartilage, titanium prosthesis, hydroxy apatite, refashioned ossicles was tried in 5 patients each.

In that study they also found most common ossicle eroded in CSOM was incus. In prothesis used patients showed faster air bone gap closure than autologous material. Synthetic material saved the time also. In this study good results achieved with autologous material compared with prosthesis

Dr sushil jha et al conducted a prospective study on 76 patients who underwent ossiculoplasty where the Age group of selected cases were between 14 to 35 years. Air bone gap pre operatively and post operatively compared by using average of 3 frequency (0.5,1,2kHz).

Air bone gap compared pre and post operatively at 2 and 5 months. Materials used in this study to reconstruct the hearing mechanics were gold, titanium, cartilage and bone. With titanium prosthesis, very good results were obtained .

A prospective study of audiological analysis of ossiculoplasty in CSOM was conducted by Dr. Vasantro pawar. In this study pre and post operative mean air conduction was compared with different ossiculoplasty in selected 34 patients.

Results showed mean air conduction threshold which was reduced from 47.72+14.60 to 40.99+14.00.so hearing improvement was 6.87+5.78 and the mean air bone gap was decereased from 26.83+10.82 to 20.11+10.66.

Another study on ossiculoplasty: analytical, descriptive, prospective study in 80 Patients was conducted by shrinivas shripatro Chavan , Prateek v.

In that study pre operatively mean air conduction was 47.89db, bone conduction was 13.35 db and mean air bone gap was 47.89 db, success rate defined in this study as an ABG less then 25db on post operative day 90. 64 patients had an ABG less then 25db out of 80 cases so over all success rate was 80% in this study. In young et al study the significant factor for outcome of ossiculoplasty was explained as malleus handle.

Dornhoffer et al study also showed results similar with young et al. malleus handle was an important prognostic factor for outcome of ossiculoplasty .Stapes supra structure contribution was very less and hearing out come was very poor when malleus was absent & stapes present[15].

Brackamann et al and golden berg study showed contrast results against dornhoffer et al and young et al study. They said malleus handle role was insignificant in outcome of ossiculoplasty

Jackson et al done a study on outcome of ossiculoplasty in 141 cases showed better results with Teflon PORP and TORP

STUDY DESIGN:

Prospective cohort clinical study conducted on 50 Patients who underwent surgery in ENT department at govt Rajaji hospital, Madurai. Study period is 2 years.

INCLUSION CRITERIA

- All cases of Chronic suppurative otitis media (safe and unsafe) requiring surgery and with an air bone gap of 40 dB or more (in pure tone audiometry) at the time of presentation
- All cases with ossicular damage as diagnosed
  by HRCT Temporal bone and otomicroscopy
- 16 to 50 years of age

EXCLUSION CRITERIA

- Sensory neural hearing loss
- Revision cases
- Stapes fixation
- Congenital atresia
- Uncontrolled metabolic conditions like diabetes mellitus, hypertension etc,
- Chronic suppurative otitis media with active intra and extra cranial complication

METHODS AND MATERIALS

Patient presented with symptoms and signs of CSOM who satisfys the inclusion and exclusion criteria are being selected as a study population. The study is conducted on 50 patients who under went surgeries for CSOM in **ENT DEPARTMENT, GOVERNMENT RAJAJI HOSPITAL, MADURAI**

All patients with CSOM were examined in detail which includes detailed clinical history, ENT examination, Otoscopic examination, Otomicroscopic examination, Tuning fork test.

Patients who came with Chronic suppurative otitis media, where first tested with pure tone audiogram to know whether the hearing loss is pure conductive or sensory or mixed. Patients with CSOM with pure conductive hearing loss are taken as the study population. Then we did otoscopic examination to know the csom is safe or unsafe type and tried to know about ossicular status if there was presence of large, subtotal and total central perforation. HRCT temporal bone done to know about the extension of the disease, position of sigmoid sinus, tegmen plate, facial nerve course and ossicular status. The surgical procedure was completely explained and consent was obtained from patient before taking into surgery. All case were operated under local/ general anaesthesia depending upon the patients age and general condition .

Preoperative evaluation

Pre operatively we did routine basic investigation(HB%,TC, DC, ESR, PLATELET COUNT, ECG, CHEST XRAY, BLOOD GROUPING AND TYPING, VIRAL MARKERS, BLEEDING TIME AND CLOTTING TIME) and fitness was obtained from anesthetist, after which we posted the patients for surgery**.** Before posting for surgery we gave adequate antibiotic coverage.

SURGICAL PROCEDURE

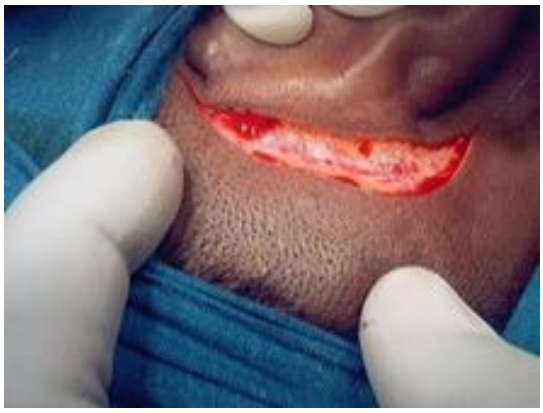
Under Strict aseptic precaution, patient in semi fowlers position, using microscope with lens , all cases were infiltrated locally (2% lignocaine + bupivacaine + adrenaline). Then modified Williams wilde`s incision was made, temporalis facia graft harvested. Periosteum elevated and cortex exposed. In CSOM safe type we did canal wall up procedure, In CSOM unsafe type we did canal wall down procedure. Depending upon the intra operative ossicular status we have planned for ossiculoplasty.

Among the 50 patients, remodeled incus were used in 13 patients with CSOM mucosal type when remnant incus is available to reconstruct ossicular chain. In 9 patients we used tragal cartilage.

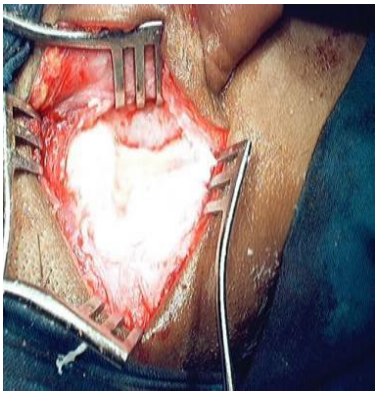
Patient with cholesteatoma or postero superior retraction pocket we used synthetic material PORP or TORP made up of Teflon (cost effective). PORP were used when malleus was present and stapes supra structure was present

,TORP were used when malleus was present, stapes supra structure was absent. Cartilage was placed between the PORP/TORP and Tympanic membrane to stabilize PORP/TORP. Temporalis facia was used toreconstruct the tympanic membrane by using underlay technique. Then medicated ear wick kept in the EAC.

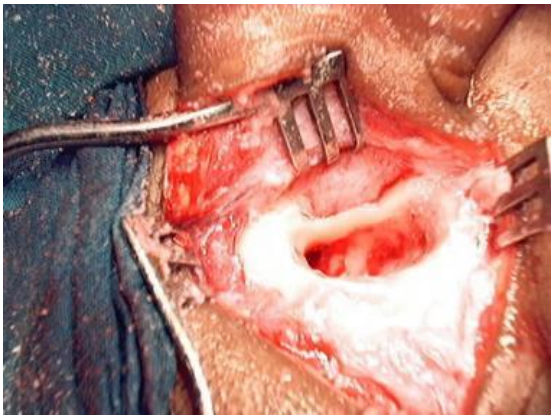
Among the 50 patients PORP were used in 13 patients, TORP were used in 15 patients. Meatoplasty was performed finally in needed case and cartilage was excised along with meatoplasty.



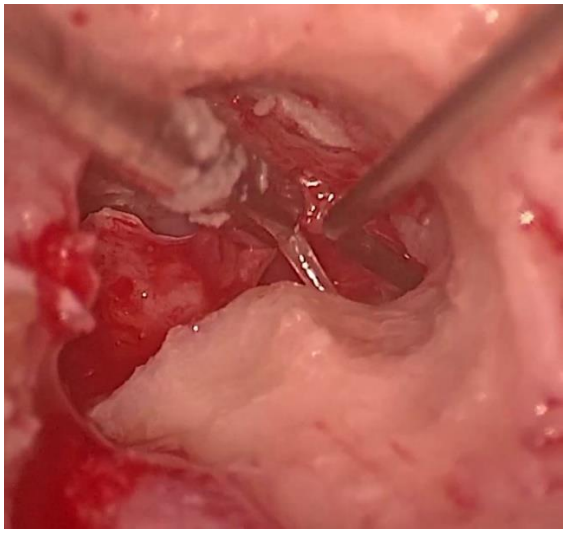
William wilde incision made



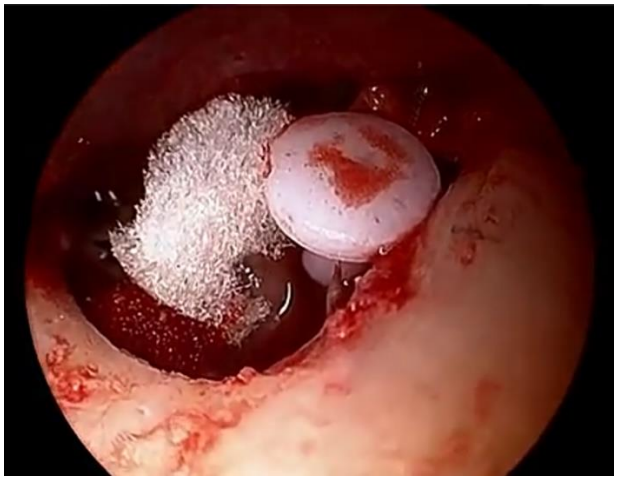
Cortex exposed



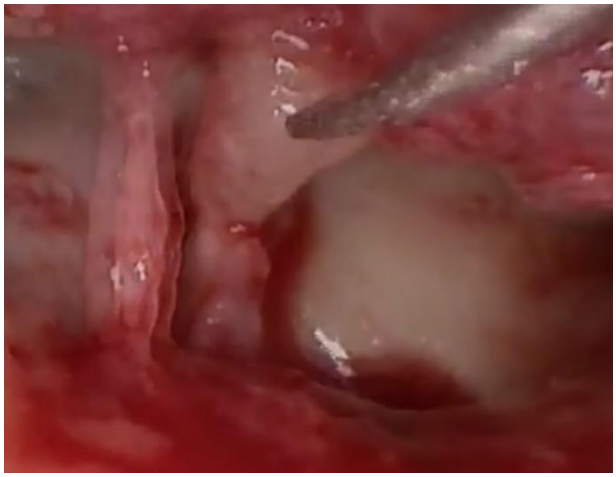
Cortical mastoidectomy done



Modified radical mastoidectomy done



Synthetic PORP/TORP placement



Remodeled incus placed as graft

PORP/ TORP madeup of Teflon

On discharge of selected cases, oral antibiotic was covered for 2 weeks and advised for regular follow up at 1st month, 6th month, 12th month after surgery. Pure tone average was calculated from mean threshold of 0.5,1,2,4kHz. From the air conduction PTA and bone conduction PTA air bone gap was calculated. PTA done 1 year after surgery was used to calculate the gain in air bone gap.

OBSERVATIONS AND RESULTS

Age distribution:

Totally 50 patients were taken for this study who is a case of CSOM with pure conductive hearing loss. The ages of the patients ranged from 16 to 50 years with mean age of 29.5 years. The minimum age in this study was 17 and the maximum age was 50. The following table shows the age distribution.

Age (in yrs)	
N	50
Mean ± SD	29.5 ± 9.0
Minimum, Maximum	17, 49

Table 4

Age In Groups

In this study ,age group less then 20 was 18% (n=9), 21 -30 was 40% (n=20), 31-40 was 40%(n=13), more then 40 was 16%(n=8)

Age Group (in yrs)	N (%)
≤20	9 (18.0)
21 – 30	20 (40.0)
31 – 40	13 (26.0)
>40	8 (16.0)
Total	50 (100.0)

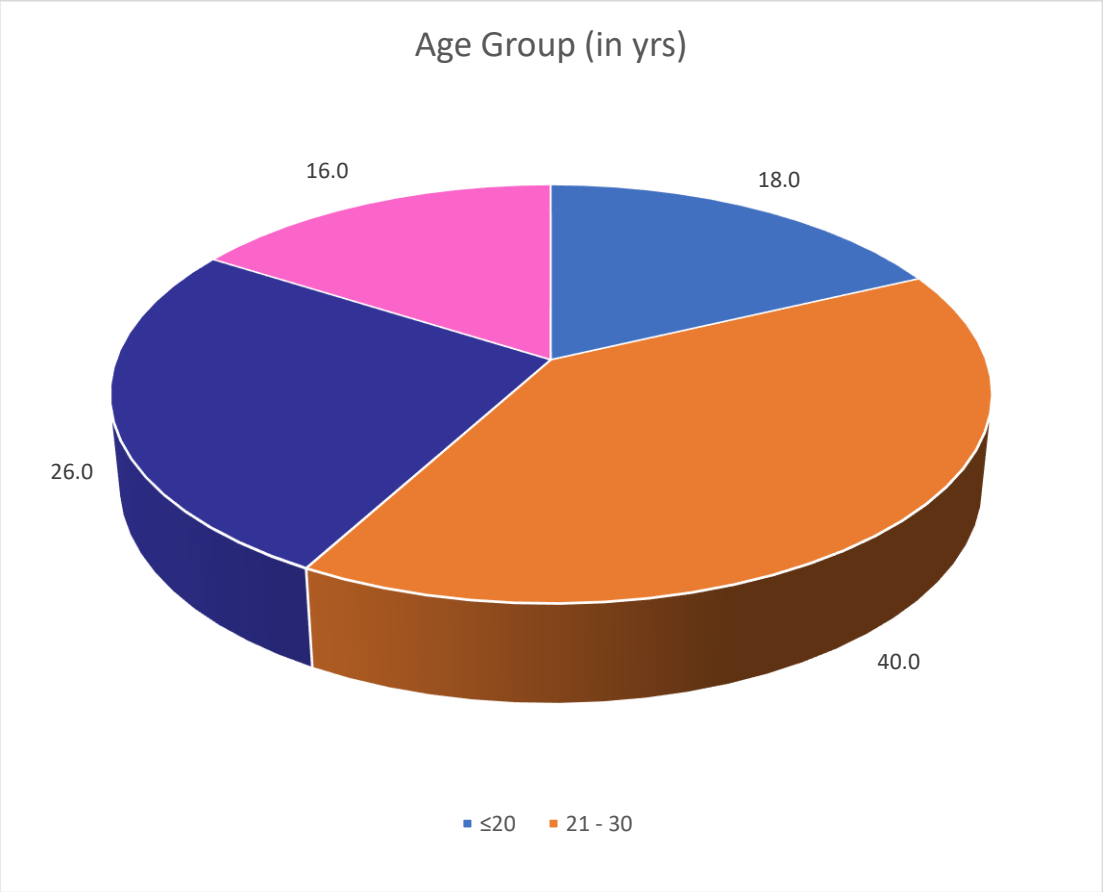


Figure 19 : Age group in distribution

GENDER DISTRIBUTION:

Gender distribution in this study is showed in the following table and figure. Among 50 patients, 27 patients(54%) were males, 23 patients(44%) were females.

Gender	N (%)
Male	27 (54.0)
Female	23 (46.0)
Total	50 (100.0)

Table 5

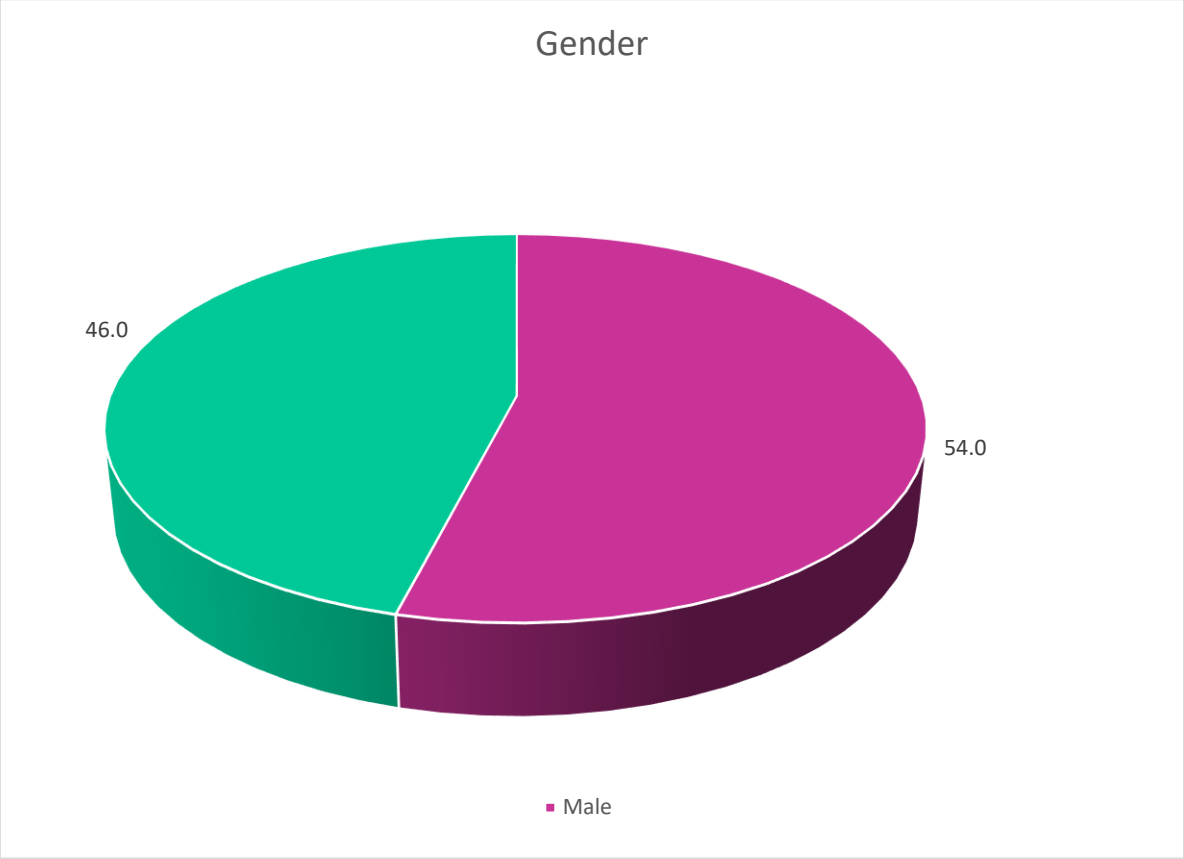


Figure 20 : Gender difference

Most common ossicle eroded was incus in our study. Among the 50 patients almost all the patients were having eroded incus (100%). Our study also showed Second most common ossicle as stapes (30%), malleus as the least eroded one (6%) .

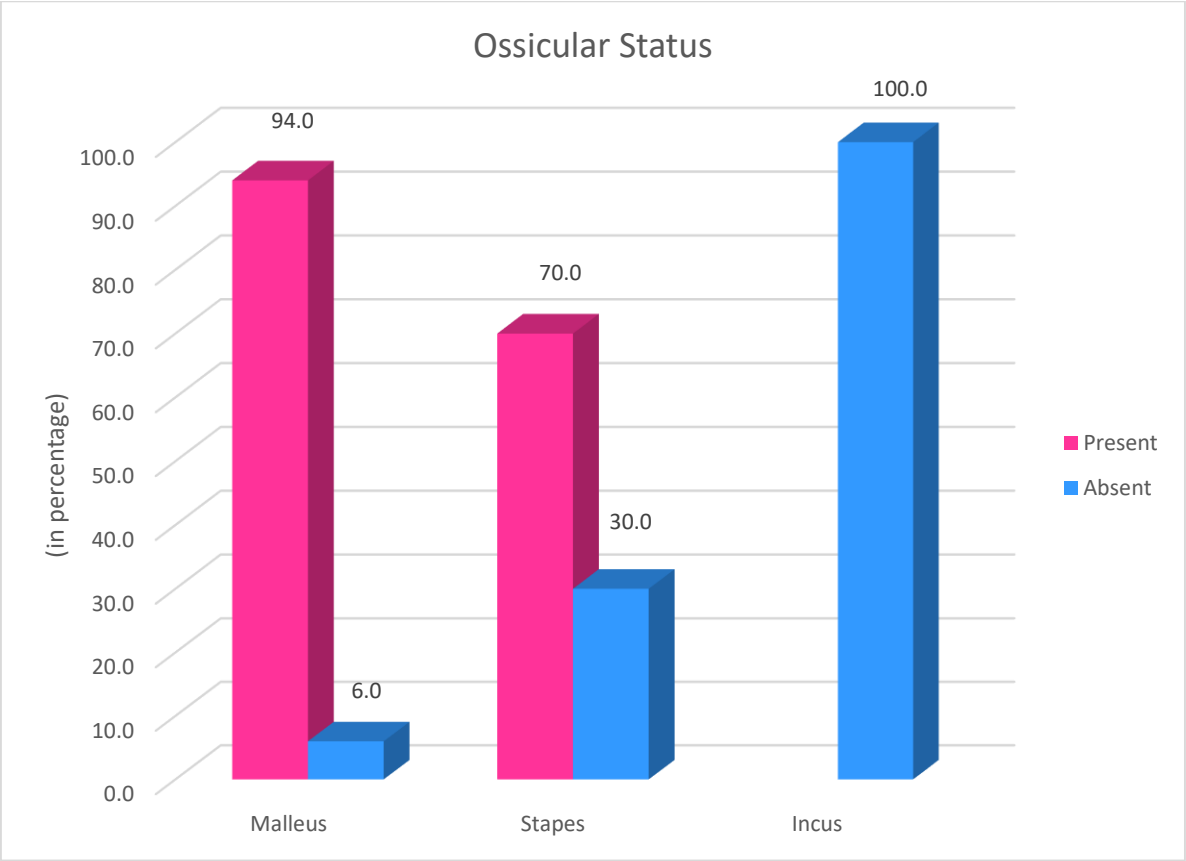


Figure 21 : Ossicular status

This analytical study was made in 50 cases which inferred with 13 cases who underwent placement of remodelled incus .among them preop mean ABG found to be 38.3db and post op mean ABG found to be with 26.6 db ABG. Air bone gain is 11.7db This analysis explained in forthcoming tables and chart

	Modified Ossicle (N=13)		
	Preop	**Postop**	**p-value**
	Median (IQR)	Median (IQR)	
AC-PTA (db)	45.0 (42.4, 47.4)	33.3 (30.0, 39.1)	0.001
BC-PTA (db)	8.3 (5.8, 11.6)	10.0 (5.8, 10.8)	0.890
ABG (db)	38.3 (31.6, 40.0)	26.6 (20.8, 30.0)	0.001

Table 6

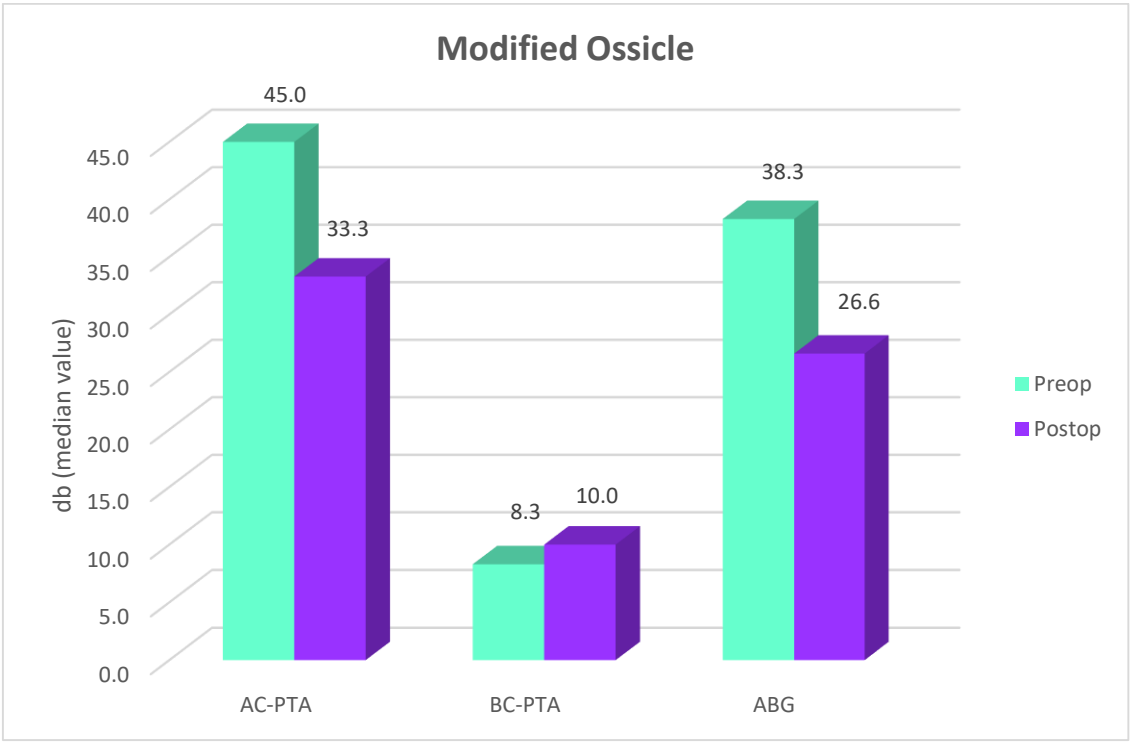


Figure 22: ABG gain of modified ossicles

This study also showed results of 9 cases managed with tragal cartilage Placement among 50 selected cases with preop mean ABG value of 36.7db and post op mean ABG value of 26.6db with gain in ABG value of 10.1db . This study depicted in tables and chart below.

	Cartilage (N=9)		
	Preop	**Postop**	**p-value**
	Median (IQR)	Median (IQR)	
AC-PTA (db)	45.0 (42.4, 46.6)	36.6 (29.1, 36.6)	0.008
BC-PTA (db)	8.3 (5.8, 11.6)	6.6 (5.8, 10.0)	0.109
ABG (db)	36.7 (34.2, 38.3)	26.6 (22.5, 30.0)	0.008

Table 7

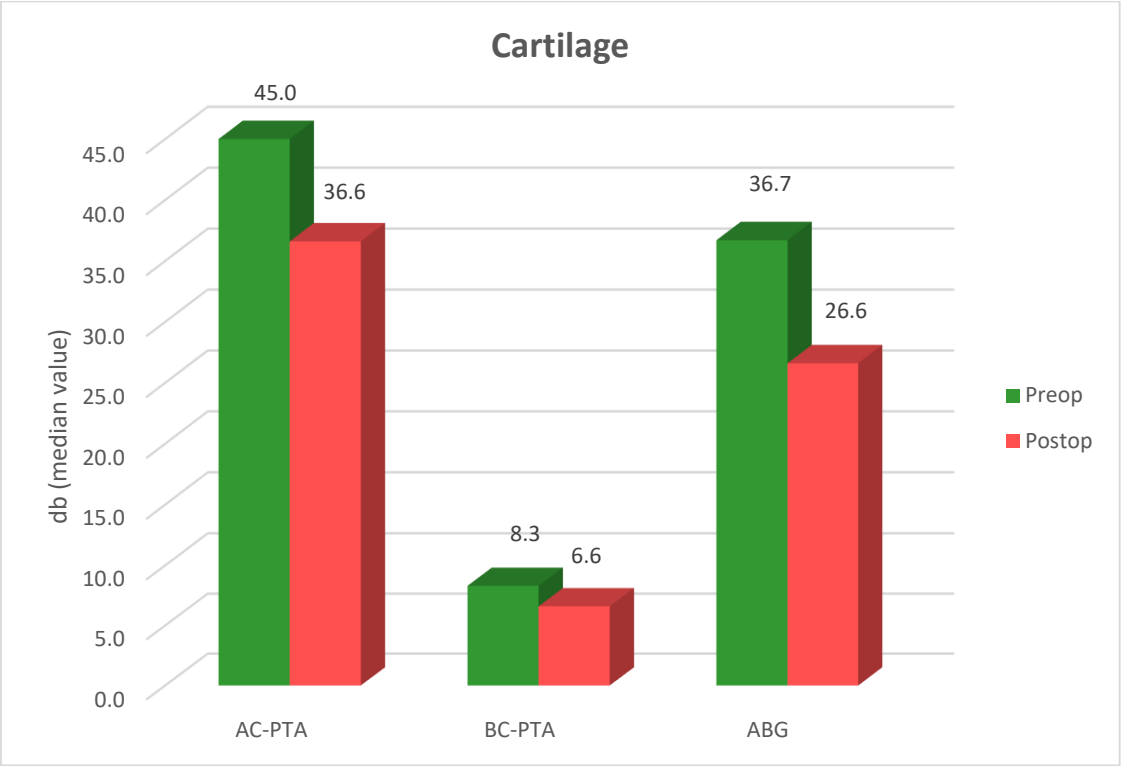


FIGURE 23 : ABG OF CARTILAGES

Also on analysis of this study with 50 selected cases 13 cases was selected for management with PORP which inferred with preop mean ABG with 40db and post op mean ABG with 25db and Gain in ABG was 15db.this analysis explained in upcoming tables and chart.

	PORP (N=13)	
	Preop	**Postop**
	Median (IQR)	Median (IQR)
ABG (db)	40.0 (36.7, 40.8)	25.0 (22.5, 33.3)
P – value	0.001	

Table 8

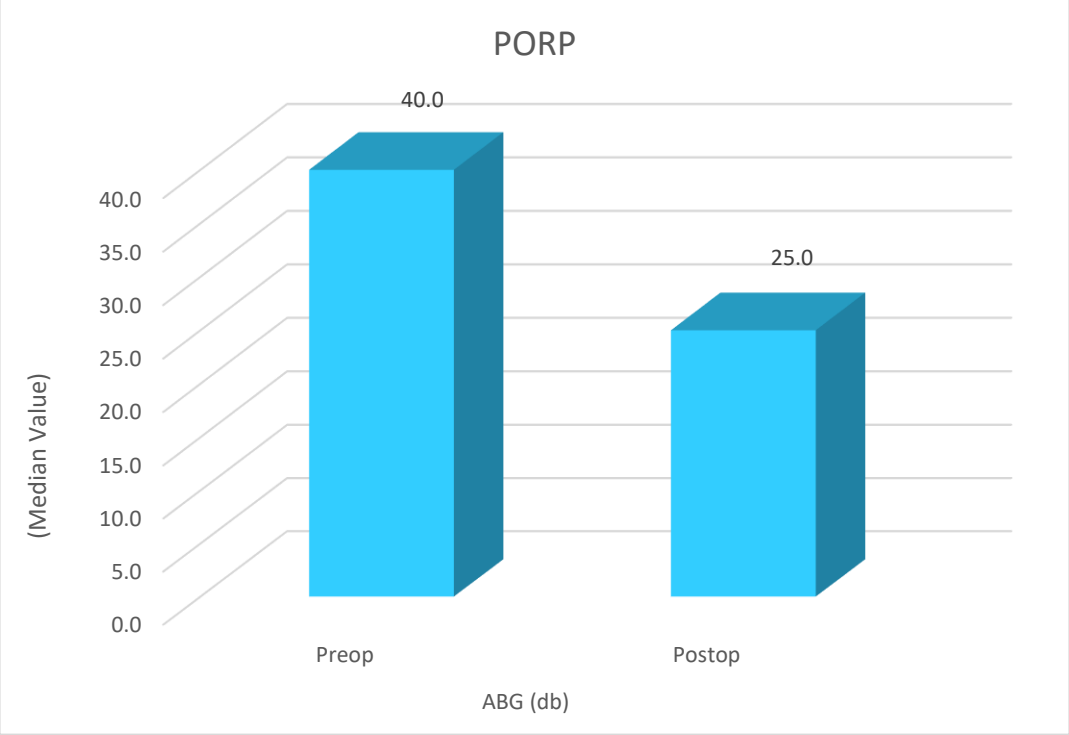


FIGURE 24: PRE AND POST OPERATIVE ABG OF PORP

Among 50 selected cases 15 cases managed with TORP with inference showing preop mean ABG of 40db and postop mean ABG of 26.7db and finally Gain in ABG was13.3db. which is depicted in upcoming chart and table.

	TORP (N=15)	
	Preop	**Postop**
	Median (IQR)	Median (IQR)
ABG (db)	40.0 (36.7, 41.7)	26.7 (23.3, 33.3)
P – value	0.001	

Table 9

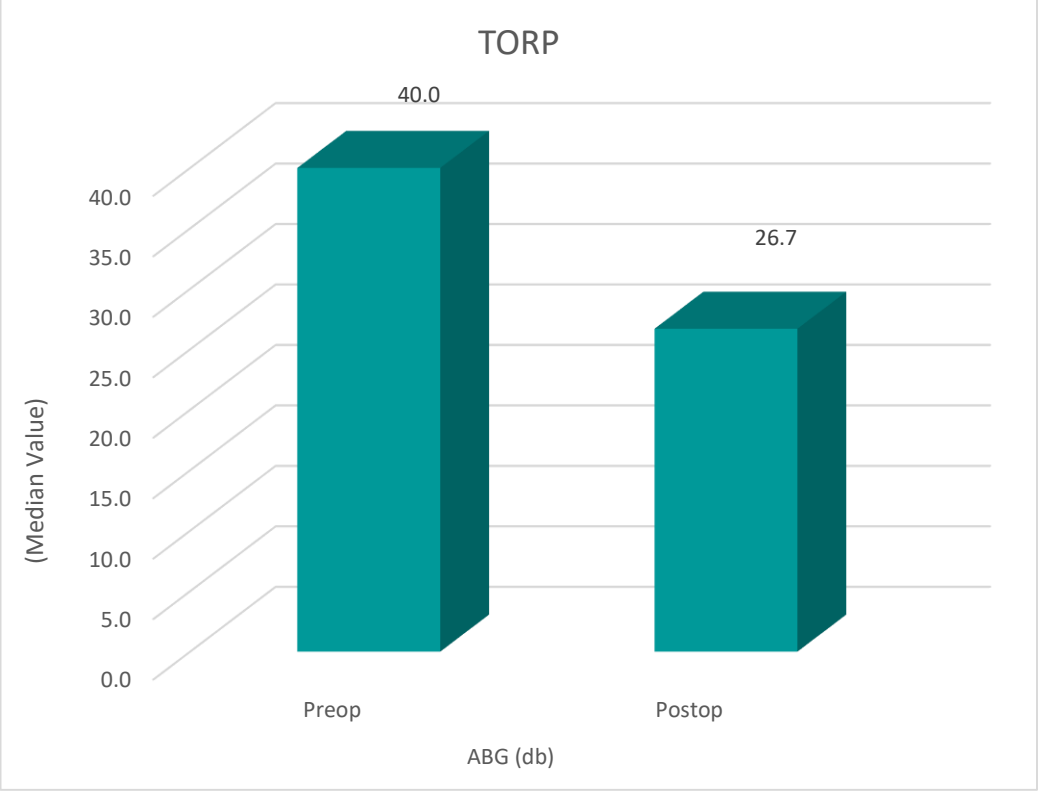


FIGURE 25: PRE AND POST OPERATIVE ABG OF TORP

On analysis of this study further proved with significant difference between pre and postoperative ABG in air conduction PTA but not in bone conduction PTA is depicted in upcoming table and chart.

	Preop	**Postop**	**p-value**
	Median (IQR)	**Median (IQR)**	
AC-PTA (db)	47.4 (45.0, 50.0)	36.6 (30.0, 40.0)	<0.001
BC-PTA (db)	10.0 (6.6, 11.6)	10.0 (6.6, 10.4)	0.126
ABG (db)	38.4 (36.6, 40.0)	26.6 (23.3, 31.6)	<0.001

Table 10

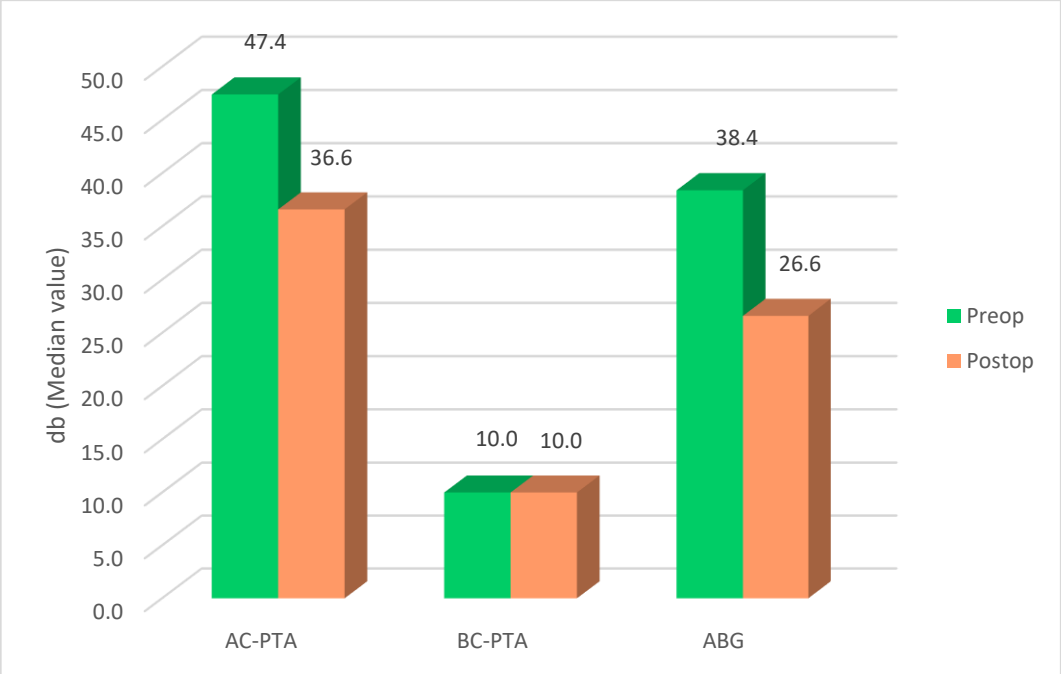


FIGURE 26: PRE AND POST OPERATIVE ABG GAIN

DISCUSSION

Among the special 5 senses in human being hearing plays a major role. If this hearing is impaired its considered as one of major disability .Although Hearing disability causes are multiple, the most common cause of hearing disability is by chronic suppurative otitis media. Even in CSOM patients the hearing disability is majorly due to ossicular disruption .This mandates surgical correction which was earlier studied and practised in two sittings with first sitting done for disease clearance and later 2 nd surgery made for reconstruction for hearing. Thus taking this point on consideration my study majorly for correction of hearing that too made in single surgical sitting with both disease clearance and reconstructive hearing mechanics which further reduces the patients stress and thus helps in maintaining the compliance and improving the quality of life and in large scale consideration decreasing the burden of disability in society.

This study also concentrates on usage of autologous grafts or else synthetic material made of Teflon which is both cost effective and further statsifying results in patients thus increasing the compliance of patients and further reduction in disability in toto .

The material which was used in my study is Polytetrafluoroethylene which is known commonly as Teflon. This material is basically biologically inert substance which is non biodegradable, non toxic and also hydrophobic

making this material as a most suitable implantable material where rejection is very rare and allergy to this substance is rarest of rare .And so Teflon used in various ENT surgeries which is thus made as important material in my study of ossicular reconstruction in middle ear surgery[16] .

In our present study functional outcome of the patients of CSOM whether safe or unsafe was evavluated who underwent canal wall up or canal wall down mastoidectomy procedure with ossiculoplasty .As a end result of this procedure acceptable hearing results are tried to make out. On analysis of this study proved significant difference between pre and postoperative ABG with value 36.7db & 21.7 respectively .

A study was conducted by E DE Corso's and B serge on role of ossiculoplasty in canal wall down tympanoplasty for middle ear cholesteatoma ;hearing results showed significant improvement of ABG of preop and post op value 28.83 db to 13.94 db respectively .And also their surgery showed result of ABG between 0-10db improved from 2.42% to 32.53% and 11-20 db improved from 16.86% to 37.34% thus 2/3rd of patient showed improvement in ABG in PTA with <20db.

In our study, materials used with autologous cartilage and synthetic Teflon (PORP, TORP)showed significant results with Gain in ABG post op compared to preop .

A study on ossiculoplasty in chronic otitis media using different types of prostheses by prathapratinam showed his result as faster Air bone gap closure in patients treated with prostheses compared to autologous graft placement in improving hearing mechanics.

In our study 50 selected patients 13 cases who underwent placement of remodelled incus showed preop mean ABG 38.3db and post op mean ABG 26.6 db and Air bone gain is 11.7db. And 9 cases managed with tragal cartilage placement among 50 selected cases with preop mean ABG value of 36.7db and post op mean ABG value of 26.6db with gain in ABG value of 10.1db .

With 50 selected cases 13 cases was selected for management with PORP which inferred with preop mean ABG with 40db and post op mean ABG with 25db and Gain in ABG was 15db. And 15 cases managed with TORP with inference showing preop mean ABG of 40db and postop mean ABG of 26.7db and finally Gain in ABG was13.3db.

A study conducted on post operative and functional outcome of hearing of PORP &TORP by Mohammed siddiq ,Meenaxi Mehta Rosmi romid with total selected cases of 32 and intervening in that 24 cases with PORP and 8 with TORP .among that 24 cases treated with PORP showed improvement in preop PTA average from 44.17db to 32.54db in post operative. And in 8 cases treated with TORP showed increase in PTA average 64.0db to 42.27db in preop and postop respectively.

On analysis ossiculoplasty success rate is majorly constituted by case selections and technical skills of surgeon .And the analysis also proved the major factor for prognosis of cases with ossiculoplasty is viable healthy ossicles that is not affected by disease.

This study also showed equal results on both cases treated with autologous ossiculoplasty and usage of synthetic materials like Teflon (PORP & TORP). Teflon treated patients in our study showed acceptable hearing improvement and the study is further about to be followed up for long term results.

CONCLUSION

This study was conducted mainly to analyse the outcome of ossiculoplasty in chronic suppurative otitis media with ossicular erosion. Final analysis of this study showed significant p value on comparing preoperative and post operative ABG in which there is a gain post operative ABG. Our study was based on usage of different materials such as autologous grafts (tragal cartilage and remodelled ossicles), synthetic materials (teflon - PORP & TORP) which doesn't show variation in results significantly. Both results were successful and equal.

In our study, we used different materials for ossiculoplasty which showed near equal results at present. To conclude, there is a gain in ABG for both autologous and synthetic materials post operatively. To make this analytical study still definitive, further long term follow up of cases is necessary to analysis longevity, effectiveness of persistence of gained hearing, disease recurrence and resurgence. Since our study has not included aetiology chronic suppurative otitis media i.e. Eustachian tube dysfunction.

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PROFORMA

Name : Age/ Sex IP No.

Address: DOE:

Occupation:

Complaints:

H/o Present illness

Details of complaints

Mode of onset

Time of onset

Duration

Course

Unilateral / bilateral

Aggravating / Relieving factors

H/o ear discharge – (foul smelling +/-, blood stained +/-)

H/o hard of hearing

H/o ear pain

H/o blocking sensation in ear

H/o ringing sensation in ear

H/o headache

H/o trauma to ear

H/o previous ear surgery

H/o Recurrent upper respiratory tract infection/sneezing / allergy / Irritation and watering of eyes

H/o fever

H/o Nasal discharge/post nasal drip

PAST HISTORY

H/o similar complaints before

H/o previous surgery

H/o Noise trauma

H/o previous trauma

H/o Bleeding diathesis

H/o Drug allergy

Treatment History

Duration of treatment

Medical / Surgical

Medical Topical Oral

Improvement if any

Personal History

Diabetes / Hypertension / Pulmonary TB / Seizure / Bronchial asthma

Sinusitis / Allergic rhinitis

Smoking / Alcoholic

Psychiatric disturbance

Family History

H/o similar complaints in family

General Examinations:

Patients Conscious,

Oriented,

Febrile,

Anaemia +/-

Icterus +/-,

Generalized lymphadenopathy +/-,

Generalized edema +/-,

Clubbing +/- ,

Cyanosis+/-

RS - NVBS, no added sounds

CVS – S1 S2, no murmur

P/A – soft, no organomegaly

CNS – NFND

LOCAL EXAMINATION OF EAR

EAR	**RIGHT**	**LEFT**
PINNA		
PREAURICULAR REGION		
POSTAURICULAR REGION		
EXTERNAL ACOUSTIC MEATUS		
TYMPANIC MEMBRANE PERFORATION SIZE SITE MARGIN		
MIDDLE EAR MUCOSA		
TUNING FORK TEST RINNE WEBER ABC		
TRAGAL SIGN		
MASTOID TENDERNESS		
FACIAL NERVE FUNCTION		
NYSTAGMUS		

NOSE	RIGHT	LEFT
EXTERNAL NOSE		
NASAL VESTIBULE		
NASAL CAVITY		
NASAL SEPTUM		
NASAL MUCOSA		
INFERIOR TURBINATE		
MIDDLE TURBINATE		

EXAMINATION OF ORAL CAVITY:

EXAMINATION OF THROAT:

EXAMINATION OF NECK

DIAGNOSTIC NASAL ENDOSCOPY PROFORMA

Govt. Rajaji Hospital, Madurai

Department of ENT

Name: Age / Sex :

IP/OPNo. Date :

Indications :

Headache :

Nasal block :

Nasal discharge :

Epistaxis :

Anosmia :

Sneezing :

Scope(s) used : 0° / 30° / 45°

I – Pass Nasal mucosa Inferior turbinate Inferior Meatus ET – orifice Nasopharynx Fossa of Rossenmuller		
II – Pass Nasal mucosa Superior Turbinate / Meatus Supreme Turbinate / Meatus Spheno ethmoidal Recess Sphenoid ostia		
III – Pass Nasal Mucosa Middle Turbinate Middle Meatus Uncinate Bulla Hiatus Accessory Ostia		
Nasal septum & Mucosa		

Conclusion :

Advice :

PROVISIONAL DIAGNOSIS

ABBREVIATION

CSOM	-	Chronic Suppurative Otitis Media
PORP	-	Partial Ossicular Replacement Prosthesis
TORP	-	Total Ossicular Replacement Prosthesis
EAC	-	External Auditory Canal
TM	-	Tympanic Membrane
AOM	-	Acute Otitis Media
ET	-	Eustachian Tube
HIF	-	Hypoxia Inducible Factor
VHL	-	Von Hippel landau Protein
MMP	-	Matrix Metalloproteinase
ABG	-	Air Bone Gap
PTA	-	Pure Tone Audiogram
AC-PTA	-	Air Conduction Pure Tone Audiogram
BC-PTA	-	Bone Conduction Pure Tone Audiogram

ஆராய்ச்சி தகவல் அறிக்கை

மதுரை அரசு இராசாசி மருத்துவமனையில் வரும் நோயாளிக்கு ஒரு ஆராய்ச்சி இங்கு நடை பெற்று வருகிறது. நீங்களும் இந்த ஆராய்ச்சியில் பங்கேற்க விரும்பிகிறோம் .

உங்களை சில சிறப்பு பரிசோதனைக்கு உட்படுத்தி அதன் தகவல்களை ஆராய்வோம். அதனால் தங்களது நோயின் ஆய்வரிகையோ அல்லது சிகிச்சையோ பாதிப்பு ஏற்படாது என்பதைதெரிவித்து கொள்கிறேன் .

முடிவுகளை வெளியிடும் போது அல்லது ஆராய்ச்சியின் போதோ தங்களது பெயரோ அல்லது அடையாளங்களோ வெளியிடமாட்டோம் என்பதை தெரிவித்துகொள்கிறோம்.

இந்த ஆராய்ச்சியில் பங்கேற்பது தங்களுடைய விருப்பத்தின் பேரில் தான் நடக்கும். மேலும் நீங்கள் எந்நேரமும் இந்த ஆராய்ச்சியில் இருந்து பின் வாங்கலாம் என்பதையும் தெரிவித்து கொள்கிறோம்.

இந்த சிறப்பு பரிசோதனை முடிவுகளை ஆராய்ச்சியின் போது அல்லது ஆராய்ச்சியின் முடிவின் போது தங்களுக்கு அறிவிப்போம் என்பதையும் தெரிவித்துகொள்கிறோம்.

பங்கேற்பாளர் கையொப்பம்

MASTER CHART

S.NO	AGE/SEX	DIAGNOSIS	PRE OPERATIVE (DB(SD)			OSSICULAR STATUS	TYPE OF OSSICULOPLASTY DONE	POST OPERATIVE PTA(1 YEAR) (DB(SD)		
			AC PTA	BCPTA	ABG	INTRA OPERATIVE		ACPTA	BCPTA	ABG
1	35/M	L COM WITH LARGE CP	43.3	8.3	35	M+ I- S+	PORP	30	8.3	21.7
2	24/F	RIGHT COM WITH LARGE CP	41.6	11.6	30	M+ I- S+	MODIFIED OSSICLE (INCUS)	30	11.6	18.4
3	46/M	LEFT COM WITH PSRP	48.3	6.6	41.7	M+ I- S-	TORP	38.3	6.6	31.7
4	18/F	RIGHT COM ATTICO ANTRAL	50	10	40	M+ I- S-	TORP	41.6	8.3	33.3
5	26/F	RIGHT COM WITH LARGE CP	45	11.6	33.4	M+ I- S+	TRAGAL CARTILAGE	36.6	10	26.6
6	49/M	LEFT ATTIC CHOLESTEATOMA	46.6	10	36.6	M+ I- S-	TORP	41.6	10	31.6
7	25/M	RIGHT COM WITH PSRP	51.6	11.6	40	M+ I- S+	PORP	45	11.6	33.4
8	41/F	RIGHT COM WITH SUB TOTAL CP	48.3	10	38.3	M+ I- S+	MODIFIED OSSICLE (INCUS)	38.3	10	28.3
9	39/M	LEFT ATTIC CHOLESTEATOMA	50	11.6	38.4	M+ I- S+	PORP	48.3	15	33.3
10	19/M	RIGHT PSRP/CHOLESTEATOMA	53.3	11.6	41.7	M- I- S-	TORP	31.6	6.6	25
11	26/f	RIGHT COM WITH LARGE CP	46.6	13.3	33.3	M+ I- S+	MODIFIED OSSICLE (INCUS)	28.3	11.6	16.7
12	18/M	LEFT COM WITH PSRP	48.3	11.6	36.7	M+ I- S-	TORP	33.3	11.6	21.7
13	37/M	LEFT ATTIC CHOLESTEATOMA	43.3	10	33.3	M+ I- S+	PORP	33.3	10	23.3
14	40/M	RIGHT PSRP WITH CHOLESTEATOMA	55	10	45	M+ I- S-	TORP	43.3	10	23.3
15	32/F	LEFT COM WITH SMALL CP	41.6	3.3	38.3	M+ I- S+	CARTILAGE	36.6	3.3	33.3
16	30/M	LEFT ATTIC CHOLESTEATOMA	48.3	5	43.3	M+ I- S+	PORP	30	5	25
17	21/M	RIGHT ATTIC CHOLESTEATOMA	45	6.6	38.4	M+ I- S+	PORP	40	6.6	33.4
18	19/F	RIGHT COM WITH LARGE CP	46.6	6.6	40	M+ I- S+	MODIFIED OSSICLE (INCUS)	38.3	6.6	31.7
19	34/M	LEFT COM WITH PSRP	51.6	11.6	40	M+ I- S+	PORP	40	11.6	28.4
20	22/M	LEFT ATTIC CHOLESTEATOMA	48.3	6.6	41.7	M+ I- S+	PORP	30	6.6	23.4
21	35/F	RIGHT ATTIC CHOLESTEATOMA	53.3	11.6	41.7	M+ I- S-	TORP	48.3	10	38.3
22	46/M	RIGHT ATTIC CHOLESTEATOMA	48.3	8.3	40	M+ I- S+	PORP	50	11.6	38.4
23	24/F	RIGHT COM WITH SUBTOTAL CP	45	11.6	33.4	M+ I- S+	CARTILAGE	30	8.3	21.7
24	40/F	LEFT ATTIC CHOLESTEATOMA	48.3	11.6	36.7	M+ I- S-	TORP	33.3	10	23.3

25	19/M	RIGHT COM WITH PSRP	41.6	3.3	38.3	M+ I- S+	MODIFIED OSSICLE (INCUS)	30	3.3	26.7
26	25/M	RIGHT ATTIC CHOLESTEATOMA	50	13.3	36.7	M+ I- S-	TORP	33.3	11.6	21.7
27	29/F	LEFT PSRP /CHOLESTEATOMA	51.6	10	41.6	M- I- S-	TORP	41.6	10	31.6
28	23/M	LEFT ATTIC CHOLESTEATOMA	41.6	15	26.6	M+ I- S+	PORP	36.6	15	21.6
29	33/F	RIGHTV ATTIC CHOLESTEATOM	46.6	6.6	40	M+ I- S+	PORP	28.3	6.6	21.7
30	17/F	RIGHT COM WITH LARGE CP	45	8.3	36.7	M+ I- S+	MODIFIED OSSICLE (INCUS)	40	10	30
31	26/M	RIGHT ADHESIVE OTITIS MEDIA	48.3	11.6	36.7	M+ I- S+	CARTILAGE	36.6	11.6	25
32	21/F	LEFT COM WITH SUBTOTAL CP	45	15	30	M+ I- S+	MODIFIED OSSICLE (INCUS)	33.3	15	18
33	19/M	RIGHT PSRP WITH CHOLESTEATOMA	53.3	8.3	45	M- I- S-	TORP	40	6.6	33.4
34	27/M	LEFT ADHESIVE OTITIS MEDIA	46.6	8.3	38.3	M+ I- S+	CARTILAGE	28.3	6.6	21.7
35	20/F	LEFT COM WITH LARGE CP	41.6	11.6	30	M+ I- S+	MODIFIED OSSICLE (INCUS)	36.6	10	26.6
36	42/F	RIGHT ATELECTACTIC EAR	50	10	40	M+ I- S-	TORP	43.3	10	33.3
37	22/M	RIGHT COM WITH LARGE CP	46.6	10	36.6	M+ I- S+	CARTILAGE	40	10	30
38	41/M	RIGHT ATTIC CHOLESTEATOMA	48.3	6.6	41.7	M+ I- S+	PORP	36.6	6.6	30
39	28/M	LEFT PSRP /CHOLESTEATOMA	48.3	11.6	36.7	M+ I- S-	TORP	33.3	10	23.3
40	21/M	RIGHT COM WITH LARGE CP	46.6	6.6	40	M+ I- S+	MODIFIED OSSICLE (INCUS)	30	6.6	23.4
41	33/F	RIGHT COMWITH LARGE CP	48.3	11.6	36.7	M+ I- S+	MODIFIED OSSICLE (INCUS)	40	10	30
42	44/F	RIGHT ADHESIVE OTITIS MEDIA	43.3	6.6	36.7	M+ I- S+	CARTILAGE	33.3	6.6	26.7
43	34/M	LEFT COM WITH LARGE CP	45	5	40	M+ I- S+	MODIFIED OSSICLE (INCUS)	28.3	5	23.3
44	24/F	RIGHT COM WITH CP	41.6	6.6	35	M+ I- S+	CARTILAGE	36.6	6.6	30
45	33/F	LEFT COM WITH SUBTOTAL CP	48.3	6.6	41.7	M+ I- S+	MODIFIED OSSICLE (INCUS)	40	6.6	33.4
46	19/M	LEFT ADHESIVE OTITIS MEDIA	53.3	13.3	40	M+ I- S-	TORP	38.3	11.6	26.7
47	23/F	LEFT PSRP /CHOLESTEATOMA	46.6	6.6	40	M+ I- S+	PORP	30	6.6	23.4
48	25/F	RIGHT COM WITH LARGE CP	45	5	40	M+ I- S+	CARTILAGE	28.3	5	23.3
49	37/M	RIGHT PSRP WITH CHOLESTEATOMA	51.6	11.6	40	M+ I- S-	TORP	31.6	10	21.6
50	43/M	LEFT COM WITH LARGE CP	43.3	3.3	40	M+ I-S+	MODIFIED OSSICLE (INCUS)	31.6	5	26.6

MADURAI MEDICAL COLLEGE
MADURAI, TAMILNADU, INDIA -625 020
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DSc (Hons)
Professor Emeritus in Neurosciences,
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ETHICS COMMITTEE CERTIFICATE

Name of the Candidate	:	Dr.N.Murugan
Course	:	PG in MS., Otorhinolaryngology
Course of Study	:	2017-2020
College	:	MADURAI MEDICAL COLLEGE
Research Topic	:	A study on outcome ossiculoplasties in surgeries of Chronic Suppurative Otitis Media with ossicular erosion
Ethical Committee as on	:	11.02.2019

The Ethics Committee, Madurai Medical College has decided to inform that your Research proposal is accepted.

Member Secretary

Chairman
Prof Dr V Nagaraajan
M.D., MNAMS, D.M., Dsc.,(Neuro), Dsc (Hon)
CHAIRMAN
EC - Madurai Medical College
Madurai

Dean / Convenor
DEAN
Madurai Medical College
Madurai-20

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24 JUN 2019
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Urkund Analysis Result

Analysed Document:	MY_THESIS_-_Copy.docx (D57584310)
Submitted:	10/24/2019 1:06:00 PM
Submitted By:	murugansn87@gmail.com
Significance:	2 %

Sources included in the report:

FULL DISSERTATION.docx (D31433654)
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3546406/
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5807288/

Instances where selected sources appear:

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