

*A dissertation on*

**COMPARATIVE STUDY OF  
TYMPANOPLASTY IN DRY AND WET EARS**



Dissertation submitted to

**THE TAMIL NADU DR.M.G.R. MEDICAL UNIVERSITY**

In partial fulfillment of the regulations for the award of the degree of

**M.S. DEGREE BRANCH-IV OTORHINOLARYNGOLOGY**

**MAY 2018**



**COIMBATORE MEDICAL COLLEGE, COIMBATORE**

**THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY**

**CHENNAI**

## **DECLARATION**

I, **Dr. S. SUGANTHI** solemnly declare that the Dissertation entitled **“STUDY OF TYMPANOPLASTY IN DRY & WET EARS”** was done by me at Coimbatore Medical College & Hospital during the period from September 2016 to September 2017 under the guidance and supervision of **PROF.DR.A.R.ALI SULTHAN M.S.DLO.**, Professor and HOD, Department of ENT, Coimbatore Medical College, Coimbatore.

This dissertation is submitted to the Tamilnadu Dr.M.G.R.Medical University towards the partial fulfillment of the requirement for the award of M.S.Degree (Branch IV) in the Otorhinolaryngology. I have not submitted this dissertation on any previous occasion to any University for the award of any degree.

Place : Coimbatore

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## **CERTIFICATE**

This is to certify that this dissertation entitled “**COMPARATIVE STUDY OF TYMPANOPLASTY IN DRY AND WET EARS**” is a bonafide research work done by Dr. S.SUGANTHI, under my direct guidance and supervision during the academic year 2016-2018.

This has been submitted in partial fulfillment for the award of **M.S.DEGREE IN OTORHINOLARYNGOLOGY (Branch – IV)** by The **Tamilnadu Dr.M.G.R.Medical University, Chennai – 600 032**.

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Dissertation Topic : OUTCOME OF TYMPANOPLASTY IN DRY AND WET EARS.

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I would grossly fail in my duty, if I do not mention here of my Patients who formed the backbone of this study without which this would not have become reality.

My family and friends have stood by me, during my times of need.

I am ever grateful to the ALMIGHTY GOD for helping me in completing the study thriving through every obstacle.

**Dr.S.SUGANTHI**



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## LIST OF ABBREVIATION

AOM	Acute Otitis Media
COM	Chronic Otitis Media
TM	Tympanic Membrane
AB Gap	Air bone Gap
PTA	Pure tone audio gram
GPA	Group-A Dry Ear
GPB	Group-B Wet Ear
dB	Decibel
C/S	Culture & Sensivity
LSC	`Lateral Semi Circular Canal
EAC	External Auditory Canal
DNE	Diagnostic Nasal Endoscopy
GERD	Gastro Oesophageal reflux disease
CP	Central Perforation
URI	Upper Respiratory Tract Infection
ET	Eustachian tube

## **INTRODUCTION**

CHRONIC OTITIS MEDIA(COM) is defined as the chronic inflammation of the mucoperiosteal lining of the middle ear cleft. i.e. Eustachian tube, middle ear, aditus and mastoid air cells which presents with recurrent ear discharge through tympanic membrane perforation. It is the most common cause of hearing impairment in our country. Incidence of COM is higher in developing countries because of poor socioeconomic status and poor nutritional status. Usually most of the perforation heals spontaneously, but this spontaneous healing is affected by chronicity of infection and certain permanent changes in the margin of perforation leading to a non-healing permanent perforation. This leads to constant exposure of middle ear for re-infection and hearing disability. Standard treatment of COM is conservative management with aural toilet, topical and systemic antibiotics and dry ear precautions. If conservative management fails, then surgical intervention is done.i.e Cortical mastoidectomy with Tympanoplasty. ENT surgeons have the dilemma whether to operate or not, in discharging ears due to the belief that success rate is inferior in wet ears. Hence the present study is done to compare the outcomes of tympanoplasty in dry and wet ears in tubotympanic type of COM.

## **AIMS AND OBJECTIVES**

- To compare the success rate of graft uptake in dry and wet ears
- To compare the post operative hearing improvement in dry and wet ears

# **REVIEW OF LITERATURE**

## **EMBRYOLOGY AND ANATOMY**

### **EMBRYOLOGY OF TM :**

4<sup>th</sup> week of gestation

TM develops from 3 sources

### **DEVELOPMENT OF TYMPANIC MEMBRANE**

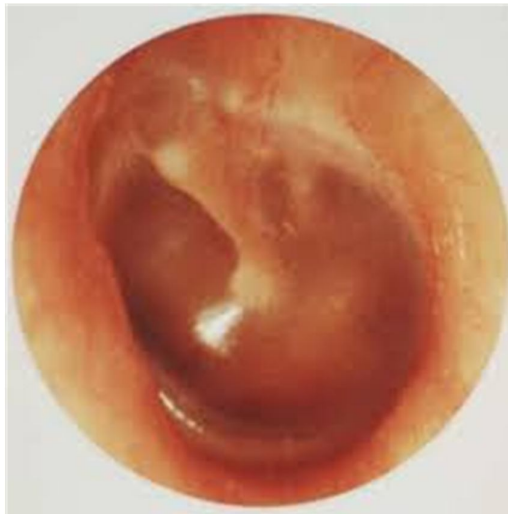
Trilaminar Structure :

Outer cuticular layer- ectoderm of 1st branchial cleft

Middle fibrous layer-mesoderm of 1<sup>st</sup> and 2<sup>nd</sup> branchial arches.

Inner mucous membrane-endoderm of 1st pharyngeal pouch  
(tubotympanic recess)

### **LEFT TYMPANIC MEMBRANE**



## **RIGHT TYMPANIC MEMBRANE**



### **ANATOMY OF TM**

- TM is oval in shape.
- 8x10mm size
- 55degrees to the floor of the meatus-angulation
- Near circumferential fibro cartilaginous thickening-Annular ligament or annulus
- 3 Layers-130 microns thick



- Outer epithelial- squamous
- Middle fibrous – superficial radial,deep circular
- Inner –mucosa
- Epithelial migratory pattern
- Centrifugal growth from the umbo outward

## TYMPANIC MEMBRANE

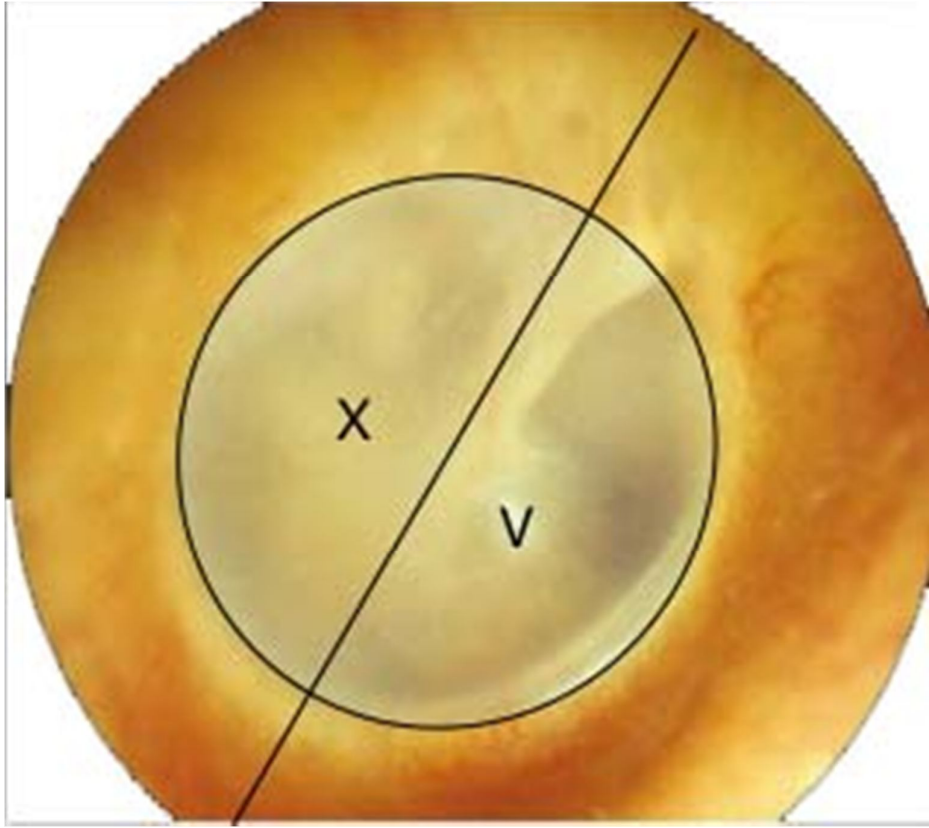
### Nerve Supply:

#### Lateral Surface:

- Auriculo Temporal Nerve(anterior half)
- Vagus (auricular branch) (posterior half)

#### Medical Surface;

- IX CN (tympanic branch) (Jacobson nerve)
- Chorda tympani



## EMBRYOLOGY OF MIDDLE EAR

Pharyngeal Pouch

Proximal Narrow part – Eustachian Tube

Distal Dilated part

- Tympanic cavity
- Antrum
- Attic
- Mastoid Air Cells

### OSSICLES

1st Arch Cartilage – 1. Head of Malleus

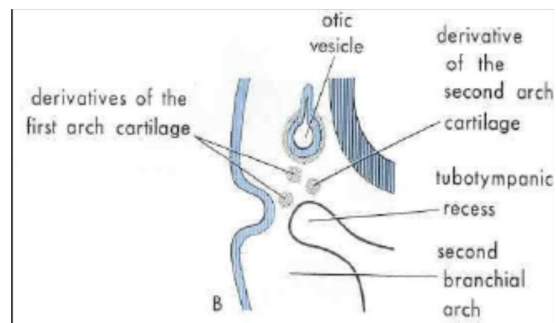
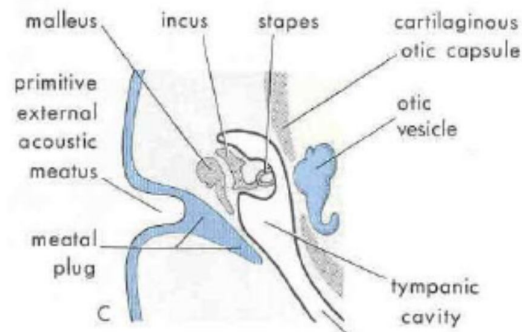
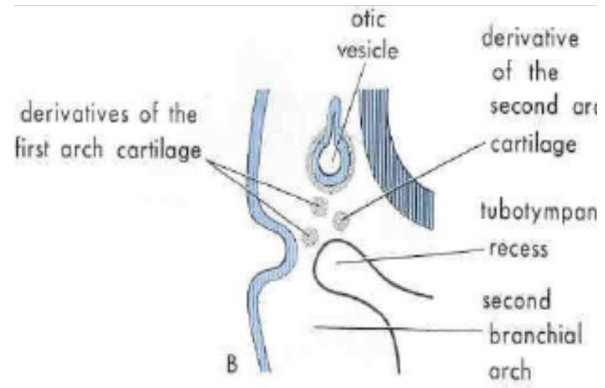
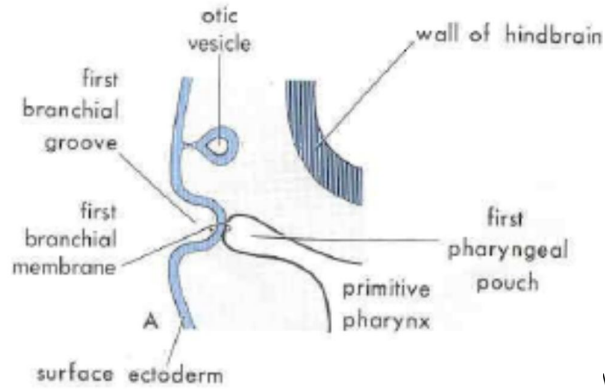
2. Body of Incus

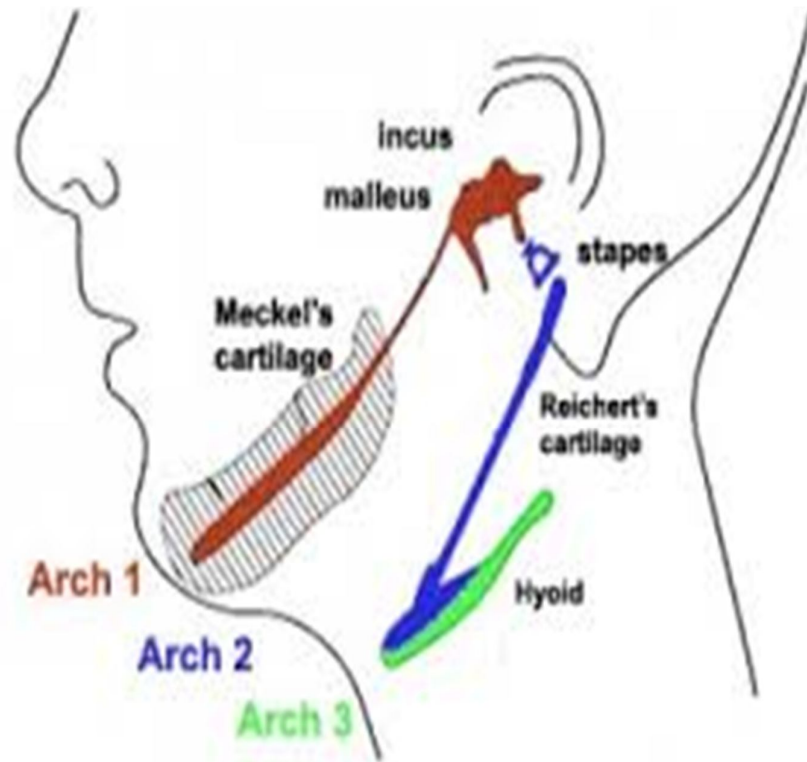
2nd Arch Cartilage – 1. Handle of Malleus

2. Long process of incus

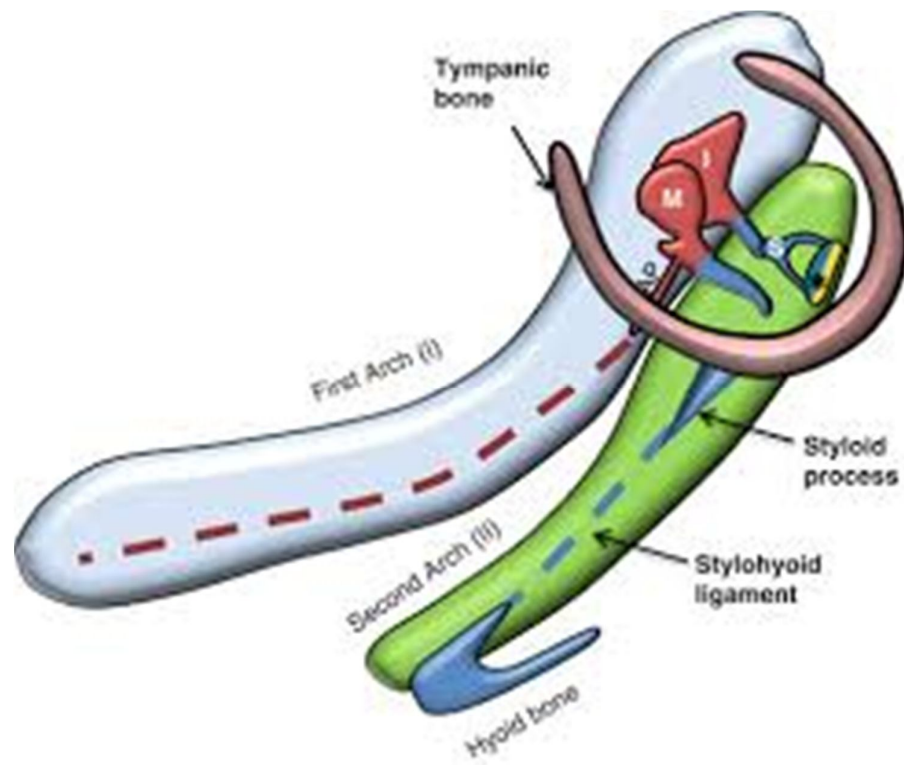
3. Head and. Crura of Stapes

**Otic Capsule – Foot Plate Of Stapes**

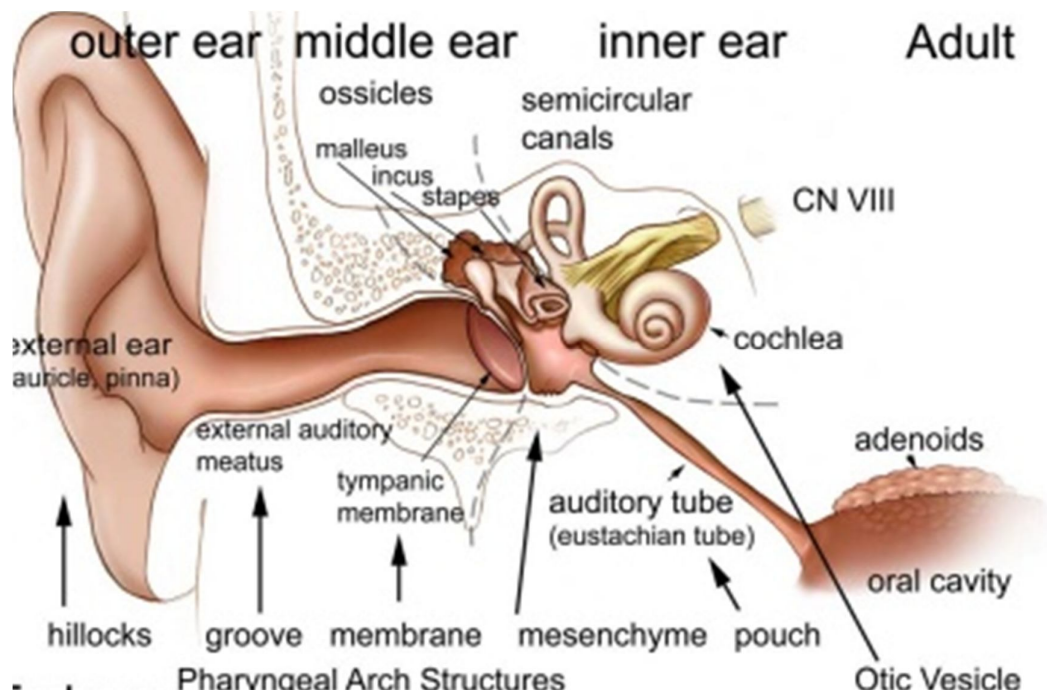




**Pharyngeal Arch Structures**



## ANATOMY OF MIDDLE EAR



### DIVISIONS OF MIDDLE EAR:

#### I EPITYMPANUM

#### II MESOTYMPANUM

- Facial recess
- Sinus tympani

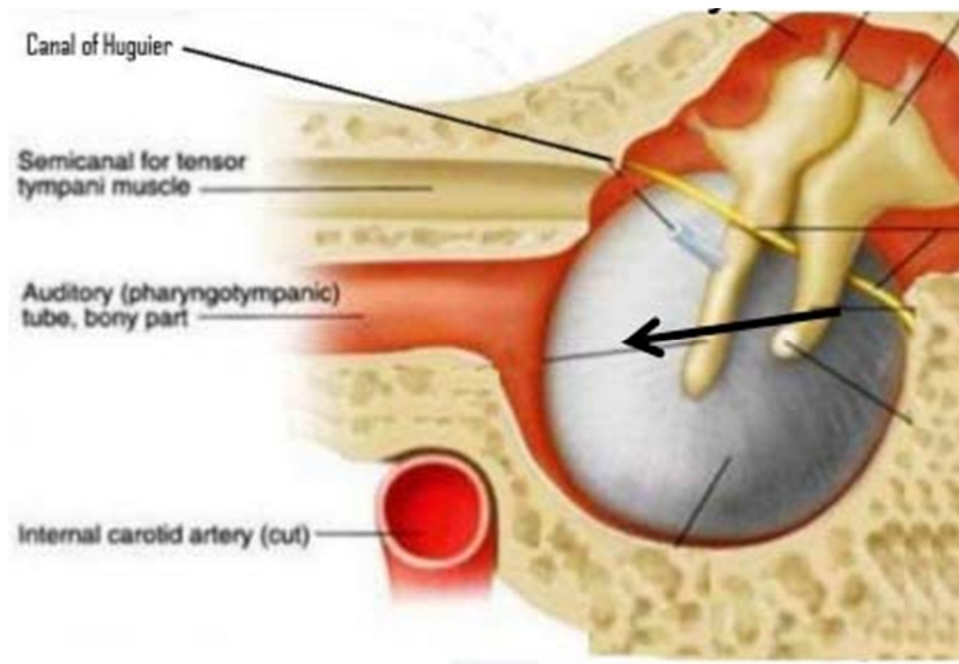
#### III HYPOTYMPANUM

### WALLS OF MIDDLE EAR:

- Roof : Tegman tympani, middle cranial fossa
- Floor : Jugular bulb, carotid artery

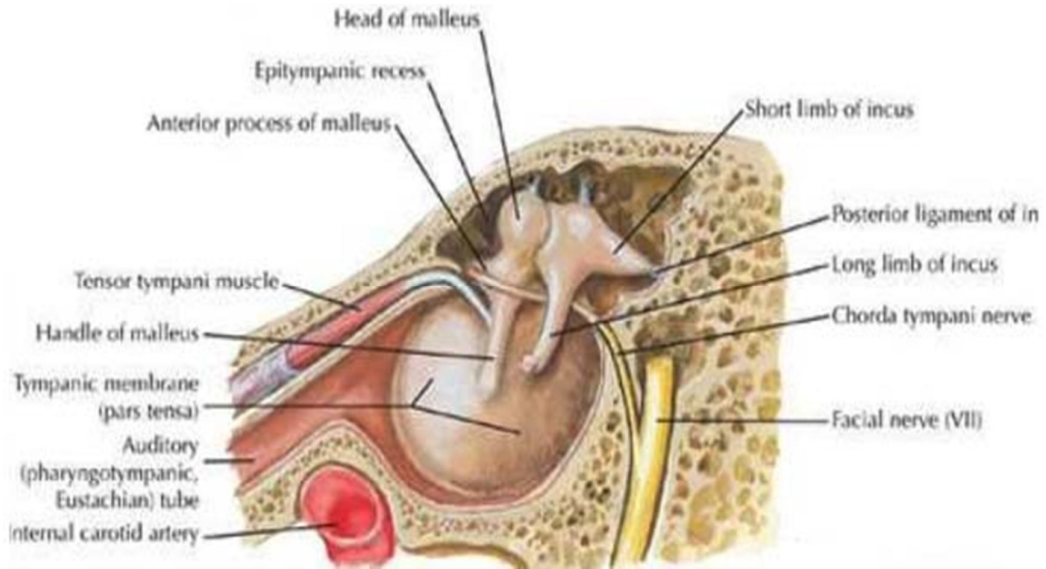
- Anterior : Tensor tympani, ET Office, carotid artery
- Posterior : Aditus, fossa incudis, pyramidal eminence, facial recess, sinus tympani
- Lateral : Tympanic membrane, scutum
- Medial : Promontory, oval window, round window, lateral SCC, facial nerve (tympanic part)

## ANTERIOR WALL

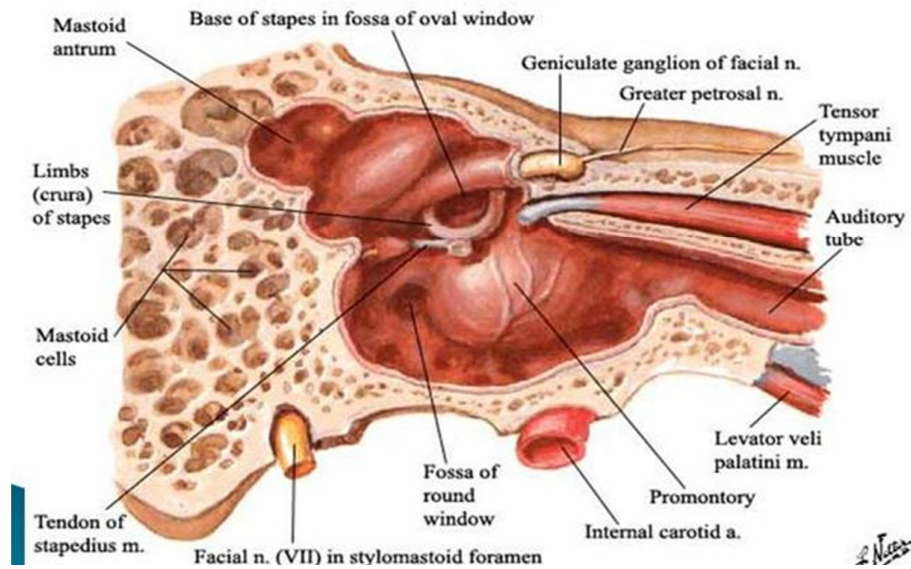




# LATERAL WALL



## Tympanic Cavity - Medial Wall Lateral View





## Blood Supply of middle ear

Sl.No.	BRANCH	PARENT ARTERY	REGION SUPPLIED
1.	Ant Tympanic	Maxillary	TM, Malleus, Incus, Ant Tympanic cavity
2.	Stylomastoid	Post Auricular	Post part of tympanic cavity, stapedius muscle
3.	Mastoid	Stylomastoid	Mastoid Air Cells
4.	Petrosal	Middle Meningeal	Roof of Mastoid and Roof of epitympanum
5.	Sup Tympanic	Middle Meningeal	Malleus, incus, Tensor tympani
6.	Inf Tympanic	Ascending pharyngeal	Mesotympanum

## **NERVE SUPPLY OF MIDDLE EAR**

### **THE TYMPANIC PLEXUS**

It is formed by the

- Tympanic branch of the glossopharyngeal nerve (Jacobson's nerve) and
- Caroticotympanic nerves, which arise from the sympathetic plexus around the internal carotid artery.

The nerves form a plexus on the promontory and provide the branches to the mucous membrane lining the tympanic cavity, Eustachian tube, mastoid antrum and air cells.

### **FUNCTION OF MIDDLE EAR :**

#### **Conduction**

- Conduct sound from the outer ear to the inner ear

#### **Protection**

- Creates a barrier that protects the middle and inner ear from foreign objects
- Middle ear muscles may provide protection from loud sounds

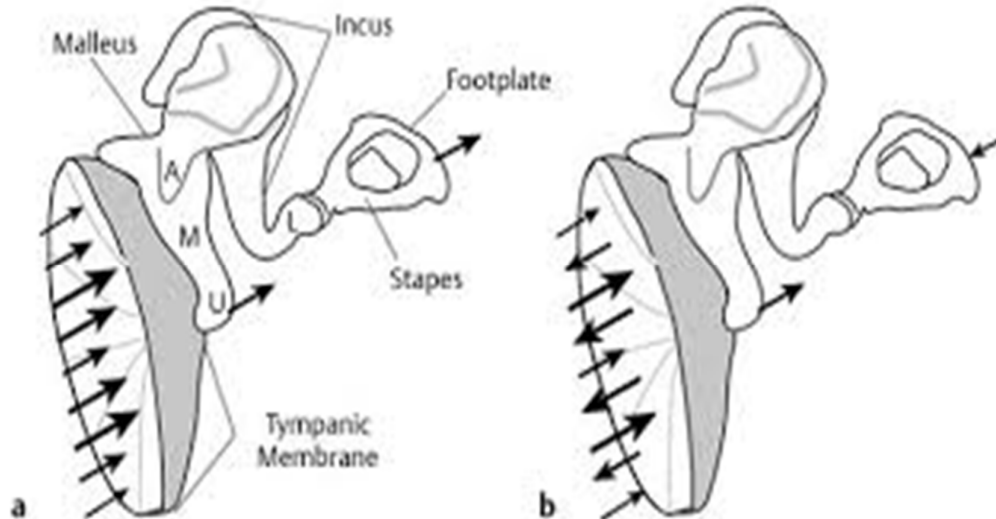
## Transducer

- Converts acoustic energy to mechanical energy
- Converts mechanical energy to hydraulic energy
- Amplifier

## Transformer action of the middle ear

Only about 1/1000 of the acoustic energy in air would be transmitted to the inner ear fluids (about 30 db hearing loss)

## PHYSIOLOGY OF THE MIDDLE EAR



Middle ear

Transforms air waves to fluid waves

## ACOUSTIC TRANSFORMER MECHANISM

### I OSSICULAR COUPLING

- HYDRAULIC LEVER
- OSSICULAR LEVER
- CATENARY LEVER

### II ACOUSTIC COUPLING

**Two mechanisms:**

- Area effect of TM
- TM area to footplate area-17:1
- Lever action of the ossicles
- 1.3:1 malleus to incus ratio( $17 \times 1.3 = 22$  Db)
- 22:1 combined transformer ratio of middle ear
- Translates to 25 Db

## **TRANSFORMER IN DISEASED STATE**

### **I Effect on ossicular coupling**

- Ossicular discontinuity
- Ossicular fixity

### **II Effect on acoustic coupling**

- Loss of round window shielding
- Effect of stapes, cochlear and round window impedance

### **III Middle ear aeration and fluid**

## **PHYSIOLOGY OF HEARING WITH TM PERFORATIONS:**

- Decreased transformer ratio
- Removes sound protection from round window
- Sound to reach both windows at the same movement-  
cancels the resultant movements of perilymph
- Total perforation results in Loss of 40-45 dB
- Ossicular chain interruption behind intact TM – Maximum  
conductive hearing loss of 60 dB.

Ideal tympanoplasty restores sound protection for round window by constructing a closed and air containing middle ear & rebuilds the sound-pressure transformer mechanism for the oval window by connecting a large TM with stapes foot plate via either an intact or a reconstructed ossicular chain.

### **CHRONIC OTITIS MEDIA (COM)**

COM is defined as the chronic inflammation of the mucoperiosteal lining of the middle ear cleft. i.e. Eustachian tube, middle ear, aditus and mastoid air cells which presents with recurrent ear discharge through tympanic membrane perforation. It is divided into tubotympanic and atticofacial disease.

### **CLASSIFICATION OF CHRONIC OTITIS MEDIA:**

HEALED COM-TYMPANOSCLEROSIS

INACTIVE MUCOSAL COM- DRY PERFORATION

INACTIVE SQUAMOUS COM-RETRACTION

ACTIVE MUCOSAL COM-PERFORATION WITH OTORRHOEA.

ACTIVE SQUAMOUS COM-CHOLESTEATOMA

COM is classified into active(wet) and inactive(dry) based on the presence or absence of middle ear inflammation and the production of discharge respectively.

### **INACTIVE MUCOSAL COM(DRY EAR):**

There is permanent perforation of the pars tensa but the middle ear and mastoid mucosa is not inflamed. The lamina propria around a perforation is thickened due to fibrous tissue proliferation. The mucocutaneous junction (the junction of the squamous epithelial layer of TM and the mucosa of the medial TM) is usually located at the perforation edge, but in some cases, epithelial cells migrate medially through the perforation. It is important to excise in-grown squamous epithelium at the time of tympanoplasty to avoid iatrogenic cholesteatoma formation.

### **CRITERIA FOR DRY EAR:**

- No discharge for at least 3 months
- Tympanic membrane remnant should be of normal colour.
- Middle ear mucosa should be normal.

### **ACTIVE MUCOSAL COM (WET EAR):**

There is a permanent defect of the pars tensa with an inflamed middle ear mucosa which produces mucopurulent discharge. There is chronic inflammation of the middle ear mucosa with edema, submucosal fibrosis, hypervascularity and infiltration with lymphocytes, plasmacells, histiocytes. Proliferation of blood vessels, fibroblasts, and inflammatory cells leading to formation of granulation tissue with mucopurulent discharge.

### **CRITERIA FOR WET EAR:**

- Congestion of middle ear mucosa.
- Congestion of drum remnant.
- Presence of discharge in the middle ear.

### **RISK FACTORS**

- Eustachian tube dysfunction-sinusitis, adenoid hypertrophy
- GERD
- Ciliary dysfunction
- Craniofacial anomalies-cleft palate, down syndrome
- Immune deficiency-primary and acquired



## **ENVIRONMENTAL FACTORS**

- Low socioeconomic status
- Lack of breast feeding in infancy
- Passive exposure to smoke Allergy
  
- History of recurrent AOM

## **ETIOLOGY OF TM PERFORATION**

### **I INFECTION**

- Bacteria
- Mycobacterium
- Viruses

### **II Trauma**

- Penetrating trauma
- Blunt trauma
- Barotrauma
- Iatrogenic

A perforation in the TM can result from either trauma or infective process, out of which the infective or suppurative process is the most common cause. Most of these perforations usually heal spontaneously. But this spontaneous healing is affected by chronicity of infection and certain pathophysiological changes at the perforation margins, leading to a nonhealing permanent perforation. This leads to constant exposure of middle ear for reinfection and hearing disability.

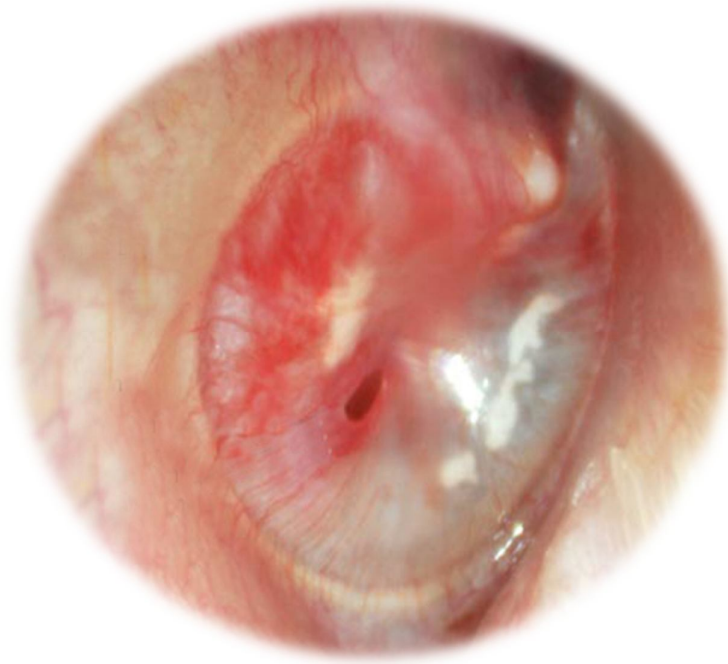
**Perforations in the tympanic membrane according to the anatomical location:**

- CENTRAL PERFORATION - is in the pars tensa and surrounded by some residual tympanic membrane or at least the annulus.
- SUBTOTAL PERFORATION - is a large defect in the pars tensa surrounded by a completely intact annulus.
- MARGINAL PERFORATION - usually in the posterior part of the TM with pathological loss of annulus.
- ATTIC PERFORATION - occur as defect of pars flaccida.

**According to the size of perforation:**

- Grade I-One quadrant (<25% of TM)
- Grade II-two quadrant(25% - 50% of TM)
- Grade III- three quadrant(50% - 75% of TM)
- Grade IV-total (only annulus left)

**SMALL**



**MEDIUM**



**LARGE**



**SUBTOTAL**



## **PATHOGENESIS OF COM :**

Chronic otitis media is a longstanding disease. Traditionally, COM has been thought to follow a bout of acute otitis media (AOM) that resulted in TM perforation. This direct correlation has fallen out of favour for several reasons. First, AOM is one of the most common childhood diseases. COM is less common in children. Majority of TM perforations secondary to AOM result in complete healing of TM.

Streptococcal otitis media which causes necrotising infection resulting in larger perforations, is seldom seen today, but the incidence of COM has remained constant. Persistent effusion in chronic secretory otitis media leads to degradation of the fibrous layer of the TM. Loss of fibrous layer results in a weakened, atrophic, two-layered TM that is vulnerable to atelectasis or perforation and hence chronic middle ear disease.

Recurrent infections of the middle ear result in irreversible mucosal changes. As the inflammation becomes chronic, there is a shift from infiltrating leucocytes toward mononuclear cells such as lymphocytes, plasmacells, macrophages. These mononuclear cells secrete inflammatory mediators and growth factors that increase capillary permeability and lead to edema and hyperemia of the middle ear mucosa.

In chronic inflammation, the mucosa undergoes metaplasia from a single layer of ciliated cuboidal or columnar epithelium to mucosa resembling that of the respiratory tract with increased numbers of goblet cells and glandular cells. So, there is increase in the viscosity of the mucus. The prominent pathologic feature in COM is the granulation tissue consisting of vascular connective tissue with inflammatory infiltrates. As the granulation tissue matures, it becomes dense and fibrotic with decreased vascularity. This leads to scarring and adhesion with the ossicular chain and TM. Irreversible changes such as subepithelial edema and mucoperiosteal fibrosis occur deep to the epithelial lining. As the inflammation persists, sclerosis along with new bone formation can cause a reduction in mastoid and antral pneumatization.

### **HISTOPATHOLOGY:**

The middle ear cleft is lined by a single layer of cuboidal or columnar epithelium. Goblet cells are a feature of the hypotympanum. COM is histologically defined as the irreversible mucosal changes in the middle ear cleft. In TM perforations, it was found that squamous epithelium extended medially from the perforation edges. Factors to be present in wound healing were only scantily present. So, there was arrested healing and spontaneous closure impossible in chronic perforations. So,

complete removal of the residual TM rim is necessary to avoid entrapment of epithelium within the middle ear. Epidermis is the first layer that closes a TM perforation. Secondly, healing of mucosal layer occurs. It begins within 48 hours and completed within 9 days. The epithelial layer of healed TM does not contain basal cells, so it is evident that it is migrated from the periphery and not by insitu proliferation.

## **MICROBIOLOGY:**

### **I MOST COMMON AEROBIC ORGANISMS:**

- STAPHYLOCOCCUS AUREUS
- GRAM NEGATIVE- E.COLI, PROTEUS, KLEBSIELLA, PSEUDOMONAS AERUGINOSA

### **II ANAEROBIC ORGANISMS:**

- BACTEROIDES
- FUSOBACTERIUM

### **III FUNGUS:**

- ASPERGILLUS
- CANDIDA



Fungi may result as overgrowth after initial treatment with antibiotic drops.

**CLINICAL FEATURES:**

- OTORRHOEA
- DEAFNESS

**EXAMINATION FINDINGS:**

- Perforation may vary from pin hole size to large subtotal defect.
- Integrity of the ossicular chain can be seen through the perforation.

**TREATMENT:**

Preoperative clinical treatment is based on the removal of secretions from the ear, use of topical antibiotic drops, ear protection, control of allergic rhinitis, and URI and control of other factors that prevent the functioning of the Eustachian tube. Surgery is done, if conservative management fails.

## **TYMPANOPLASTY –AN OVERVIEW**

Tympanoplasty is the procedure of removal of disease from the middle ear and reconstruction of the hearing mechanism along with TM grafting.

### **HISTORY OF TYMPANOPLASTY:**

#### **1640-BANZER**

- First attempt at repair of TM
- Used pigs bladder as a lateral graft

#### **1853-TOYNBEE**

- Placed a rubber disc attached to a silver wire over the TM
- Reported significant hearing improvement

#### **1863-YEARSLEY**

- Placed a cotton ball over a perforation

#### **1877-BLAKE**

- PAPER PATCH

#### **1876-ROOSA**

- CHEMICAL CAUTERY

**1878-BERTHOLD**

- COINED THE TERM MYRINGOPLASTY

**1950-WULLSTEIN AND ZOLLNER**

**1956-DESCRIBED 5 TYPES OF TYMPANOPLASTY**

**1960-HEERMAN**

- First used temporalis fascia grafting material in tympanoplasty.

**1961-STORRS**

- TEMPORALIS FASCIA GRAFTING

**1967-HOUSE GLASSCOCK AND SHEEHY**

Techniques for lateral grafting

**INDICATIONS FOR SURGERY:**

- Conductive hearing loss due to TM perforation or ossicular dysfunction
- Chronic or recurrent otitis media secondary to contamination
- Progressive hearing loss due to chronic middle ear pathology

## **CONTRAINDICATIONS FOR SURGERY:**

- Malignant tumours
- Unusual infections like malignant otitis externa.
- Intracranial complications
- Cholesteatoma

## **GOALS OF THE SURGERY:**

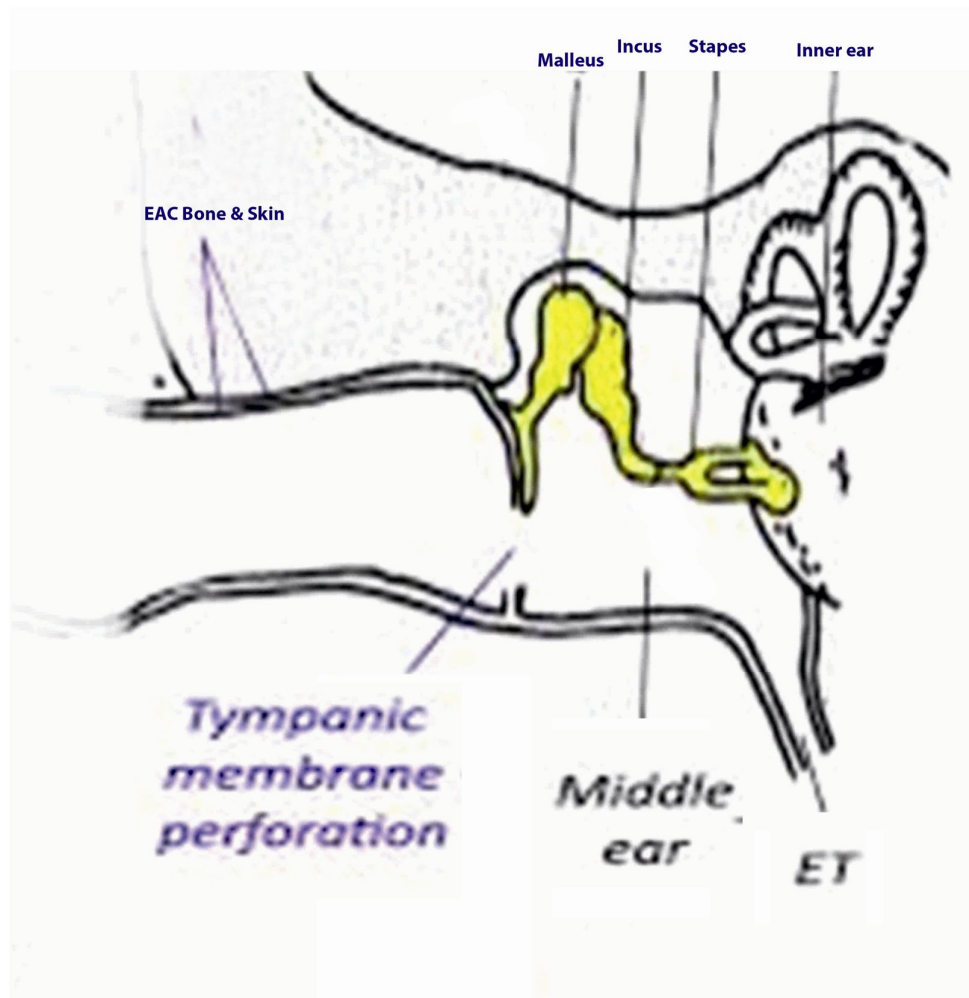
- Establish an intact TM
- Eradicate middle ear disease and create an air containing middle ear space
- Restore hearing by sound pressure transformation between the eardrum and the cochlea

## **TECHNIQUES:-**

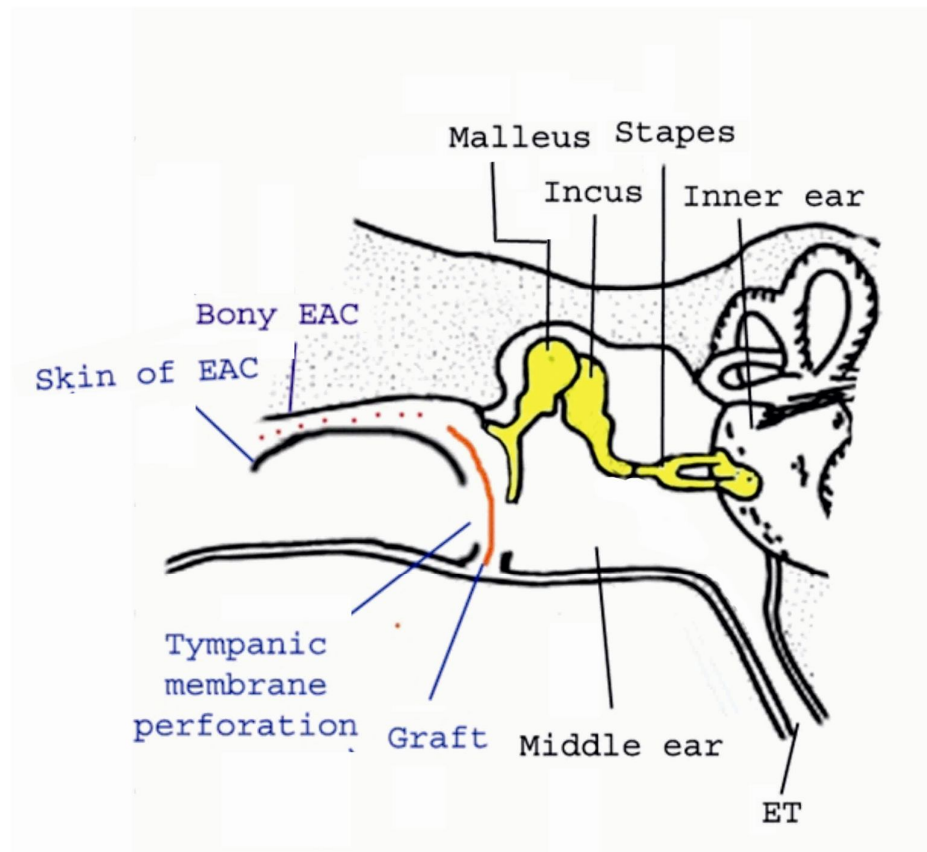
- OVERLAY (LATERAL GRAFTING)

OVERLAY –surface epithelium was removed around the perforation site and graft was put on the fibrous layer of TM.

## TYMPANOPLASTY (TYMPANIC MEMBRANE PERFORATION)



## TYMPANOPLASTY (GRAFT INSERTION)



### OVER LAY GRAFTING

#### ADVANTAGES:

- Graft remains vascularised
- Exposure of anterior meatal recess
- Middle ear space not reduced

#### DISADVANTAGES:

- Lateralisation of the graft
- Blunting of anterior meatal recess

- Chance of iatrogenic cholesteatoma formation

Healing may take longer (4-8 weeks)

- Technically more demanding
- Formation of epithelial pearl

### **UNDERLAY(MEDIAL GRAFTING)**

- UNDERLAY technique was introduced by SHEA. The graft was placed medial to the handle of malleus and TM remnant.

### **ADVANTAGES:**

- Less blunting or lateralisation
- High graft uptake

### **DISADVANTAGES:**

- Limited visualization of anterior meatal recess
- Difficult with small EAC.
- Less suitable in large anterior perforation
- Reduction in middle ear space

### **TM grafts:**

Histologically TM grafts become lined by squamous epithelium on the ear canal side and the middle ear mucosa on the tympanic cavity side.

## **GRAFTING MATERIALS**

- TEMPORALIS FASCIA GRAFT
- CARTILAGE GRAFT
- FAT GRAFT
- HYALURONIC ACID FAT GRAFT
- TRAGAL PERICHONDRIUM AND CARTILAGE
- VEIN GRAFT
- CONCHAL CARTILAGE
- FASCIA LATA
- SUBCUTANEOUS TISSUE
- PERIOSTEUM



## **APPROACH**

- **TRANSCANAL**

- Posterior moderate sized perforations
- Favourable EAC anatomy

- **ENDAURAL**

Visualisation of annulus and anterior sulcus is difficult

- **POSTAURAL**

- All perforation sizes
- Better angle of visualization

## **VARIOUS SURGICAL TECHNIQUES**

- **OVERLAY-UNDERLAY TECHNIQUE**

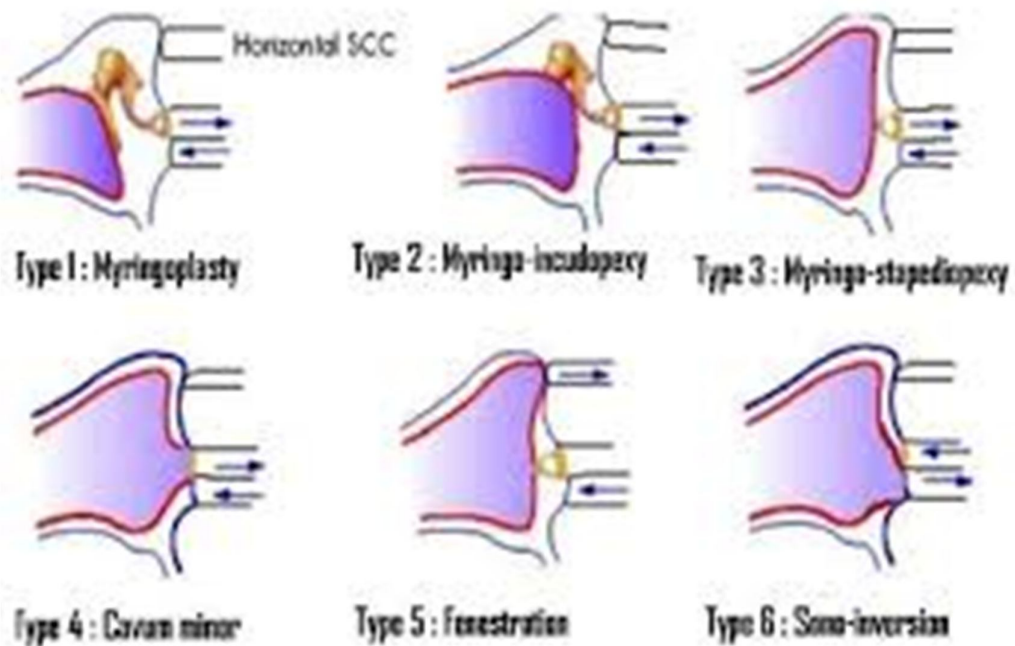
- **COMBINED TECHNIQUE**

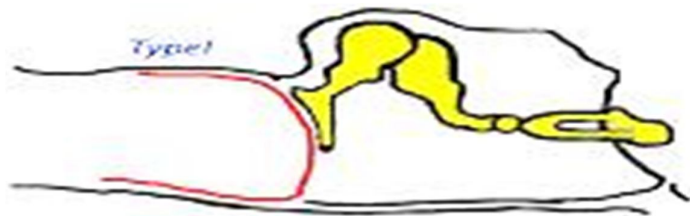
- Two grafts-one under the handle of malleus
- Second on the fibrous layer of TM

- **CIRCUMFERENTIAL SUB ANNULAR GRAFT TECHNIQUE**

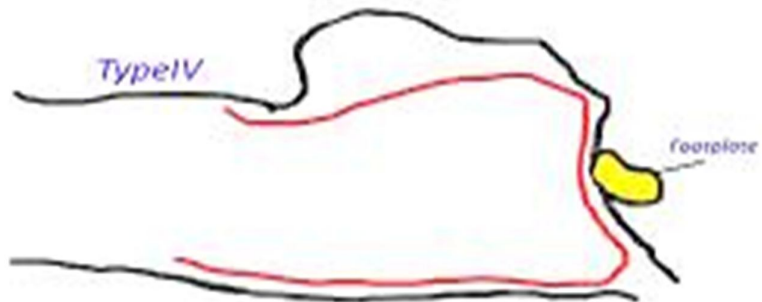
- SWING DOOR TECHNIQUE
- BUTTERFLY AND PALISADE TECHNIQUE CARTILAGE TYMPANOPLASTY
- CATILAGE SHIELD TYMPANOPLASTY
- THE BUTTON GRAFT TECHNIQUE
- CARTILAGE TYMPANOPLASTY WITH ISLAND TECHNIQUE
- ENDOSCOPIC VS MICROSCOPIC TYMPANOPLATY

### CLASSIFICATION OF TYMPANOPLASTY





*Wullstein classification of tympanoplasty*



- WULLSTEIN AND ZOLLNER (1956):

### **TYPE I**

- TM is grafted to an intact ossicular chain

### **TYPE II**

- Malleus is partially eroded
- TM is grafted to the long process of incus/ remaining malleus

### **TYPE III**

- COLUMELLA EFFECT /MYRINGOSTAPEDIOPEXY
- Malleus and incus are eroded
- TM is grafted to the stapes suprastructure with cartilage in between

### **TYPE –IV**

- Stapes suprastructure is eroded but foot plate is mobile
- TM is grafted to a mobile footplate
- Sound protection of the roundwindow and formation of airspace in the hypotympanum

### **TYPE V**

- TM is grafted to a fenestration in the lateral semicircular canal in cases with no ossicles and a fixed footplate

## **MIRKOTOS CLASSIFICATION**

- 1.INTACT CHAIN
- 2.SHORT COLUMELLA
- 3.LONG COLUMELLA
- 4.SOUND PROTECTION
- 5A-LSC FENESTRATION
- 5B-PLATINECTOMY

## **BELLUCI CLASSIFICATION**

Added status of middle ear

- GROUP I-Dry ear
- GROUP II-Occasional discharge
- GROUP III –Persistent drainage with mastoiditis
- GROUP IV-Persistent drainage and nasopharyngeal malformation(cleft palate and choanal atresia)

## **AUSTIN/KARTUSH CLASSIFICATION**

**Describes the residual ossicular remnants**

**Malleus handle (M+, M-)**

**Stapes suprastructure (S+, S-)**

- Type A: (M+ I + S+) - INTACT OSSICULAR CHAIN
- Type B: (M+/S+) OR (M+ /S-)- Good prognosis
- Type C : (M- /S +) OR ( M- / S+) - Poor prognosis
- Type D : (M-/S-) Poor prognosis

**(MERI) MIDDLE EAR RISK INDEX**

	<b>RISK FACTOR</b>	<b>RISK VALUE</b>
I	OTORRHOEA	
	I: DRY	0
	II: OCCASIONALLY WET	1
	III :PERSISTENLY WET	2
	IV: WET,CLEFT PALATE	3
II	PERFORATION	
	ABSENT	0
	PRESENT	1
III	CHOLESTEATOMA	
	ABSENT	0
	PRESENT	1
IV	OSSICULAR STATUS	
	O :M+I+S+	0
	A:M+S+	1

	B:M+S-	2
	C:M-S+	3
	D:M-S-	4
	E:OSSICULAR HEAD FIXATION	2
	F:STAPES FIXATION	3
V	MIDDLE EAR(GRANULATION OR EFFUSION)	
	NO	0
	YES	1
VI	PREVIOUS SURGERY	
	NONE	0
	STAGED	1
	REVISION	2

**The Total score is 12.**

Mild disease	1-3
Moderate disease	4-6
Severe disease	7-12

## **MATERIALS AND METHODS**

### **SOURCE OF DATA:**

This study included 100 patients with COM with central perforation with their consent for participation in the study after obtaining clearance from the ethical committee.

- 50 patients with dry ear in group I
- 50 patients with wet ear in group II

STUDY WAS DONE IN THE DEPARTMENT OF OTORHINOLARYNGOLOGY IN CMCH( COIMBATORE MEDICAL COLLEGE HOSPITAL)

### **STUDY PERIOD:**

- SEPTEMBER 2016-SEPTEMBER 2017-

### **STUDY DESIGN:**

PROSPECTIVE RANDOMISED COMPARATIVE CLINICAL STUDY



**SELECTION CRITERIA:**

**SAMPLE SIZE :100 PATIENTS**

**INCLUSION CRITERIA:**

- AGE between 15-50 both male and female
- No evidence of active infection in nose and throat
- COM Tubotympanic type with conductive hearing loss
- Hearing loss less than 50 dB

**EXCLUSION CRITERIA:**

- Patients with marginal and attic perforation
- Only hearing ear
- Sensorineural hearing loss
- Revision tympanoplasty cases
- Complicated otitis media
- Middle ear malignancy and otitis externa
- Pregnant and lactating women
- Tympanosclerosis
- Underlying diseases such as Diabets or poor immune system.

## **PRE OPERATIVE EVALUATION:**

### **HISTORY:**

- Otorrhoea
- Hearing loss
- Tinnitus
- Vertigo
- Otagia
- Facial paralysis

### **PHYSICAL EXAMINATION:**

- COMPLETE HEAD AND NECK EXAMINATION

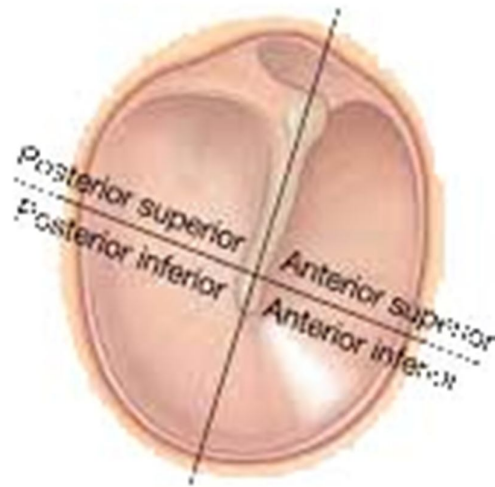
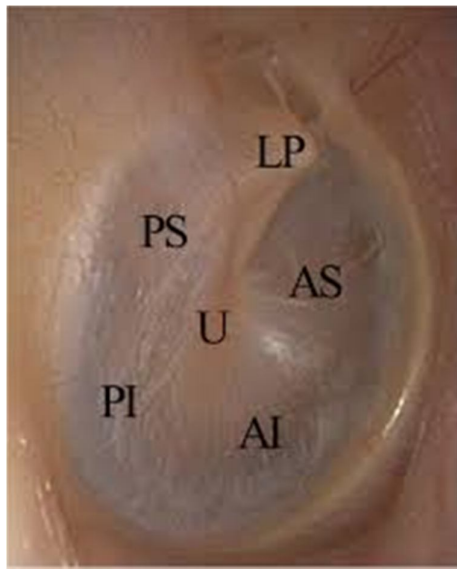
### **INVESTIGATIONS:**

- COMPLETE BLOOD COUNT
- BLOOD UREA , CREATININE
- BLOOD SUGAR
- CHEST X-RAY PA VIEW, ECG, CT PNS

## DIAGNOSTIC NASAL ENDOSCOPY:

- To check nasal conditions and pathologies that interfere with proper functioning of the Eustachian tube.

## OTOMICROSCOPY:



- Ear canal
- TM perforation-location according to quadrant –(antero superior, antero inferior, postero superior, postero inferior) and size( percentage of area perforated in the TM)
- Status of middle ear

## **AURAL SWAB FOR CULTURE AND SENSITIVITY**

### **PURE TONE AUDIOMETRY:**

- It was done within 3 months prior to surgery.

### **CARHART AND JERGER'S TECHNIQUE (5 UP AND 10 DOWN METHOD)**

- It was done in acoustically treated room with no ambient noise.
- Standard head phones used for air conduction.

### **X-RAY BOTH MASTOIDS (LAW'S VIEW):**

- To determine the pneumatisation type, to look for low lying dura and forward lying sinus

### **+/- HRCT TEMPORAL BONE**

### **INFORMED WRITTEN CONSENT**

### **MANAGEMENT:**

### **TOPICAL MEDICATION:**

- Topical antibiotics are more effective than oral or iv antibiotics

If medical management fails, then cortical mastoidectomy with tympanoplasty is done.

#### **PREOPERATIVE COUNSELLING:**

- Nature of the disease
- Treatment options
- Outcomes of surgical options
- Postoperative hearing deterioration possible

#### **SURGERY**

All the patients underwent cortical mastoidectomy with tympanoplasty under GA through postaural approach and underlay technique (medial graft).

#### **SURGICAL STEPS:**

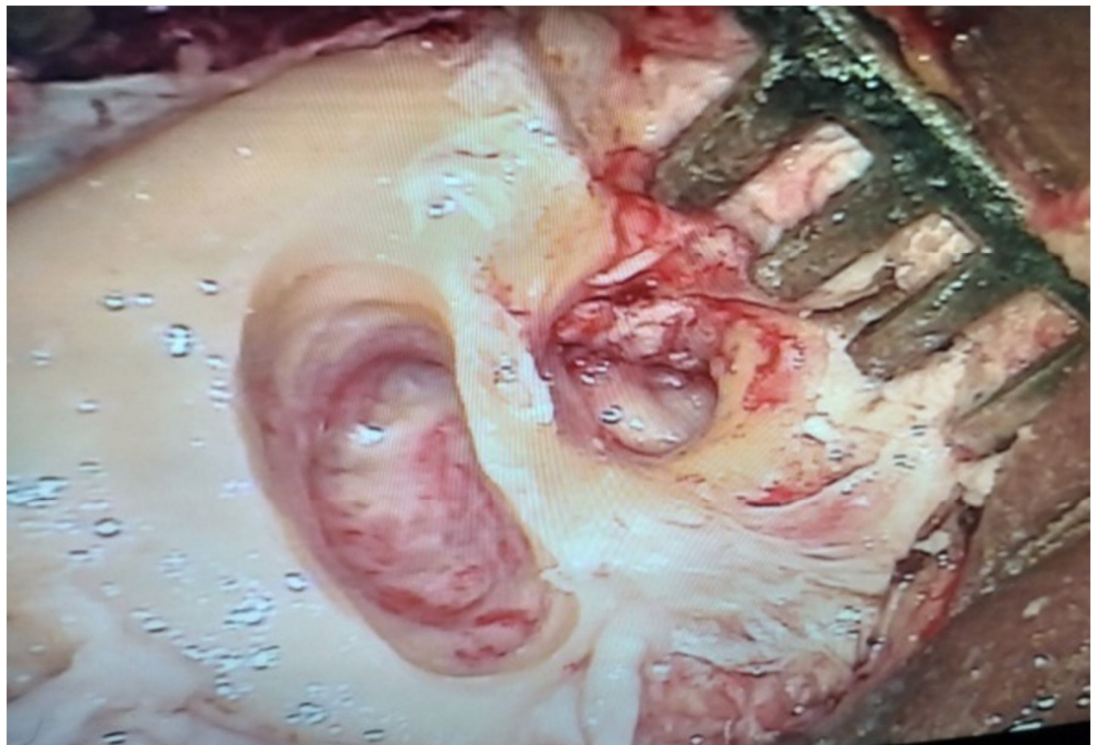
- Postauricular exposure, harvest and dehydration of the temporalis fascia
- T-shaped incision in the periosteum overlying the mastoid
- Periosteum elevated and moved anteriorly into the ear canal

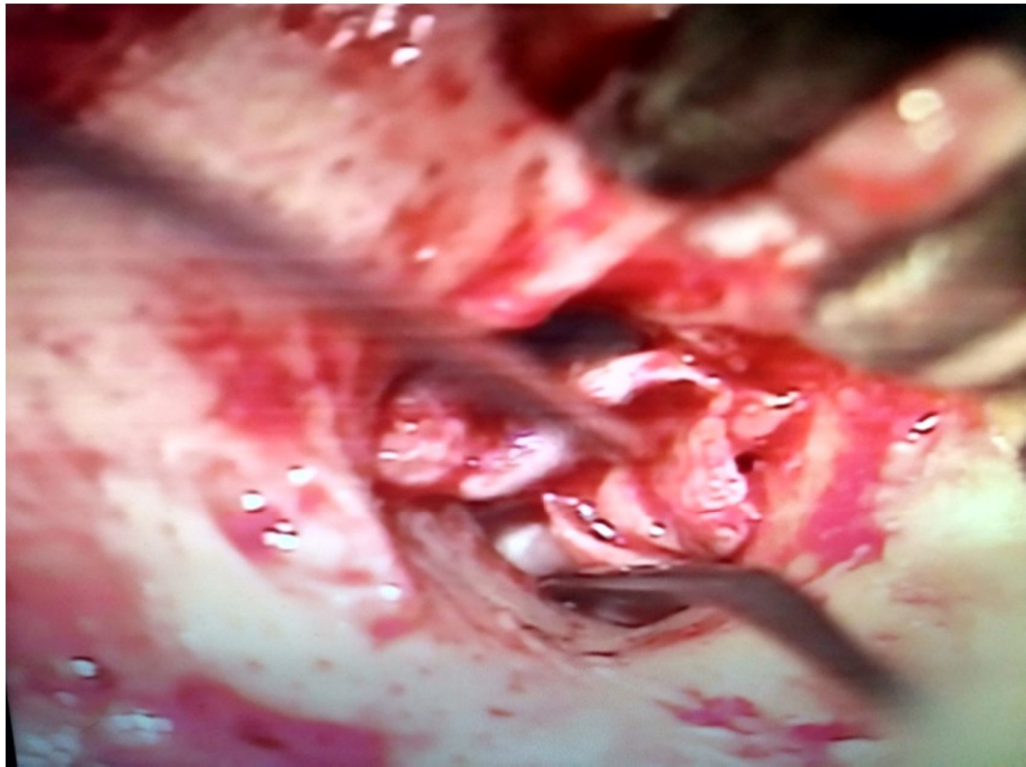
- Deepithelialisation of the TM remnant-separates the continuity of the inner mucosa with the outer epithelium.
- Elevation of the tympanomeatal flap-Inspect the undersurface of the TM for squamous epithelium and to inspect the middle ear
- To look for ossicular status, Round window reflex, Eustachian tube orifice.
- Mastoid antrum opened, aditus widened and patency ensured.
- Pack the middle ear and Eustachian tube with gelfoam
- Placement of the temporalis fascia under the anterior TM remnant
- Replacement of the tympanomeatal flap
- Gelfoam placed over the TM remnant , graft and TM flap
- Closure of the postauricular incision
- Mastoid dressing applied.

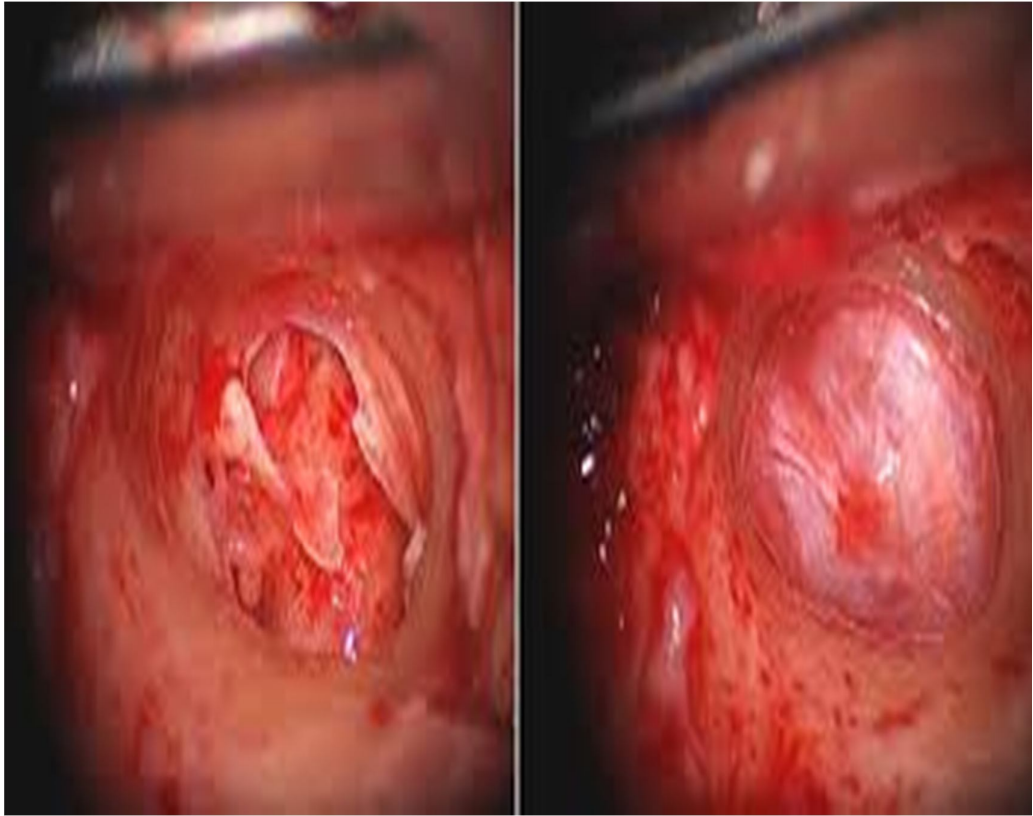














## **POSTOPERATIVE CARE:**

All the patients were given iv antibiotics, analgesics, antihistaminics, topical nasal decongestants .

Mastoid dressing changed on the 1st , 4th and 7th postoperative days.

### **Patient instructions:**

- Avoid nose blowing
- sneeze with mouth open
- Avoid lifting heavy weight or straining
- Dry ear precautions

Suture removal on 8th POD and ear drops started.

At 3 weeks- residual gelfoam removed from EAC.

At 3 months and 6 months- assessment of the graft uptake done by otoendoscopic examination and post-operative audiogram done.

## REPORTING PROTOCOLS:

Tympanoplasty reporting protocol based on AB gap(KARTUSH)

AIR –BONE GAP	RESULT
0-10 dB	EXCELLENT
10-20 dB	GOOD
20-30 dB	FAIR
>30 dB	POOR

### BELFAST(15/30dB) RULE OF THUMB

Patients are likely to derive significant benefit postoperatively if the air conduction threshold in speech frequencies(500hz,1 khz,2khz,4 khz) was less than or equal to 30 dB or if the inter aural difference (air conduction mean threshold) is reduced to less than or equal to 15dB.



## RESULTS

The study was conducted on a total of 100 patients with COM. The patients were categorized into 2 groups – those with dry ear (A Group – 50 patients) and those with wet ear (B Group- 50 patients). In the present study, the cases selected were between 20-50 years. Majority of the patients were found in the age group of 31-40 years (48%). Most of the patients were female(73% ) (38% Dry, 35%-Wet). Mean age of the patients with dry ears was 32.6 (SD=8.4) and 35.18 for wet ears (SD =9.334) .There was no statistically significant difference between the two groups in terms of age ( $P>0.05$ ). In both groups, right ear was affected mostly in group A (dry) (68%) and in group B (wet) (42%).Left ear was affected in 26% of dry and 24% of wet ears. Bilateral ear was affected 6% of dry and 34% of wet ears. Majority of the perforations were medium (28%)and large sized(29%) in both groups.

The duration of the disease was <5 years in 44%,5-10 years in 38% and >10 years in 27%.The mastoid was sclerotic in 12% in dry ears and 28% in wet ears, partially sclerotic 15% in dry and 22% in wet ears and cellular in 15%(dry ears) and 8% in wet ears. Middle ear mucosa was congested and hypertrophied in 22% of wet ears, congested and

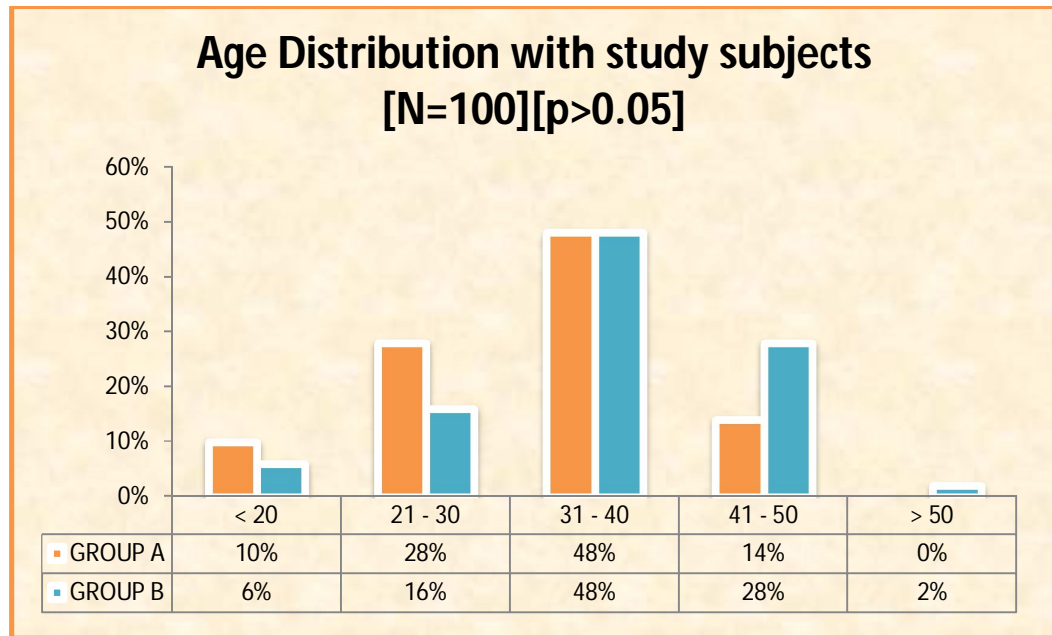
oedematous in 20% of wet ears, normal in 20% of dry ear, pale in 18% of dry ears. Average hearing improvement in all dry ears before and after surgery was 21.9 dB and this was 20.5 dB in wet ears. No significant difference between both groups in hearing improvement. Postoperative hearing improvement more than 10 DB was noted in 95% in dry and 92% in wet ears. Post operative air-bone gap of less than 20 DB was noted in 28 out of 50 in dry ears and 26 out of 50 in wet ears. Successful graft uptake was noted in 96% of dry ears and 94% of wet ears. Graft failure was noted in 2 out of 50 (4%) patients in dry ears and 3 out of 50 (6%) in wet ears. Preoperative ear status whether dry or wet did not significantly affect the improvement of mean air-bone gap.

The compiled results are depicted below.

**TABLE 1 :AGE DISTRIBUTION**

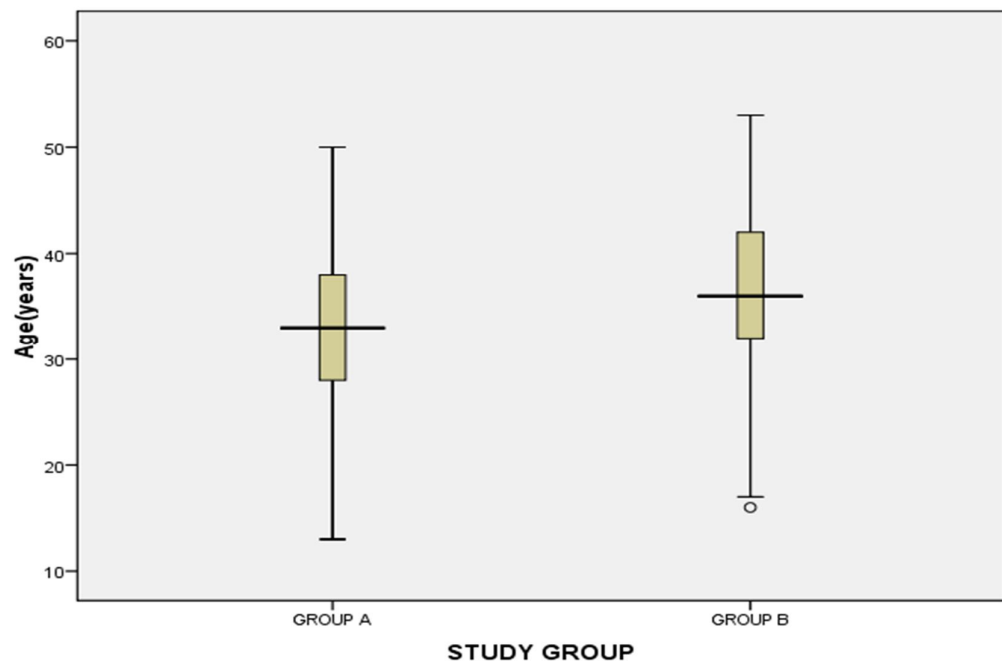
AGE	STUDY GROUP		TOTAL	(%)
	A	B		
<20	5	3	8	8%
21-30	14	8	22	22%
31-40	24	24	48	48%
41-50	7	14	21	21%
>50	0	1	1	1%
<b>TOTAL</b>	<b>50</b>	<b>50</b>	<b>100</b>	

P = 0.242



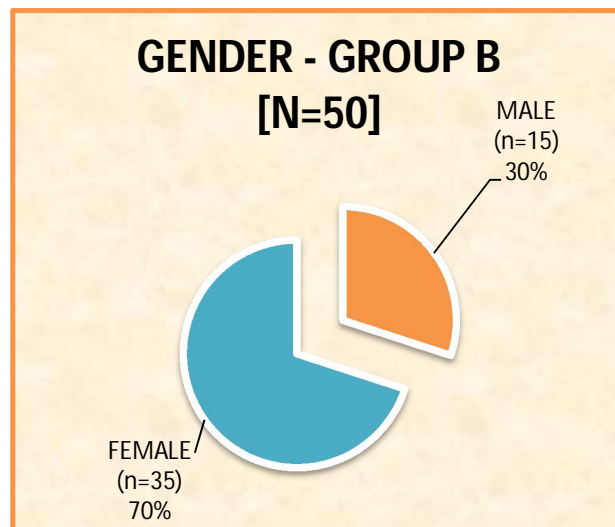
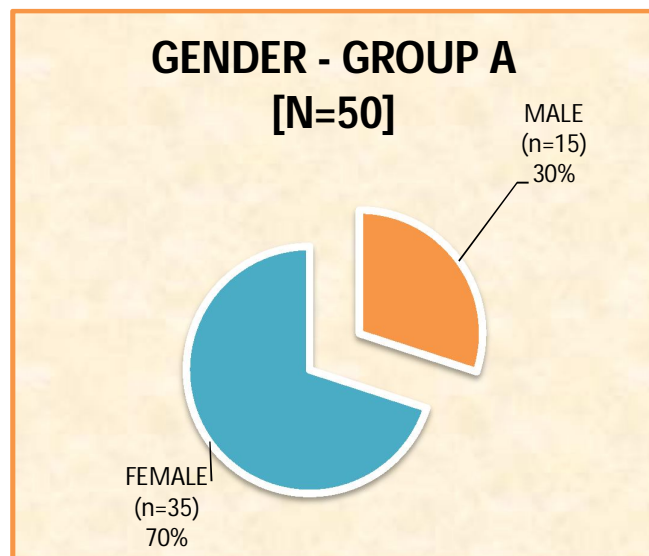


Study Group	Mean (Years)	SD	95% CI for Mean		Minimum	Maximum	Sig
			Lower	Upper			
Group A	32.6	8.4	30.2	35	13	50	<b>&gt;0.05</b>
Group B	35.18	9.334	32.53	37.83	16	53	
<b>Total</b>	<b>33.9</b>	<b>8.913</b>	<b>32.13</b>	<b>35.67</b>	<b>13</b>	<b>53</b>	



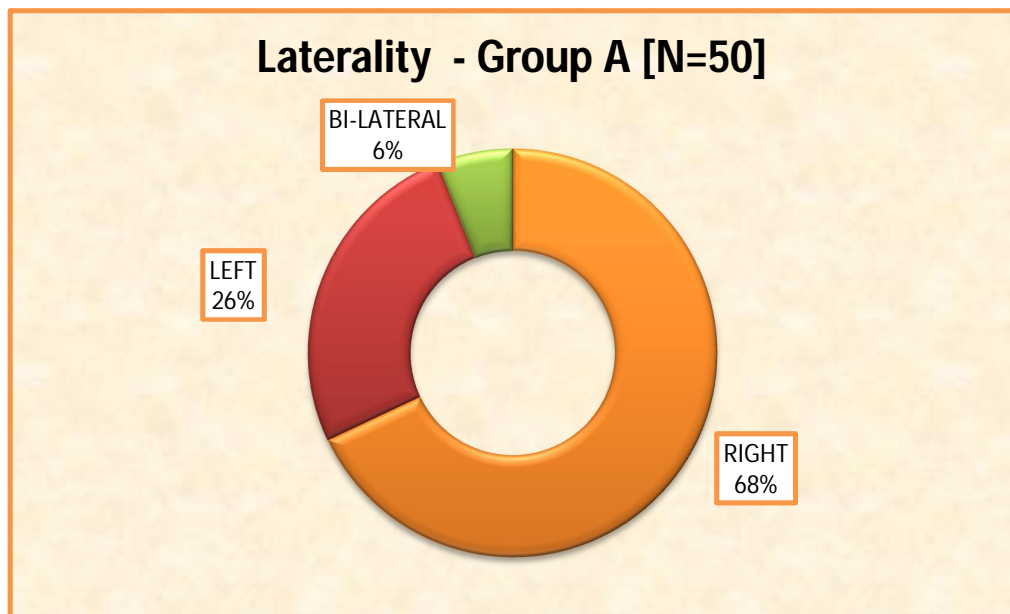
**TABLE 2: GENDER DISTRIBUTION**

GENDER	STUDY GROUP		TOTAL	(%)
	A	B		
MALE	12	15	27	27%
FEMALE	38	35	73	73%
<b>TOTAL</b>	<b>50</b>	<b>50</b>	<b>100</b>	<b>100%</b>



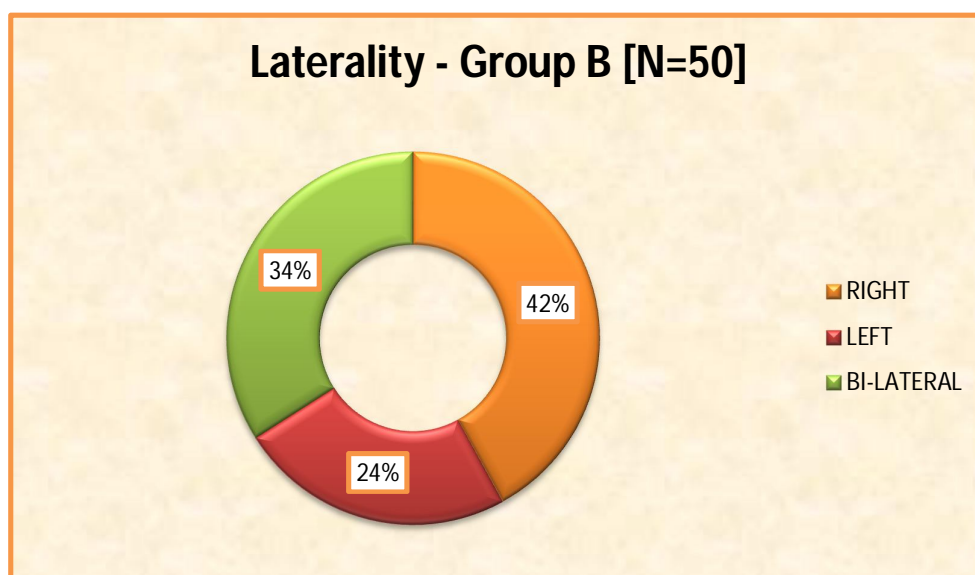
**TABLE 3 :SIDE AFFECTED IN DRY EARS**

<b>SIDE AFFECTED</b>	<b>GROUP -A</b>	<b>(%)</b>		
RIGHT	34	68%		
LEFT	13	26%		
BI-LATERAL	3	6%	p=0.002	p<0.05
TOTAL	50	100%		



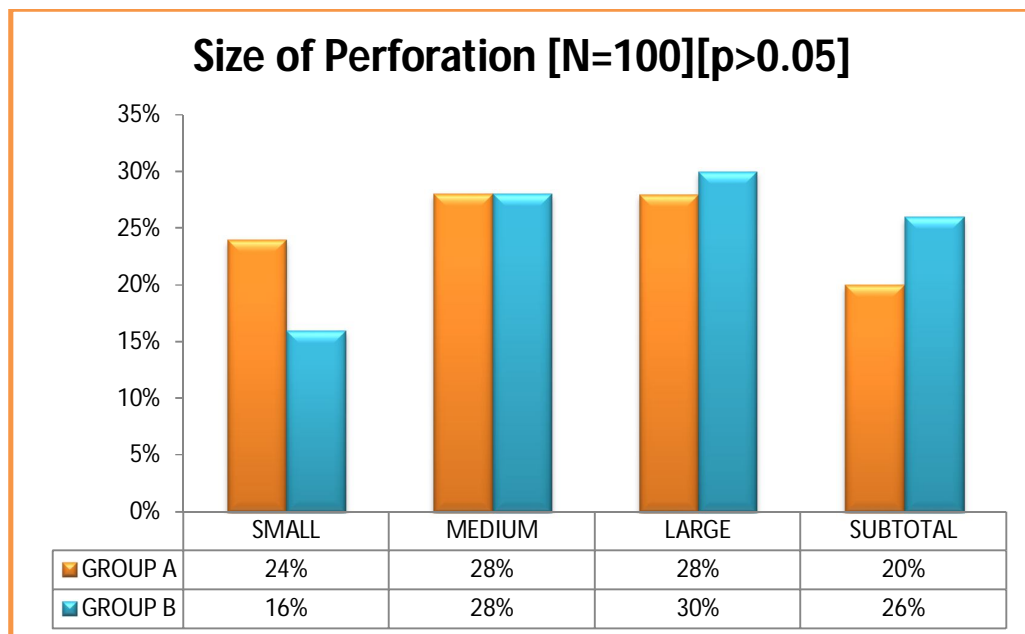
**TABLE 4 : SIDE AFFECTED IN WET EARS**

<b>SIDE AFFECTED</b>	<b>GROUP - B</b>	<b>(%)</b>
RIGHT	21	42%
LEFT	12	24%
BI-LATERAL	17	34%
<b>TOTAL</b>	<b>50</b>	<b>100%</b>



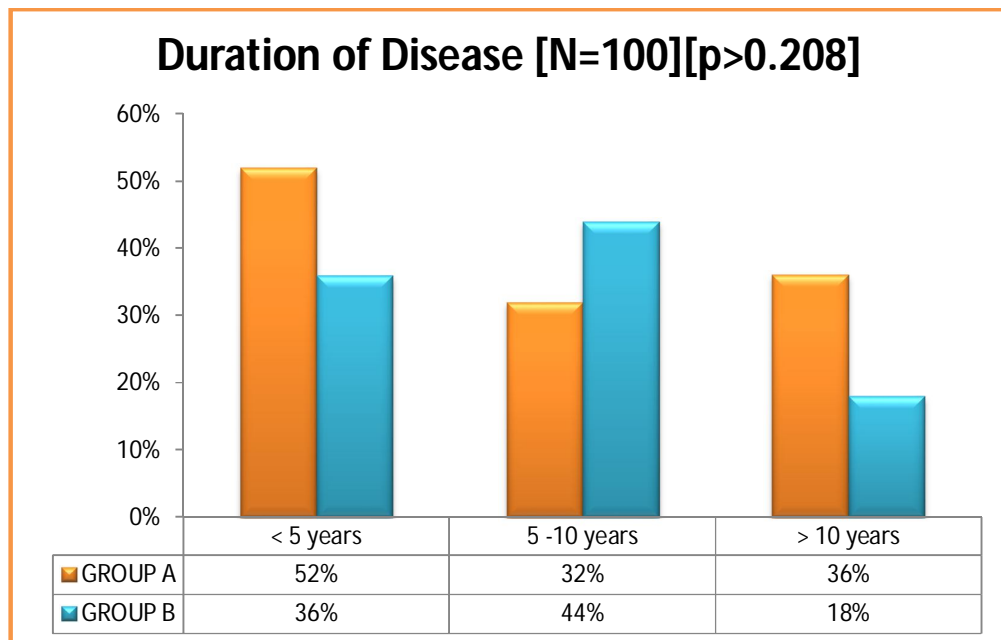
**TABLE 5 : SIZE OF PERFORATION**

SIZE	STUDY GROUP		TOTAL	(%)
	A	B		
SMALL	12	8	20	20%
MEDIUM	14	14	28	28%
LARGE	14	15	29	29%
SUBTOTAL	10	13	23	23%
<b>TOTAL</b>	<b>50</b>	<b>50</b>	<b>100</b>	<b>100%</b>



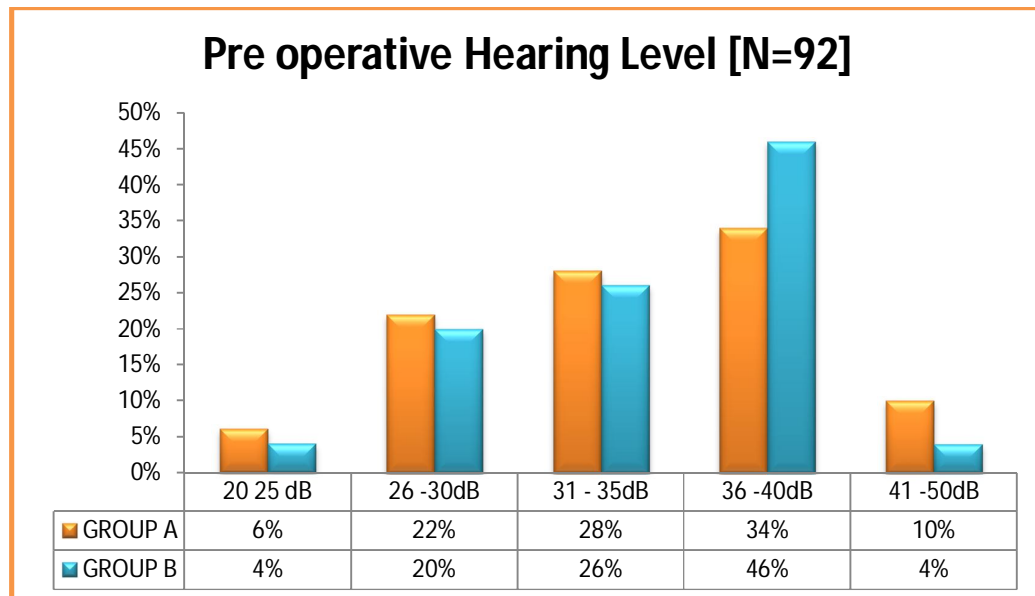
**TABLE 6 :DURATION OF DISEASE**

DURATION	STUDY GROUP		TOTAL	(%)
	A	B		
<5 years	26	18	44	44%
5-10 years	16	22	38	38%
>10 years	18	9	27	27%
<b>TOTAL</b>	<b>50</b>	<b>50</b>	<b>100</b>	<b>100%</b>



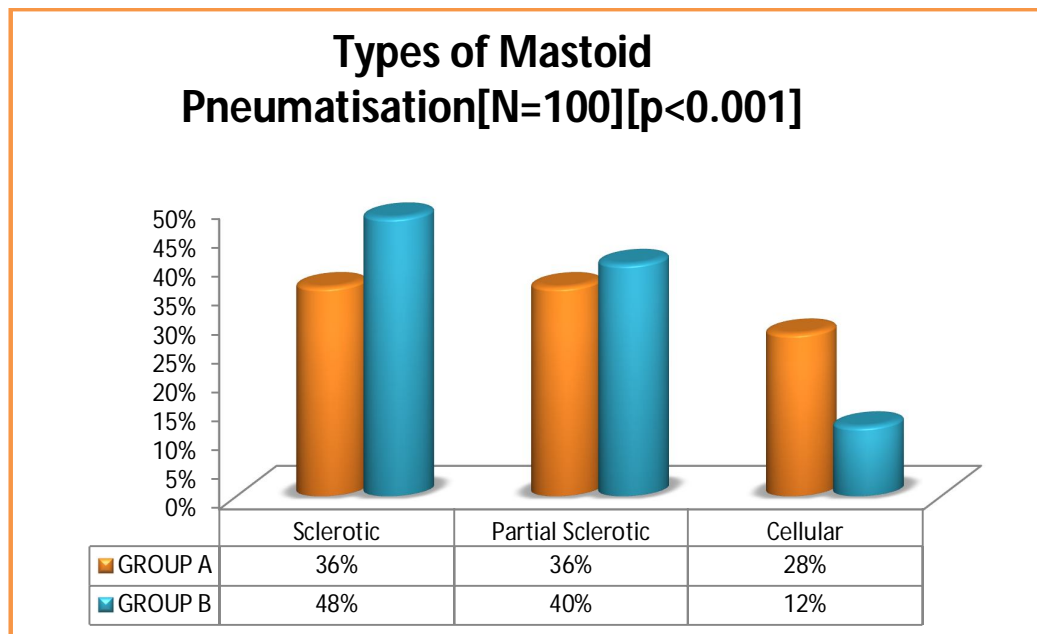
**TABLE 7 : PREOPERATIVE HEARING LEVEL  
MEASURED BY PTA**

HEARING	STUDY GROUP		TOTAL	(%)
	A	B		
20-25 DB	3	2	5	5%
26-30 DB	11	10	21	21%
31-35 DB	14	13	27	27%
36-40 DB	17	23	40	40%
41-50 DB	5	2	7	7%
<b>TOTAL</b>	<b>50</b>	<b>50</b>	<b>100</b>	<b>100%</b>



**TABLE 8 : TYPES OF MASTOID PNUMATISATION**

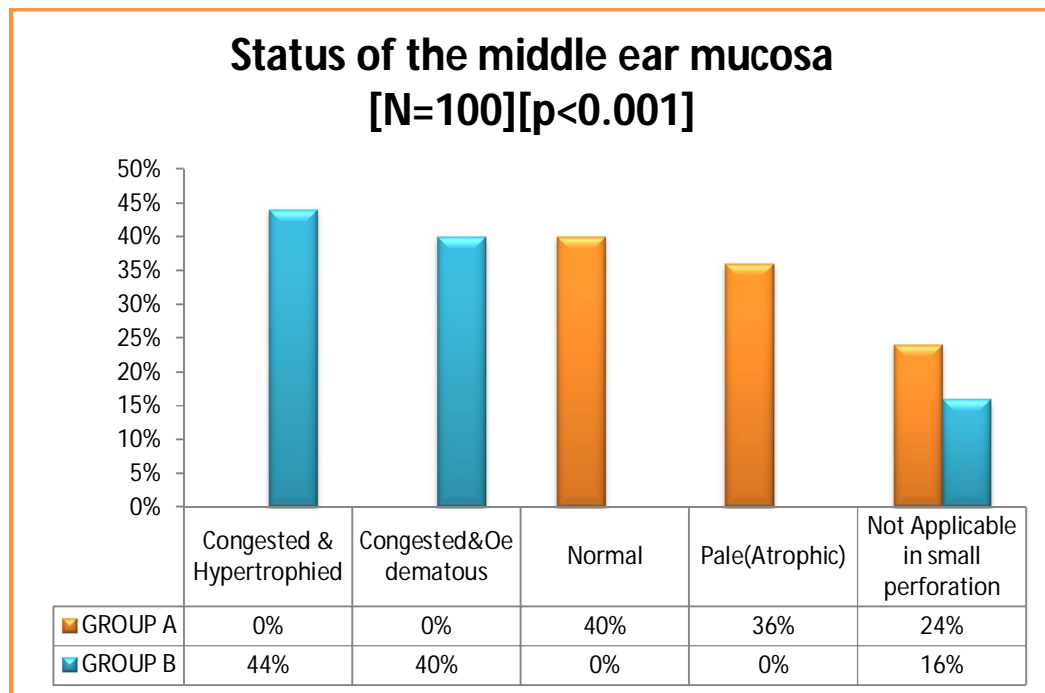
TYPES	STUDY GROUP		TOTAL (%)
	A	B	
Sclerotic	18	24	42%
Partial Sclerotic	18	20	38%
Cellular	14	6	20%
<b>TOTAL</b>	<b>50</b>	<b>50</b>	<b>100%</b>





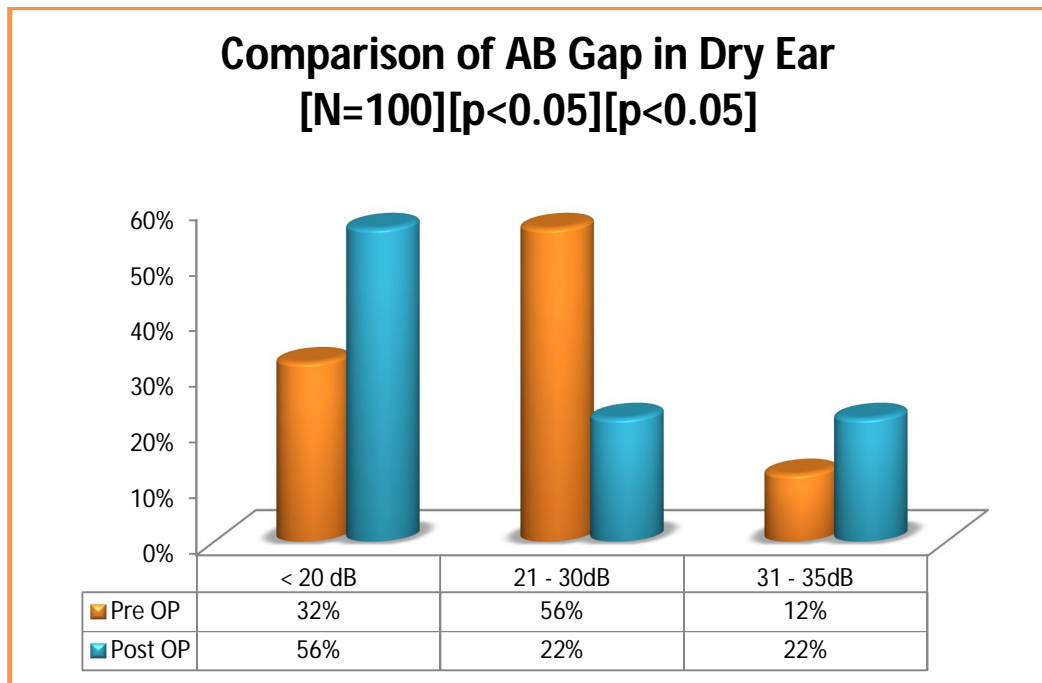
**TABLE 9 : STATUS OF THE MIDDLE EAR MUCOSA**

STATUS	STUDY GROUP		TOTAL	(%)
	A	B		
Congested & hypertrophied	-	22	22	22%
Congested & oedematous	-	20	20	20%
Normal	20	-	20	20%
Pale	18	-	18	18%
Not Applicable in small perforation	12	8	20	20%
Total	<b>50</b>	<b>50</b>	<b>100</b>	<b>100%</b>



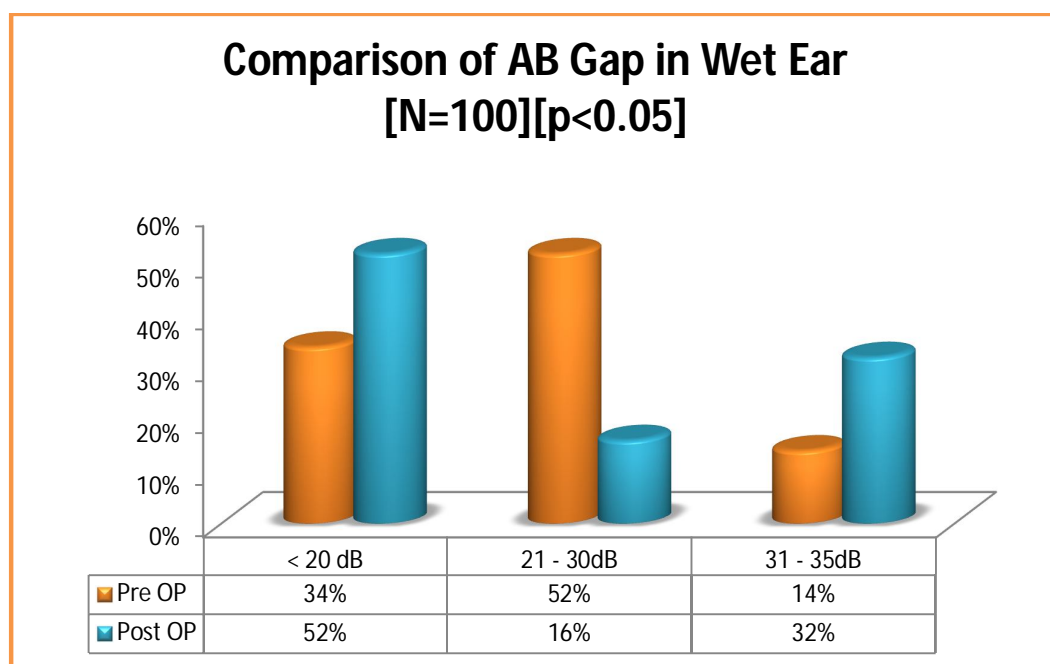
**TABLE 10 : COMPARISON OF AB GAP IN DRY EARS**

<b>AB GAP</b>	<b>PRE OP</b>	<b>POST OP</b>	<b>TOTAL</b>	<b>(%)</b>
<20 DB	16	28	44	44%
21-30 DB	28	11	39	39%
31-35 DB	6	11	17	17%
<b>TOTAL</b>	<b>50</b>	<b>50</b>	<b>100</b>	<b>100%</b>



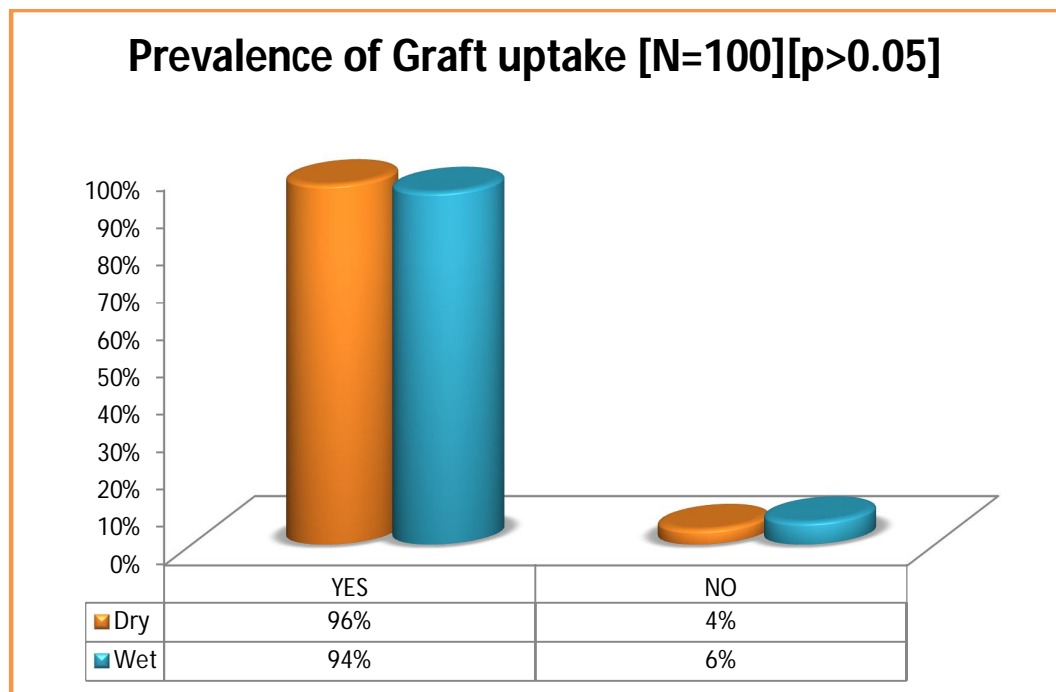
**TABLE 11 : COMPARISON OF AB GAP IN WET EARS**

<b>AB GAP</b>	<b>PRE OP</b>	<b>POST OP</b>	<b>TOTAL</b>	<b>(%)</b>
<20 DB	17	26	43	43%
21-30 DB	26	8	34	34%
31-35 DB	7	16	23	23%
<b>TOTAL</b>	<b>50</b>	<b>50</b>	<b>100</b>	



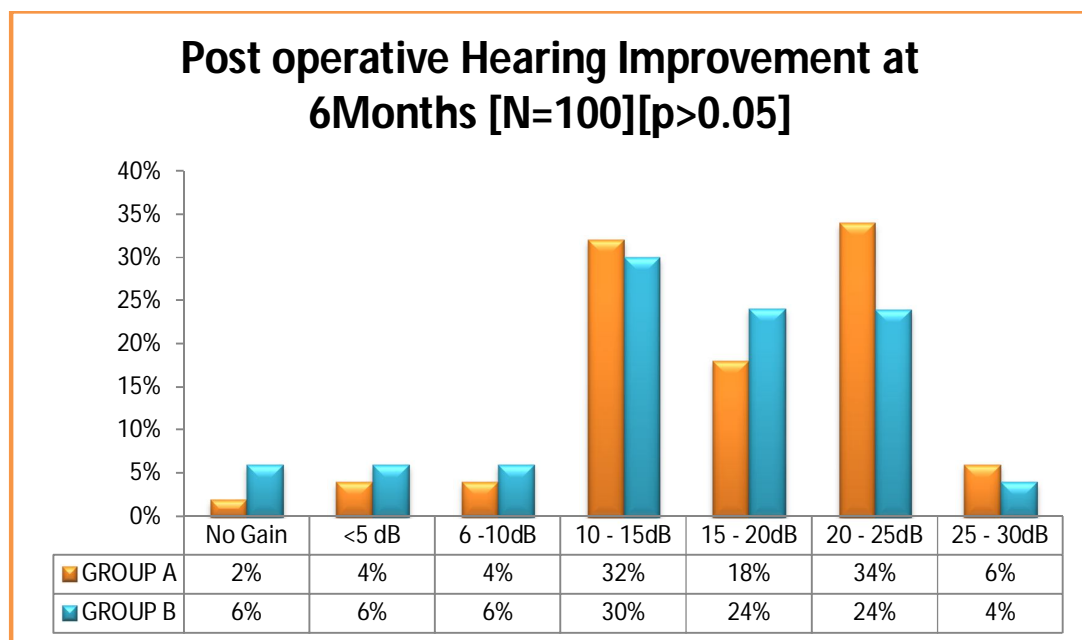
**TABLE 12 : PREVALENCE OF GRAFT UPTAKE**

<b>GRAFT</b>	<b>DRY</b>	<b>WET</b>	<b>TOTAL</b>	<b>(%)</b>
YES	48	47	95	95%
NO	2	3	5	5%
<b>TOTAL</b>	<b>50</b>	<b>50</b>	<b>100</b>	



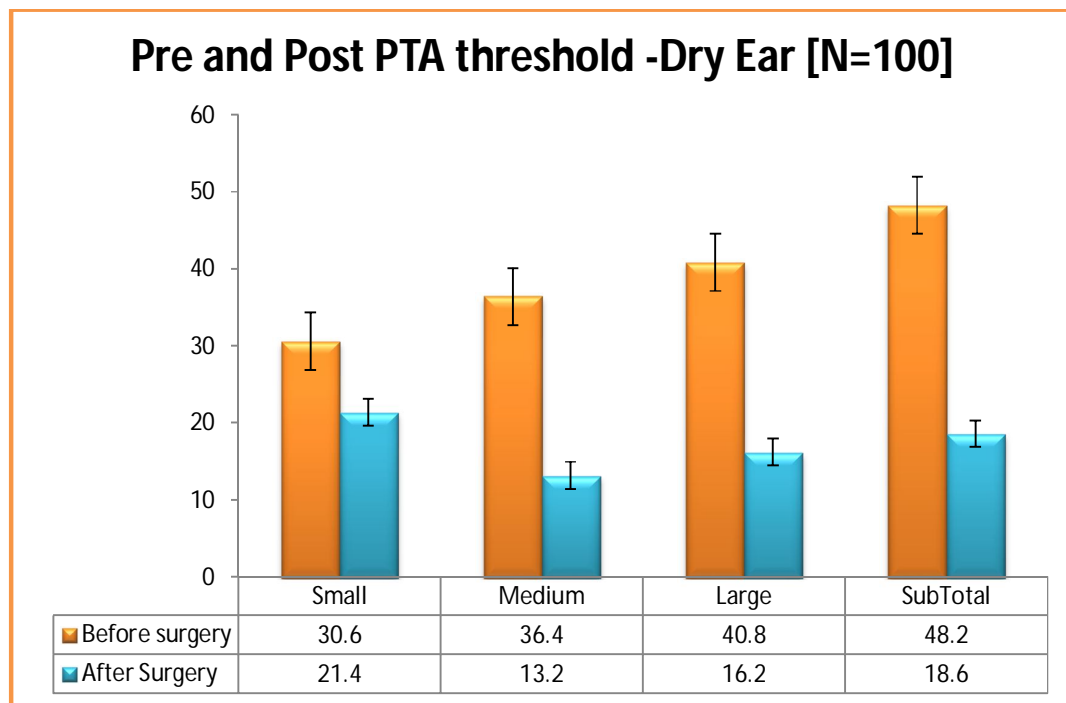
**TABLE 13 : POST - OPERATIVE HEARING IMPROVEMENT  
(AT 6 MONTHS)**

HEARING GAIN	STUDY GROUP		TOTAL	(%)
	GROUP A	GROUP B		
No Gain	1	3	4	3%
<5 DB	2	3	5	5%
6-10 DB	2	3	5	5%
10-15 DB	16	15	31	31%
15-20 DB	9	12	21	21%
20-25DB	17	12	29	29%
25-30DB	03	02	05	05%
<b>TOTAL</b>	<b>50</b>	<b>50</b>	<b>100</b>	



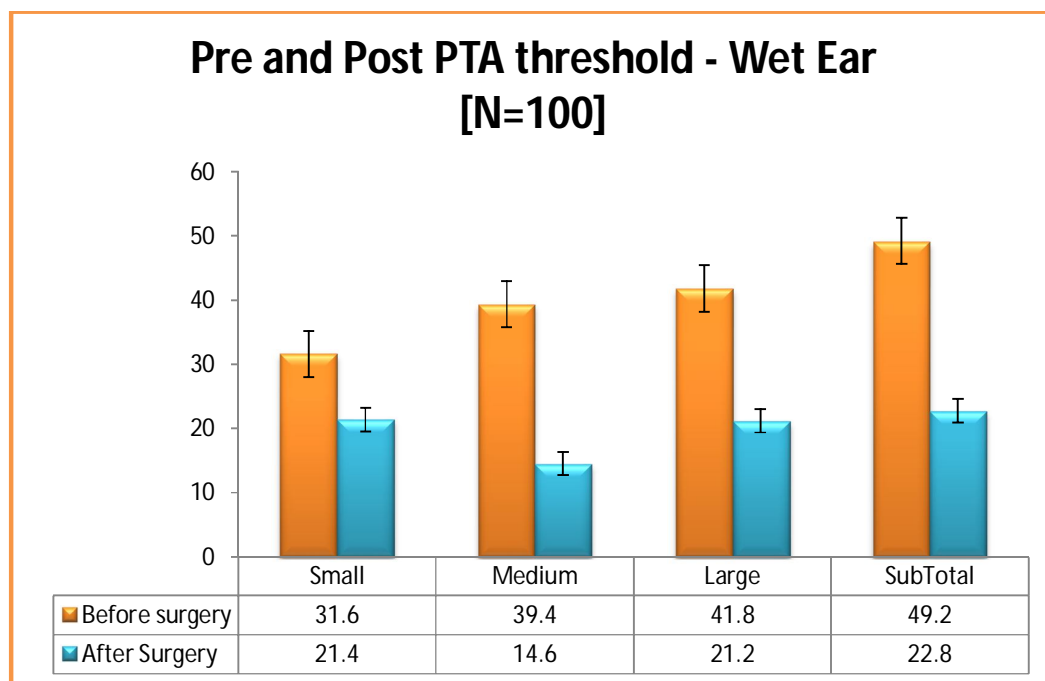
**TABLE 14 : POST - OPERATIVE HEARING IMPROVEMENT IN DRY EARS**

TYPE OF PERFORATION	AVERAGE PTA THRESHOLD		
	NOS	BEFORE SURVERY	AFTER SURGERY
Small	13	30.6	21.4
Medium	17	36.4	13.2
Large	14	40.8	16.2
Sub Total	6	48.2	18.6



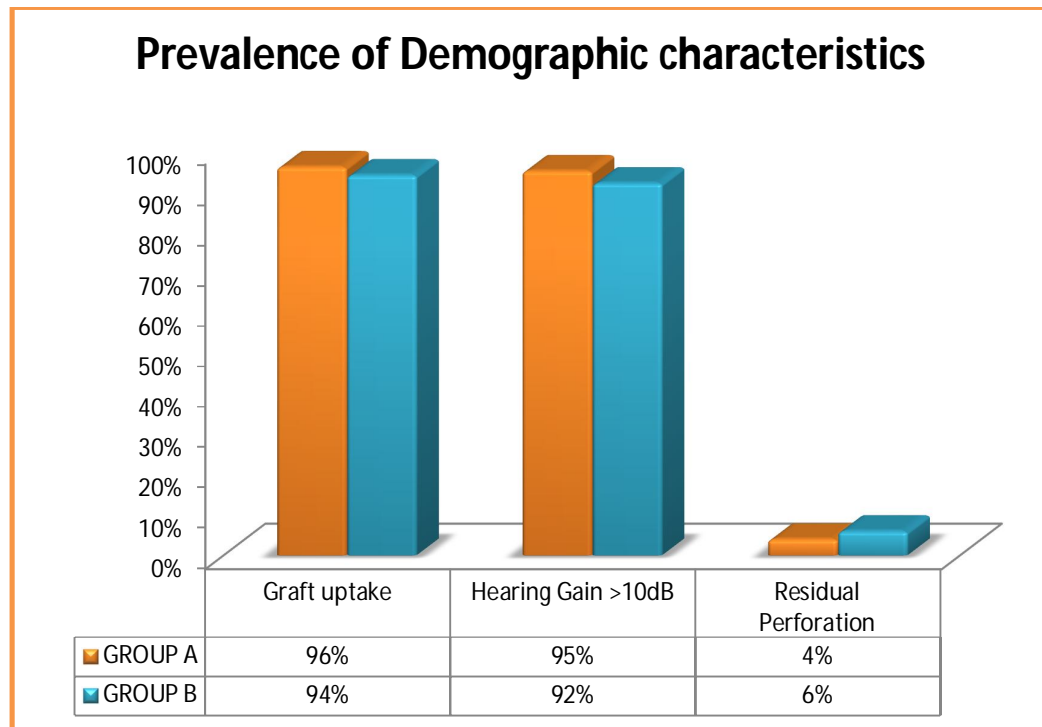
**TABLE 15 : POST OPERATIVE HEARING IMPROVEMENT IN WET EARS**

TYPE OF PERFORATION	AVERAGE PTA THRESHOLD		
	NOS	BEFORE SURGERY	AFTER SURGERY
Small	8	31.6	21.4
Medium	19	39.4	14.6
Large	15	41.8	21.2
Sub Total	8	49.2	22.8



**TABLE 16 : DEMOGRAPHIC CHARACTERISTICS  
OF BOTH GROUPS**

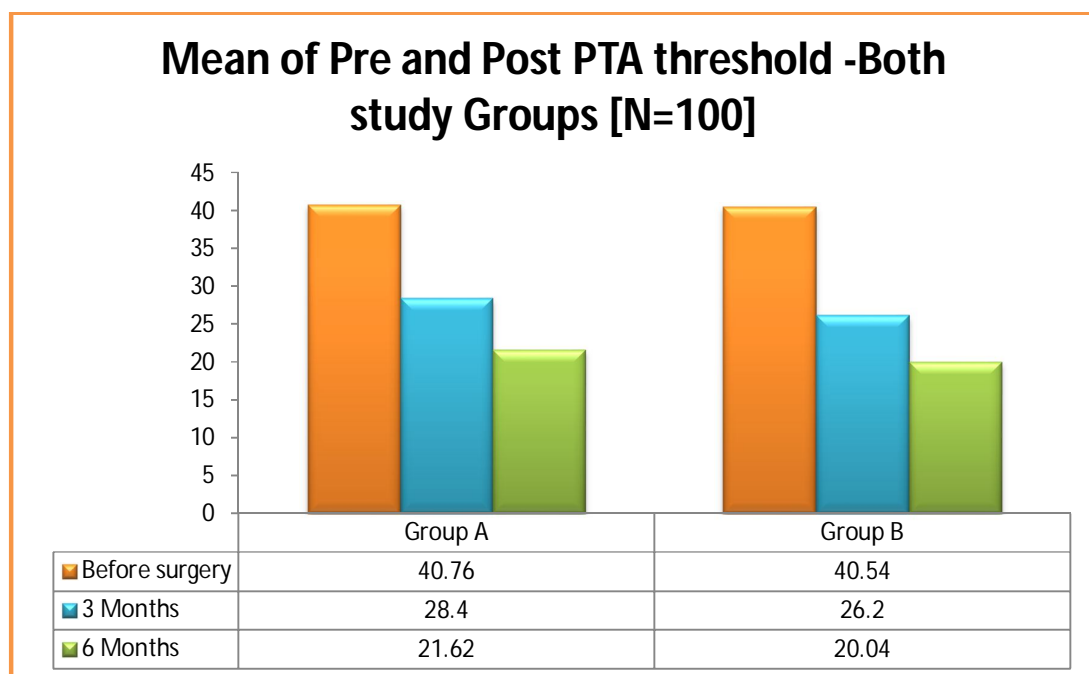
CHARACTERISTICS	STUDY GROUP	
	GROUP A	GROUP B
Graft uptake	96%	94%
Hearing Gain >10db	95%	92%
Residual Perforation	4%	6%





**TABLE 17 :BAR CHART SHOWING COMPARISON OF PTA BETWEEN GROUP A & B AT 3<sup>RD</sup> MONTH, AND 6<sup>TH</sup> MONTH**

STUDY	AVERAGE PTA THRESHOLD			
	GROUP	NOS	BEFORE SURGERY	AFTER SURGERY 3 MONTHS
Group A	50	40.76	28.4	21.62
Group B	50	40.54	26.2	20.04



## STATISTICAL ANALYSIS:

The data are reported as the mean +/- SD or the median, depending on their distribution. Frequencies are expressed in percentages. The differences in quantitative variables between groups were assessed by means of the unpaired t test and paired t test. The chi square test was used to assess differences in categorical variables between groups.

A p value of <0.05 using a two-tailed test was taken as being of significance for all statistical tests. All data were analysed with a statistical software package (SPSS, version 16.0 for windows)

### Mean of Clinical Variables

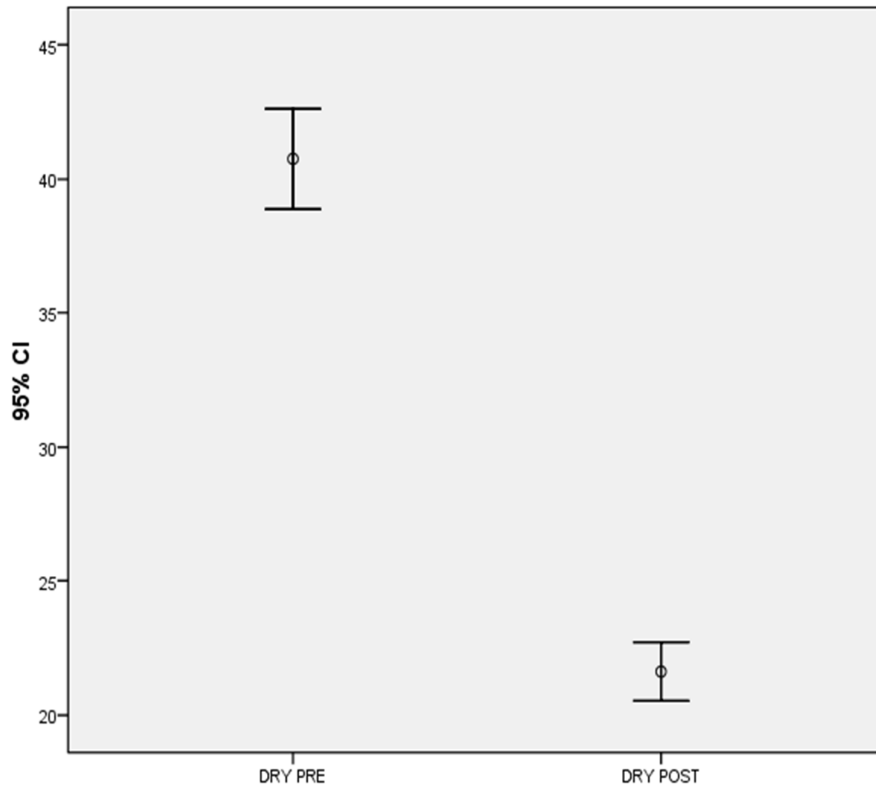
Mean+/- SD		
	DRY	WET
Before	40.76+/-6.57	40.54+/-6.56
After (6Months)	21.62+/-3.82	20.042+/-4.61
	p<0.001	p<0.001

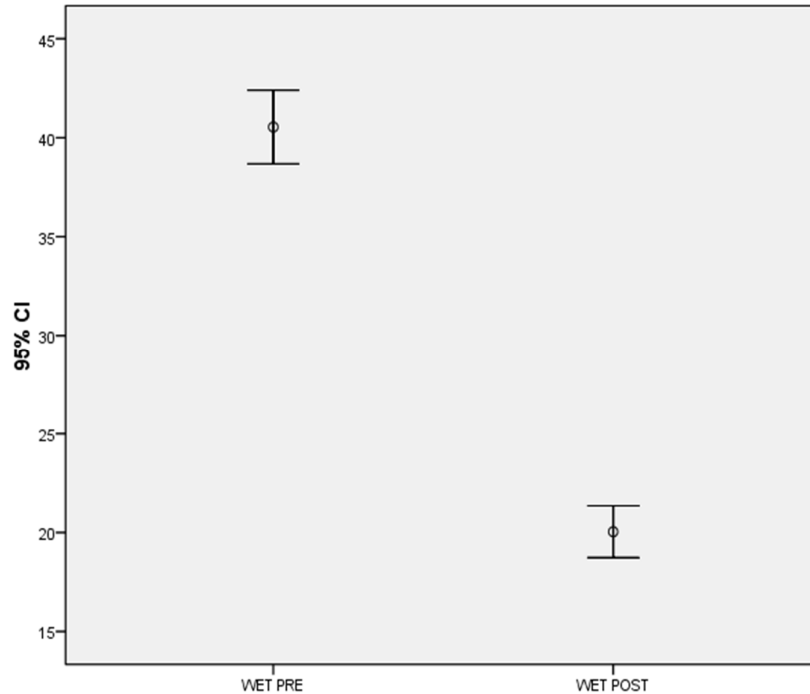
Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
DRY	PRE	40.76	50	6.56	0.93
	POST	21.62	50	3.82	0.54
WET	PRE	40.54	50	6.57	0.93

	POST	20.04	50	4.61	0.65
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### Paired Samples Test

		Paired Differences				
		Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference	
					Lower	Upper
DRY	PRE-POST	19.13	6.9045	0.97644	17.17176	21.09624
WET	PRE-POST	20.50	6.45023	0.9122	18.66486	22.33114





### **STATISTICAL ANALYSIS:**

The data are reported as the mean +/- SD or the median, depending on their distribution.

Frequencies are expressed in percentages.

The differences in quantitative variables between groups were assessed by means of the unpaired t test and paired t test

The chi square test was used assess differences in categoric variables between groups.

A p value of <0.05 using a two-tailed test was taken as being of significance for all statistical tests. All data were analysed with a statistical software package .(SPSS, version 16.0 for windows)

## DISCUSSION

Tympanoplasty is a surgery that removes infection from the middle ear and restore middle ear function in patients with COM. A number of investigations done regarding the impact of various factors such as perforation size, sex, age, discharge status of the ear at the time of surgery, status of the opposite ear, surgical approaches and techniques, and materials used for the graft. Robert and colleagues examined the risk factors of re-perforation following Tympanoplasty. They found that surgical technique was the more effective factor on the final results based on statistical analysis. Similarly, in our study factors such as age and sex, had no impact on the final results. Assuming that tympanoplasty in completely dry and atrophic ears with central perforations is more likely to fail in comparison to wet ears with central perforations, Vijayendra and colleagues (2007) performed histopathological examinations on the remaining tympanic membranes of the patients. They observed that in completely dry and atrophic membranes, blood vessels are quite marginalized, absent or as small as possible. In contrast, there were lots of inflammatory cells and blood vessels in the remaining membranes of wet ears. Therefore, they concluded that these types of changes in blood vessels are the main causes of failure in completely dry and atrophic

membranes with central perforations. Hence, they recommended taking the following steps while operating on these types of ears and membranes; (i) resection of the margins of perforations and converting central perforations to subtotal; (ii) raising large tympanomeatal flaps; (iii) temporal fascia graft placement between the bony wall of the canal and the large TM flap. They believe that these measures increase the chances of a successful surgery. Contrary of Vijayendra's results, the graft incorporation rate in dry eared patients was better than that of wet eared ones (96% of dry ears and 94% of wet ears) in our study. However this difference was not statistically significant.

Nagle and colleagues examined the results of type 1 tympanoplasty in 100 wet eared and dry eared patients with perforated tympanic membrane. They also compared the aural status and closing of the membrane perforation in the two groups. Hatice Emir and Ceylan et al., found that the status of the operated ear whether dry or discharging at the time of surgery did not influence the graft success rate. The most significant factor influencing results appeared to be the surgeon's experience. Ophir et al., in their study on tympanoplasty reports a success rate of 79%. They claim that the outcome of surgery could not be related to the presence or absence of chronic otitis media in the untreated ear, the status of operated ear (whether dry or discharging) or performance of

adenoidectomy before tympanoplasty. Glasscock et al., reviewed 1556 tympanic membrane graft cases, and opined that an ear did not have to be dry to achieve a good result. Adkins WY et al., in their study, reported an overall success rate of 89%. They concluded that age of the patient, duration of dry ear had no bearing on the success, although bilateral tympanic membrane perforation indicated poor prognosis. VatiainenE analysed failure cases in 417 tympanoplasty. He concluded that necrosis of the graft and anterior blunting were the main causes in early failures, whereas infection was the most common cause of re-perforation in later failures. Re-perforation was more frequent in larger perforations than small ones. Other preoperative factors like dry or wet ear, site of perforation or the grafting technique did not affect the graft uptake rate.

## SUMMARY

COM has a high prevalence in the population and its treatment continues to be a challenge for otorhinolaryngologists. Tympanoplasty is one of the most commonly performed procedures in otology.

Various factors influenced the success rate of this procedure such as age, site of perforation, condition of the middle ear mucosa, ear, status of the contralateral ear, number of otorrhoea per year, grafting material, surgical techniques, and associated pathologies like adenotonsillitis, sinusitis,

It is a common belief that surgery in wet ear seems to have a poorer result. While performing dry and wet tympanoplasties, some are of the opinion that results of dry ear are better while some believe that results of wet ear are better. The present study has been done to find out the graft uptake rates in dry and wet tympanoplasty, to compare the hearing gain achieved in dry and wet tympanoplasty and to look for complications both in dry and wet ear during the follow-up period.

Aural swab in wet ear showed discharge being sterile on culture and sensitivity.



94% of the patients with wet ear had successful graft uptake after 6 months of followup in our study.

Presence of increased vascularity and inflammatory infiltrates were the reasons for better results in discharging ears.

The atrophic portion of the remnant TM has to be removed to improve the success rate.

Anterior perforations required special care to secure the anterior edge of the graft between the bony anterior canal wall and its skin (anterior tucking). Good vascularisation or angiogenesis of the grafting material is important for successful grafting in tympanoplasty.

The main complication of the underlay technique is re-perforation due to failure of graft uptake because of poor vascularity especially in large and subtotal perforation.

## CONCLUSION

We had a success rate of 96% in dry ears and 94 % in wet ears. Presence of mucoid discharge which is culture negative at the time of surgery does not affect on the success rate of surgery as it doesnot interfere much with the results of tympanoplasty. There is no significant difference in the success rate in both the dry and culture negative wet ears in our study. Hearing improvement, graft uptake and clinical improvement were found to be statistically insignificant between both groups.

## **LIMITATIONS**

The present study has following limitations:

1. There was difficulty in long term follow-up of patients
2. As it was conducted in a particular area, it cannot be generalized.

## BIBLIOGRAPHY

1. Bezolds Catalogue of the Looyunji'k Collection. Leiden Papyrus, 348: Norske Magazine for Laageuidenskaben II.R, vol 10, 1880 and Nordeskt Medicinskt Archiuvol 12, no. 11,1880
2. Hippocrates (1935) De Carnibus. [in German and Greek]. TranslatedbyTeubren BB. Leipzig, Berlin
3. Banzer M. Disputatio de Auditione Laesa. Wittenbergae: Johannis Rohrerei; 1651.
4. Petit JL (1774) Traite des Maladies Chirurgicales. Paris
5. Ballance CA. Essays on the surgery of the temporal bone. London: MacMillan; 1919.
6. Toynbee J. On the use of an artificial membrane Qmpaniin cases of deafness dependent upon perforations or destruction of the natural organ. London: J Churchill & Sons; 1853.
7. Wilde W (1853) Aural surgery. Dublin
8. Von Troltsch AF. Lehrbuch der Ohrenheilkundemit Einschlussder Anatomiedees Ohres. Leipzig: Fogel; 1873.
9. Von Bergmann E. Die Chirurgische Behandlunguon Hirnkrankheiten. Berlin: A Hirschwall; 1889.
10. Zaufal E. Technik der Trepanation des Proc. Mastoid. Nach Kuster'schenGrundsätzen. Arch Ohrenh. 1890;30:291.

11. Blake CJ. Transactions of the first congress of the international otological society. New York: D. Appleton & Company; 1887.
12. Berthold E. Uebermyringoplastik. Wier Med Bull. 1878;1:627.
13. Wullstein H. The restoration of the function of the middle ear in chronic otitis media. Ann Otol Rhinol Laryngol. 1971;80(2):210–217.
14. Zollner F. The principles of plastic surgery of the sound-conducting apparatus. J Laryngol Otol. 1955;69:637. doi: 10.1017/S0022215100051240
15. Sooy FA. A method of repairing a large marginal perforation. Ann OtoE. 1956;65:911
16. House WF. Myringoplasty. Arch Otolaryngol. 1960;71:399–404. doi: 10.1001/archotol.1960.03770030041009.
17. House WF, Sheehy JL. Myringoplasty: use of ear canal skin compared with other techniques. Arch Otolaryngol. 1961;73:407. doi: 10.1001/archotol.1961.00740020417009.
18. Sheehy JL, Glasscock ME. Tympanic membrane grafting with temporalis fascia. Arch Otolaryngol. 1967;86:391. doi: 10.1001/archotol.1967.00760050393008.
19. Shea JJ., Jr Vein graft closure of eardrum perforations. J Laryngol Otol. 1960;74:358–362. doi: 10.1017/S002221510005670X.
20. Austin DF. Transcanal tympanoplasty. Otolaryngol Clin North Am. 1972;5:12743.

21. Tabb HG. Closure of perforations of the tympanic membrane by vein grafts: a preliminary report of 20 cases. *Laryngoscope*. 1960;70:271
22. Storrs LA. Myringoplasty with the use of fascia grafts. *Arch Otolaryngol*. 1961;74:65–69.
23. Patterson ME, Lockwood RW, Sheehy JL. Temporalis fascia in tympanic membrane grafting. *Arch Otolaryngol*. 1967;85:73–77.
24. Derlacki EL. Repair of central perforations of tympanic membrane. *Arch Otolaryngol*. 1953;58:405–420. doi: 10.1001/archotol.1953.00710040427003.
25. Banzer M. *Op. cit*
26. Toynbee J. *Op. cit*
27. Yearsley J. Deafness, practically illustrated. 2. London: J Churchill & Sons; 1863.
28. Perkins R. Human homograft otologic tissue transplantation: buffered formaldehyde preparation. *Trans Am Acad Ophthalmol Otolaryngol*. 1970;74:278–282.
29. Blake CJ. *Op. cit*
30. House HP (1986) Personal communication, May 1986
31. Pohlman ME. The artificial eardrum. *Ann Otol Rhinol Laryngol*. 1951;60(1):17–21
32. Shea JJ., Jr Vein graft closure of eardrum perforations. *J Laryngol Otol*. 1960;74:358–362. doi: 10.1017/S002221510005670X.

33. Kartush JM, Michaelides EM, Becvarovski Z, LaRouere MJ. Over-under tympanoplasty. *Laryngoscope*. 2002;112:802–807. doi: 10.1097/00005537-200205000-00007.
34. Karlan MS. Gelatin film sandwich in tympanoplasty. *Otolaryngol Head Neck Surg*. 1979;87:84–86. doi: 10.3109/00016487909126391
35. Hartwein J, Leuwer RM, Kehrl W. The total reconstruction of the tympanic membrane by the ‘Crown-cork’ technique. *Am J Otolaryngol*. 1992;13:172–175. doi: 10.1016/0196-0709(92)90118-D
36. Schwaber MK. Postauricular undersurface tympanic membrane grafting: some modifications of the ‘swinging door’ technique. *Otolaryngol Head Neck Surg*. 1986;95:182–187.
37. Escudero LH, Castro AO, Drumond M, et al. Argon laser in human tympanoplasty. *Arch Otolaryngol*. 1979;105:252–253. doi: 10.1001/archotol.1979.00790170022005.
38. Williams JD. Microclip application in tympanoplasty. *Ann Otol Rhinol Laryngol*. 1977;86:223–226.
39. Goodman WS, Wallace IR. Tympanoplasty: 25 years later. *J Otolaryngol*. 1980;9:155–164.
40. Albera R, Ferrero V, Canale G. Annular wedge tympanoplasty: a variation of overlay myringoplasty. *Acta Otorhinolaryngol Ital*. 1997;17(1):15–21.

41. Kartush J. TMPatcher: a new device to close tympanic membrane. Perforations in an office setting. *Am J Otol.* 2000;21:615–620.
42. Sheehy JL, Glasscock ME. Tympanic membrane grafting with temporalis fascia. *Arch Otolaryngol.* 1967;86:57–68.
43. Austin DF, Shea JJ., Jr A new system of tympanoplasty using vein graft. *Laryngoscope.* 1961;71:596–611
44. Doyle JP, Schleuning AJ, Echevarria J. Tympanoplasty: should grafts be placed medial or lateral to the tympanic membrane? *Laryngoscope.* 1972;82:1425–1430. doi: 10.1288/00005537-197208000-00005
45. Glasscock ME. Tympanic membrane grafting with fascia: overlay vs. undersurface technique. *Laryngoscope.* 1973;83:754–770. doi: 10.1288/00005537-197305000-00011.
46. Sheehy JL, Anderson RG. Myringoplasty: a review of 472 cases. *Ann Otol Rhinol Laryngol.* 1980;89:331–334
47. Palva T, PaIva A, Karja J. Myringoplasty. *Ann Otol Rhinol Laryngol.* 1969;78:1074–1080. 52. Escudero LH, Castro AO, Porto SPS et al (1977) Laser radiation in ear surgery. Read before the 11th World Congress of Otorhinolaryngology, Buenos Aires, March
48. Eichler J, Lenz H. Laser applications in medicine and biology: a bibliography. *Appl Opt.* 1977;16:27–45. doi: 10.1364/AO.16.00002754. Escudero LH, Castro AO, Drumond M, Porto SPS, Bozinis DG, Penna AFS, Gallego-Lluesma E. Argon



- laser in human tympanoplasty. *Arch Otolaryngol.* 1979;105:252–253. doi: 10.1001/archotol.1979.00790170022005.
49. 55. Marchioni D, Alicandri-Ciufelli M, Molteni G, Genovese E, Presutti L. Endoscopic tympanoplasty in patients with attic retraction pockets. *Laryngoscope.* 2010;120(9):1847–1855. doi: 10.1002/lary.21069
50. Badr-el-Dine M. Value of ear endoscopy in cholesteatoma surgery. *Otol Neurotol.* 2002;23:631–635. doi: 10.1097/00129492-200209000-00004.
51. Presutti L, Marchioni D, Mattioli F, Villari D, Alicandri-Ciufelli M. Endoscopic management of acquired cholesteatoma: our experience. *J Otolaryngol Head Neck Surg.* 2008;37:481–487.
52. Ayache S, Tramier B, Strunski V. Otoendoscopy in cholesteatoma surgery of the middle ear: what benefits can be expected? *Otol Neurotol.* 2008;29:1085–1090. doi: 10.1097/MAO.0b013e318188e8d7
53. A. Akyigit, T. Karlidag, E. Keles, I. Kaygusuz, S. Yalcın, C. Polat, O. Eroglu Endoscopic cartilage butterfly myringoplasty in children O.G. Awad, K.A. Hamid Endoscopic type 1 tympanoplasty in pediatric patients using tragal cartilage Ayache, B. Tramier, V. Strunski Otoendoscopy in cholesteatoma surgery of the middle ear: what benefits can be expected? *Otol. Neurotol.*, 29 (8) (2008 Dec), pp. 1085-1090, 10.1097/MAO.0b013e318188e8d7

54. Dine, A.L. James, G. Panetti, D. Marchioni, L. Presutti, J.F.Nogueira  
Instrumentation and technologies in endoscopic ear surgery  
*Otolaryngol. Clin. North Am.*, 46 (2) (2013 Apr), pp. 211-225,  
10.1016/j.otc.2012.10.005
55. B.U. Coskun, U. Cinar, H. Seven, S. Ugur, B. Dadas  
The effects of the incision types in myringoplasty operations on cosmesis  
*Eur. Arch. Otorhinolaryngol.*, 263 (9) (2006 Sep), pp. 820-822
56. V. Couloigner, F. Baculard, W. ElBakkouri, P. Viala, M. François,  
P. Narcy, T. Van Den Abbeele  
Inlay butterfly cartilage tympanoplasty in children  
*Otol. Neurotol.*, 26 (2) (2005 Mar), pp. 247-251
57. R.D. Eavey  
Inlay tympanoplasty: cartilage butterfly technique  
*Laryngoscope*, 108 (5) (1998 May), pp. 657-661  
el-Guindy, 1992
58. 67.Ghanemet al.2006M.A. Ghanem, A. Monroy, F.S. Alizade, Y. Nicolau,  
R.D. Eavey  
Butterfly cartilage graft inlay tympanoplasty for large perforations  
*Laryngoscope*, 116 (10) (2006 Oct), pp. 1813-1816
59. 68.Haksevert al.,2015M. Haksever, D. Akduman, F. Solmaz, E. Gündoğdu  
Inlay butterfly cartilage tympanoplasty in the treatment of dry central perforated chronic otitis media as an effective and time-saving procedure  
*Eur. Arch. Otorhinolaryngol.*, 272 (4) (2015), pp. 867-872
60. G.J. Jako  
Postaural versus endaural exposure in tympanoplasty  
*Laryngoscope*, 77 (11) (1967 Nov), pp. 2022-2031

61. S. Kakehata, K. Futai, A. Sasaki, H. Shinkawa Endoscopic transtympanic tympanoplasty in the treatment of conductive hearing loss: early results *Otol. Neurotol.*, 27 (1) (2006 Jan), pp. 14-19
62. T.S. Karhuketo, H.J. Puhakka Endoscope-guided round window fistula repair *Otol. Neurotol.*, 22 (6) (2001 Nov), pp. 869-873
63. T.S. Karhuketo, J.H. Ilomaki, H.J. Puhakka Tympanoscope-assisted myringoplasty *ORL: J. Otorhinolaryngol. Relat. Spec.*, 63 (2001), pp. 353-357 Kessler et al., 1994
64. A. Kessler, W.P. Potsic, R.R. Marsh Type 1 tympanoplasty in children *Arch. Otolaryngol. Head Neck Surg.*, 120 (5) (1994 May), pp. 487-490 Kojima et al., 2014
65. H. Kojima, M. Komori, S. Chikazawa, Y. Yaguchi, K. Yamamoto, K. Chujo, H. Moriyama Comparison between endoscopic and microscopic stapes surgery *Laryngoscope*, 124 (1) (2014 Jan), pp. 266-271, 10.1002/lary.24144
66. Migirov and Wolf Migirov L, Wolf M. Minimally invasive transcanal endoscopic ear surgery. <http://dx.doi.org/10.5772/60551>.
67. Mokbelet al., 2015 K.M. Mokbel, W. Moneir, H. Elsis, A. Albosky Endoscopic transcanal cartilage myringoplasty for repair of subtotal tympanic membrane perforation: a method to avoid postauricular incision *J. Otolaryngol. Rhinol.*, 1 (2015), p. 2 Nogueira Nogueira JF. Endoscopic ear surgery. Dissection manual.

68. Patelet al.,2015J. Patel, R.G. Aiyer, Y. Gajjar, R. Gupta, J. Raval, P.P. SutharEndoscopic tympanoplasty vs microscopic tympanoplasty in tubotympanic CSOM: a comparative study of 44 casesInt. J. Res. Med. Sci., 3 (8) (2015), pp. 1953-1957
69. Plinkert and Löwenheim, 1997P. Plinkert, H. LöwenheimTrends and perspectives in minimally invasive surgery in otorhinolaryngology-head and neck surgeryLaryngoscope, 107 (11 Pt 1) (1997 Nov), pp. 1483-1489Poe and Bottrill, 1994
70. D.S. Poe, I.D. BottrillComparison of endoscopic and surgical explorations for perilymphatic fistulasAm. J. Otol., 15 (6) (1994 Nov), pp. 735-738
71. Pothier, 2013D.D. PothierIntroducing endoscopic ear surgery into practiceOtolaryngol. Clin. North Am., 46 (2) (2013 Apr), pp. 245-255, 10.1016/j.otc.2012.10.009
72. Raj and Meher, 2001A. Raj, R. MeherEndoscopic transcanal myringoplasty – a studyIndian J. Otolaryngol. Head Neck Surg., 53 (1) (2001 Jan), pp. 47-49, 10.1007/BF02910979
73. Rosenberget al.,1994S.I. Rosenberg, H. Silverstein, T.O. Willcox, M.A. GordonEndoscopy in otology and neurotology Am. J. Otol., 15 (2) (1994 Mar), pp. 168-172
74. Sakagamiet al.,2000M. Sakagami, Y. Mishiro, K. Tsuzuki, T. Seo, M. SoneBilateral same day surgery for bilateral perforated chronic otitis mediaAuris Nasus Larynx, 27 (1) (2000 Jan), pp. 35-38

75. Sarkar, 2013S. SarkarA review on the history of tympanoplasty  
Indian J. Otolaryngol. Head Neck Surg., 65 (Suppl. 3) (2013 Dec),  
pp. 455-460, 10.1007/s12070-012-0534-5(Epub 2012 Mar 22)
76. Thomassin et al., 1990 J.M. Thomassin, J.M. Duchon-  
Doris, B. Emram, C. Rud, J. Conciatori, P.VilcoqEndoscopic ear  
surgery. Initial evaluationAnn. Otolaryngol.Chir.  
Cervicofac., 107 (8) (1990), pp. 564-570
77. Thomassin et al., 1993J.M. Thomassin, D. Korchia, J.M. Doris  
Endoscopic-guided otosurgery in the prevention of residual  
cholesteatomas Laryngoscope, 103 (8) (1993 Aug), pp. 939-943
78. Tuncer, 2016U. TuncerHistory of the endoscopic ear surgery  
TurkiyeKlinikleriJ E.N.T.-Special Topics, 9 (1) (2016), pp. 1-3
79. Yu and Yoon, 2010M.S. Yu, T.H. YoonBilateral same-day surgery  
for bilateral perforated chronic otitis media: inlay butterfly  
cartilage myringoplastyOtolaryngol. Head Neck  
Surg., 143 (5) (2010 Nov), pp. 669-672, 10.1016/  
j.otohns.2010.07.013
80. Yung, 2001M.W. YungThe use of middle ear endoscopy: has  
residual cholesteatoma been eliminated?J. Laryngol.  
Otol., 115 (12) (2001 Dec), pp. 958-961
81. Hirsch BE. "Myringoplasty and Tympanoplasty."In Operative  
Otolaryngology/Head & Neck Surgery. Eugene N Myers. Pages  
1246 – 1261. 2

82. Surgery of the Ear. Shambaugh and Glasscock. 1980. Pages 411 – 412.
83. Sheehy JL and Shelton C. “Tympanoplasty: To stage or not to stage.” *Oto –HNS*. Vol 104. No 3, pages 399-407.
84. Podoshin L et al. “Tympanoplasty in Adults: A Five- Year Survey.” *ENT Journal*. Vol 75, No 3. Pages 149- 156.
85. Luetje CM. “Reconstruction of the Tympanic Membrane and Ossicular Chain.” In Byron J Bailey *Head & Neck Surgery – Otolaryngology*. 2nd ed. Pages 2073 – 2082.
86. Smyth GDL. “Toynbee Memorial Lecture 1992: Facts and fantasies in modern otology: the ear doctor’s dilemma.” *Journal of Laryngology and Otology*. Vol 106, pp 591-596.
87. Halik JJ and Smyth GDL. “Longterm results of Tympanic Membrane Repair.” *Oto-HNS*. Vol 98, No 2. Pages 162-9.
88. Albu S et al. “Prognostic Factors in Tympanoplasty.” *American Journal of Otology*. Vol 19:136-140.
89. Tos M and Lau T. “Stability of Tympanoplasty in Children.” *Oto Clinics of North America*. Vol 22, No 1, pages 15- 28.
90. Podoshin L et al. “Type I Tympanoplasty in Children.” *American Journal of Otology*. 17:293-296. 11 Gianoli GJ et al. “Pediatric Tympanoplasty
91. Zollner, F. The principles of plastic surgery of the sound-conducting Apparatus. *J Laryngol Otol*. 1955;69:637-652

92. Nadol, J.B., Schuknecht, H.F. Surgery of the Ear and Temporal Bone. (ed 1). Raven Press, New Your, NY;1993
93. Merchant, S.N., Rosowski, J.J. Auditory physiology and middle-ear mechanics. in: M.E. Glasscock, A.J. Gulya (Eds.) Surgery of the Ear. ed5. BC Decker, Ontario, Canada; 2003:59–82.
94. Schuknecht, H.F. Pathology of the Ear. (ed 2). Lea and Febiger, Philadelphia, PA; 1993.
95. Merchant, S.N., Ravicz, M.E., Voss, S.E. et al, Toynebee Memorial Lecture 1997- Middle-ear mechanics in normal, diseased and reconstructed ears. *J Laryngol Otol.* 1998;112:715–731
96. Merchant, S.N., Nadol, J.B. Jr. Histopathology of ossicular implants. *Otolaryngol Clin North Am.* 1994;27:813–833.
97. Merchant, S.N., McKenna, M.J., Mehta, R.P. et al, Middle-ear mechanics of type III tympanoplasty (stapes columella): II. Clinical studies. *Otol Neurotol.* 2003;24:186–194.
98. Mehta, R.P., Ravicz, M.E., Rosowski, J.J. et al, Middle-ear mechanics of type III tympanoplasty (stapes columella): I. Experimental studies. *Otol Neurotol.* 2003;24:176–185.
99. Merchant, S.N., Wang, P., Jang, C.H. et al, Efficacy of tympanomastoid surgery for control of infection in active chronic otitis media. *Laryngoscope.* 1997;107:872–877.
100. Wullstein, H. Results of tympanoplasty. *Arch Otolaryngol.* 1960;71:478–485.

101. Lee, K., Schuknecht, H.F. Results of tympanoplasty and mastoidectomy at the Massachusetts Eye and Ear Infirmary. *Laryngoscope*. 1971;81:529–543.
102. Jackson, C.G., Glasscock, M.E., Schwaber, M.K. et al, Ossicular chain reconstruction (The TORP and PROP in chronic ear disease) . *Laryngoscope*. 1983;93:981–988.
103. Brackmann, D.E., Sheehy, J.L., Luxford, W.M. TORPS and PORPS in tympanoplasty (Review of 1042 operations). *Otolaryngol Head Neck Surg*. 1984;92:32–37.
104. Colletti, V., Fiorino, F.G., Sittoni, V. Minisculptured ossicle grafts versus implants (Long-term results) . *Am J Otol*. 1987;8:553–559.
105. Toner, J.G., Smyth, G.D.L. Surgical treatment of cholesteatoma (A comparison of three techniques) . *Am J Otol*. 1990;11:247–249.
106. Roden, D., Honrubia, V.F., Wiet, R. Outcome of residual cholesteatoma and hearing in mastoid surgery. *J Otolaryngol*. 1996;25:178–181.
107. Rosowski, J.J., Merchant, S.N. Mechanical and acoustical analysis of middle ear reconstruction. *Am J Otol*. 1995;16:486–497.
108. Whittemore, K.R., Merchant, S.N., Rosowski, J.J. Acoustic mechanisms (Canal wall-up versus canal wall-down mastoidectomy) . *Otolaryngol Head Neck Surg*. 1998;118:751–761.
109. Gyo, K., Goode, R.L., Miller, C. Effect of middle-ear modification on umbo vibration-human temporal bone experiments with a new



- vibration measuring system. *Arch Otolaryngol Head Neck Surg.* 1986;112:1262–1268
110. Farrior, J. The anterior tympanomeatal angle in tympanoplasty: Surgical technique for the prevention of blunting. *Laryngoscope.* 1983;93:992–997.
111. Farrior, J. Sandwich graft tympanoplasty: Experiences, results, complications. *Laryngoscope.* 1989;99:213–217.
112. Farrior, J. Complications of otitis media in children. *South Med J.* 1990;83:645–648.
113. Farrior, J. Complications of tympanoplasty. in: Eisle DW (Ed.) *Complications in Head and Neck Surgery.* Mosby, Baltimore, MD; 1993:694–706.
114. Farrior, J. Incisions in tympanoplasty: Anatomic considerations and indications. *Laryngoscope.* 1983;93:75–86.
115. Applebaum, EL, Deusch, EC. Fluorescein angiography of the tympanic membrane. *Laryngoscope.* 1985;95:1054–1058.
116. Glasscock, ME, Jackson, CG, Nissen, AS et al, Postauricular under surface tympanic membrane graft: A follow-up report. *Laryngoscope.* 1982;92:718–727.
117. Tos, M, Everberg, M, Henricksen, J. Autologous tissue seal in myringoplasty. *Laryngoscope.* 1987;97:532–547.
118. Weides, DJ. Use of the Williams microclips in various aspects of tympanoplasty surgery. *Laryngoscope.* 1981;91:2106–2125.

119. Wehrs, RE. Homograft tympanic membrane after twelve years. *Ann Otol Rhinol Laryngol.* 1982;91:533–539.
120. Sheehy, J.L. Surgery of chronic otitis media. in: G. English (Ed.) *Otolaryngology*. Volume 1. Harper and Row, Philadelphia; 1985:1–86.
121. Glasscock, M.E. 3rd, Hart, M.J. Surgical treatment of the atelectatic ear. in: M. Friedman (Ed.) *Operative techniques in otolaryngology–head and neck surgery*. WB Saunders, Philadelphia; 1992:15–20.
122. Levinson, R.M. Cartilage-perichondrial composite graft tympanoplasty in the treatment of posterior marginal and attic retraction pockets. *Laryngoscope.* 1987;97:1069–1074.
123. Eviatar, A. Tragal perichondrium and cartilage in reconstructive ear surgery. *Laryngoscope.* 1978;88:11–23.
124. Adkins, W.Y. Composite autograft for tympanoplasty and tympanomastoid surgery. *Laryngoscope.* 1990;100:244–247.
125. Milewski, C. Composite graft tympanoplasty in the treatment of ears with advanced middle ear pathology. *Laryngoscope.* 1993;103:1352–1356.
126. Amedee, R.G., Mann, W.J., Riechelmann, H. Cartilage palisade tympanoplasty. *Am J Otol.* 1989;10:447–450.
127. Duckert, L.G., Muller, J., Makielski, K.H. et al, Composite autograft “shield” reconstruction of remnant tympanic membranes. *Am J Otol.* 1995;16:21–26.

128. Loeb, L. Autotransplantation and homotransplantation of cartilage in the guinea pig. *Am J Pathol.* 1926;2:111–122.
129. Peer, L.A. The fate of living and dead cartilage transplanted in humans. *Surg Gynecol Obstet.* 1939;68:603–610.
130. Kerr, A.G., Byrne, J.E., Smyth, G.D. Cartilage homografts in the middle ear: a long-term histological study. *J Laryngol Otol.* 1973;87:1193–1199.
131. Don, A., Linthicum, F.H. Jr. The fate of cartilage grafts for ossicular reconstruction in tympanoplasty. *Ann Otol Rhinol Laryngol.* 1975;84:187–191.
132. Yamamoto, E., Iwanaga, M., Fukumoto, M. Histologic study of homograft cartilages implanted in the middle ear. *Otolaryngol Head Neck Surg.* 1988;98:546–551.
133. Hamed, M., Samir, M., El Bigermy, M. Fate of cartilage material used in middle ear surgery light and electron microscopy study. *Auris Nasus Larynx.* 1999;26:257–262.
134. Dornhoffer, J.L. Hearing results with cartilage tympanoplasty. *Laryngoscope.* 1997;107:1094–1099.
135. Zahnert, T., Huttenbrink, K.B., Murbe, D. et al, Experimental investigations of the use of cartilage in tympanic membrane reconstruction. *Am J Otol.* 2000;21:322–328.
136. Heermann, J. Jr., Heermann, H., Kopstein, E. Fascia and cartilage palisade tympanoplasty. Nine years' experience. *Arch Otolaryngol.* 1970;91:228–241.

137. Dornhoffer, J.L., Gardner, E. Prognostic factors in ossiculoplasty: a statistical staging system. *Otol Neurotol*. 2001;22:299–304.
138. Black, B. Ossiculoplasty prognosis: the spite method of assessment. *Am J Otol*. 1992;13:544–551.
139. Goldenberg, R.A. Hydroxylapatite ossicular replacement prostheses: preliminary results. *Laryngoscope*. 1990;100:693–700.
140. Bellucci, R.J. Dual classification of tympanoplasty. *Laryngoscope*. 1973;83:1754–1758.
141. Jurovitzki, I., Sade, J. Myringoplasty: long-term followup. *Am J Otol*. 1988;9:52–55.
142. Dornhoffer, J.L. Surgical management of the atelectatic ear. *Am J Otol*. 2000;21:315–321.
143. Buchwach, K.A., Birck, H.G. Serous otitis media and type 1 tympanoplasties in children. A retrospective study. *Ann Otol Rhinol Laryngol Suppl*. 1980;89:324–325.
144. Strong, M.S. The eustachian tube: basic considerations. *Otolaryngol Clin North Am*. 1972;5:19–27.
145. 162. Bailey, H.A. Jr. Symposium: contraindications to tympanoplasty. I. Absolute and relative contraindications. *Laryngoscope*. 1976;86:67–69.
146. Raine, C.H., Singh, S.D. Tympanoplasty in children. A review of 114 cases. *J Laryngol Otol*. 1983;97:217–221.

147. Dornhoffer, J. Cartilage tympanoplasty: indications, techniques, and outcomes in a 1,000-patient series. *Laryngoscope*. 2003;113:1844–1856.
148. Dornhoffer, J.L. Hearing results with the Dornhoffer ossicular replacement prostheses. *Laryngoscope*. 1998;108:531–536.
149. Dornhoffer, J.L. Surgical modification of the difficult mastoid cavity. *Otolaryngol Head Neck Surg*. 1999;120:361–367.
150. Lim, D.J. Human tympanic membrane. An ultrastructural observation. *Acta Otolaryngol*. 1970;70:176–186.
151. Pfaltz, C.R. Retraction pocket and development of cholesteatoma in children. *Adv Otorhinolaryngol*. 1988;40:118–123.
152. Dornhoffer, J.L. Retrograde mastoidectomy with canal wall reconstruction: a single-stage technique for cholesteatoma removal. *Ann Otol Rhinol Laryngol*. 2000;109:1033–1039.
153. Sekula, J. [Meatotympanoplasty]. *Otolaryngol Pol*. 1968;22:397–406.
154. Wehrs, R. Reconstructive mastoidectomy with homograft knee cartilage. *Laryngoscope*. 1972;82:1177–1188.
155. Smyth, G.D. Cholesteatoma surgery: the influence of the canal wall. *Laryngoscope*. 1985;95:92–96.
156. Parisier S, Hanson M. Pediatric cholesteatoma: results of individualized single surgery management. Presented at the Fifth International Conference on Cholesteatoma and Mastoid Surgery. Alghero-Sardinia, Italy, September 1–6, 1996..

157. Hirsch, B.E., Kamerer, D.B., Doshi, S. Single-stage management of cholesteatoma. *Otolaryngol Head Neck Surg.* 1992;106:351–354.
158. AUSTIN DF, SHEA JJ., Jr A new system of tympanoplasty using vein graft. *Laryngoscope.* 1961 Jun;71:596–611.
159. BEALES PH. The problem of the mastoid segment after tympanoplasty. *J Laryngol Otol.* 1959 Aug;73:527–531.
160. BENDEK GA. Histopathology of transudatory-secretory otitis media. Preliminary report. *Arch Otolaryngol.* 1963 Jul;78:33–38
161. HALL A, RYTZNER C. Autotransplantation of ossicles. Stapedectomy and biological reconstruction of the ossicular chain mechanism. *Arch Otolaryngol.* 1961 Jul;74:22–26.
162. HARRISON W. Prosthetics in tympanoplasty. *AMA Arch Otolaryngol.* 1960 Mar;71:437–442
163. HOUSE WF, SHEEHY JL. Myringoplasty. Use of ear canal skin compared with other techniques. *Arch Otolaryngol.* 1961 Apr;73:407–415.
164. PLESTER D, NYSTEN H. [A contribution to the problem of plastic closure of the tympanic membrane]. *Z Laryngol Rhinol Otol.* 1959 Oct;38:685–688.
165. TABB HG. The surgical management of chronic ear disease, with special reference to staged surgery. *Laryngoscope.* 1963 Apr;73:363–383.

166. THORBURN IB. Tympanomyoplasty--further experience in the use of pedicle temporal muscle flaps. *J Laryngol Otol.* 1963 Jun;77:501–508.
167. Wullstein, H. Functional operations in the middle ear with split-thickness skin graft. *Arch Otorhinolaryngol.* 1953;161:422–435.
168. Zollner, F. The principles of plastic surgery of the sound-conducting apparatus. *J Laryngol Otol.* 1955;69:637–652.
169. Cayé-Thomasen, P., Andersen, J., Uzun, C., Hansen, S., Tos, M. Ten-year results of cartilage palisades versus fascia in eardrum reconstruction after surgery for sinus or tensa retraction cholesteatoma in children. *Laryngoscope.* 2009;119:944–952.
170. Iacovou, E., Vlastarakos, P.V., Papacharalampous, G., Kyrodimos, E., Nikolopoulos, T.P. Is cartilage better than temporalis muscle fascia in type I tympanoplasty? Implications for current surgical practice. *Eur Arch Otorhinolaryngol.* 2013;270:2803–2813.
171. Sheehy, J.L., Anderson, R.G. Myringoplasty. A review of 472 cases. *Ann Otol Rhinol Laryngol.* 1980;89:331–334.
172. Chhapola, S., Matta, I. Cartilage–perichondrium: an ideal graft material?. *Indian J Otolaryngol Head Neck Surg.* 2012;64:208–213.
173. Yetiser, S., Hidir, Y. Temporalis fascia and cartilage-perichondrium composite shield grafts for reconstruction of the tympanic membrane. *Ann Otol Rhinol Laryngol.* 2009;118:570–574.

174. Sheehy, J.L., Glasscock, M.E. 3rd. Tympanic membrane grafting with temporalis fascia. *Arch Otolaryngol.* 1967;86:391–402.
175. Dornhoffer, J. Cartilage tympanoplasty: indications, techniques, and outcomes in a 1,000-patient series. *Laryngoscope.* 2003;113:1844–1856.
176. Beutner, D., Hüttenbrink, K.B., Stumpf, R., Beleites, T., Zahnert, T., Luers, J.C. et al, Cartilage plate tympanoplasty. *Otol Neurotol.* 2010;31:105–110.
177. Dornhoffer, J.L. Cartilage tympanoplasty. *Otolaryngol Clin North Am.* 2006;39:1161–1176.
178. Lyons, S.A., Su, T., Vissers, L.E., Peters, J.P., Smit, A.L., Grolman, W. Fascia compared to one-piece composite cartilage-perichondrium grafting for tympanoplasty. *Laryngoscope.* 2016;126:1662–1670.
179. Cavaliere, M., Panetti, M., Iemma, M. Tragal cartilage shield tympanoplasty: our technique and results in 612 cases. *Acta Otolaryngol.* 2014;134:890–897.
180. Aidonis, I., Robertson, T.C., Sismanis, A. Cartilage shield tympanoplasty: a reliable technique. *Otol Neurotol.* 2005;26:838–841.



## **PROFORMA**

NAME :

AGE :

SEX :

OCCUPATION :

ADDRESS :

SOCIOECONOMIC STATUS :

HOSPITAL OP/IP NUMBER :

**PRESENTING COMPLAINTS :**

### **1. EAR DISCHARGE**

- SIDE
- DURATION
- TYPE
- ONSET
- QUANTITY
- SMELL
- AGGRAVATING /RELIEVING FACTORS

### **2. HARD OF HEARING :**

- ON SET
- SIDE
- DURATION
- PROGRESSIVE OR NOT

- FLUCTUATING OR NOT
- HISTORY OF EAR DISCHARGE
- HISTORY OF OTOTOXIC DRUGS
- HISTORY OF TRAUMA
- AUTOPHONY

#### **ASSOCIATED SYMPTOMS**

- OTALGIA
- TINNITUS
- VERTIGO
- HEAD ACHE
- NASAL OBSTRUCTION
- POST NASAL DISCHARGE
- RECURRENT ATTACKS OF UPPER RESPIRATORY TRACT INFECTIONS

#### **PAST HISTORY**

- ALLERGY
- ASTHMA
- TRAUMA
- OTOTOXIC DRUGS
- PREVIOUS EAR SURGERY
- IRRADIATION
- HYPERTENSION

- DIABETES
- PULMONARY TUBERCULOSIS

### **PERSONAL HISTORY**

- SMOKING
- ALCOHOLISM
- DIET
- BOWEL AND BLADDER HABITS

### **FAMILY HISTORY**

- HARD OF HEARING
- HISTORY OF CONSANGUINOUS MARRIAGE

### **SOCIO ECONOMIC HISTORY**

### **GENERAL EXAMINATION**

TEMPERATURE

PULSE

BLOOD PRESSURE

PALLOR

ICTERUS

CLUBBING

CYANOSIS

EDEMA

GENERALISED LYMPHADENOPATHY

### **SYSTEMIC EXAMINATION**

- CARDIOVASCULAR SYSTEM
- RESPIRATORY SYSTEM
- CENTRAL NERVOUS SYSTEM
- GASTROINTESTINAL SYSTEM

### **LOCAL EXAMINATION**

**EXAMINATION OF EAR :**            **RIGHT**            **LEFT**

PINNA

PRE AURICULAR REGION

POST AURICULAR REGION

EXTERNAL AUDITORY CANAL

MASTOID REGION

TRAGAL SIGN

TYMPANIC MEMBRANE

    PARS TENSA

    PARS FLACCIDA

    HANDLE OF MALLEUS

    COLOUR

    CONE OF LIGHT

    RETRACTED OR NOT

    MOBILITY

TUNING FORK TESTS

RINNE TEST

WEBER TEST

ABSOLUTE BONE CONDUCTION

THREE FINGER TEST

FACIAL NERVE

FISTULA SIGN

VESTIBULAR FUNCTION TESTS

### **EXAMINATION OF NOSE**

- ANTERIOR RHINOSCOPY
- POST NASAL EXAMINATION

### **EXAMINATION OF THROAT**

### **INVESTIGATIONS**

Pure Tone Audiometry

Video Otoscopy

Diagnostic Nasal Endoscopy

Xray Both mastoids

HR CT Temporal Bone

## **INFORMED CONSENT FORM**

I am Dr. SUGANTHIS, carrying out a study on the topic,  
**“COMPARATIVE STUDY OF TYMPANOPLASTY IN DRY AND WET EARS”**

My research project is being carried out under the department of Otorhinolaryngology, Coimbatore Medical College and Government Hospital.

Your Child, Sri/Kum\_\_\_\_\_ aged\_\_\_\_\_years,, S/o.D/o\_\_\_\_\_residing at\_\_\_\_\_is requested to be a participant in the research study titled **“COMPARATIVE STUDY OF TYMPANOPLASTY IN DRY AND WET EARS”** conducted by Dr.Suganthi.S one of the post graduate trainees in the Department of ENT, Government Coimbatore Medical College and Hospital, Coimbatore. He/she is eligible for the study as per the inclusion criteria. You can ask her any question or seek from her any clarifications about the study which you may have before agreeing to participate in the study.

### **RESEARCH BEING DONE :**

**“COMPARATIVE STUDY OF TYMPANOPLASTY IN DRY AND WET EARS”**

### **PURPOSE OF RESEARCH**

To compare the success rate of graft uptake in dry and wet ears

To compare the post operative hearing improvement in dry and wet ears

**PROCEDURES INVOLVED :**

All the patient towards selected underwent cortical mastoidectomy with tympanoplasty and followed post operatively at 1<sup>st</sup> month, 3<sup>rd</sup> month, & 6<sup>th</sup> month.

**DECLINE FROM PARTICIPATION**

Prelingually deaf children with no benefit with hearing aid who is undergoing cochlear implantation will be studied intra-operatively and post-operatively (after a period of one month).

**DECLINE FROM PARTICIPATION**

You are hereby made aware that participation in this study is purely voluntary and honorary and that you have the option and the right to decline from participation in the study.

**PRIVACY AND CONFIDENTIALITY**

You are hereby assured about your privacy. Privacy of subject will be respected and any information about you or provided by you during the study will be kept strictly confidential.

## **AUTHORIZATION TO PUBLISH RESULTS**

Results of the study may be published for scientific purposes and/or presented to scientific groups, however you will not be identified, neither will your privacy be breached.

## **STATEMENT OF CONSENT**

I, \_\_\_\_\_, do hereby volunteer and consent to my child participating in this study being conducted by Dr.Suganthi.S. I have read and understood the consent form (or) it has been read and explained to me thoroughly. I am fully aware of the study details as well as aware that I may ask questions to her at any time.

Signature / Left Thumb Impression of the parent/guardian

Station : Coimbatore

Date :

Signature/Left Thumb Impression and Name of the witness

Station : Coimbatore

Date :



## xggj y; gotk;

bgah; :

ghypdk; : taJ :

Kfthp :

muR nfhi t kUj;Jtf; fy;Y}hapy; **fhJ/ \fF/ bjhz i l**  
kUj;Jtj; Ji wapy; (KJfi y gl;lnkwgogg[ gapYk; khz tp  
**KU. s. Rfej p mth;fs; nkwb;fhs;Sk; " <u kw;Wk; cyhej fhj py;**  
**, i l rbrtp mWi t rpfri rapd; gydf;fs;"** vDk; Ma;tpy; bra;Ki w  
bjhlghgd mi dj;J tpgu' fi sak; nfi;L vdJ renj f' fi sj;  
bj sptg;Lj j pf; bfhz ni d;

ehd; , ej Ma;tpy; vdi d ghprhj i d braa KG kdJl Dk/  
Ra rpej i dal; Dk; rkkj pf;fpnwd;

vdJ neha; gw;wpa , ej Ma;tpy; v' ;fsJ mi dj;J tpgu' ;fSk;  
ghJ fhf;fgg;LtJl d; neha; gFj papd; gli fgg; l k; kw;Wk; , j d; Kot;fs;  
Ma;tpj Hpy; btspapl gg;L;tj py; Ml nrgi d , yi y vdgi jj;  
bj hptj ;J f; bfhs;fpnwd; vej neuj ;j pYk; , ej Ma;tpyp;Ue;J ehd;  
tpyp;fpf; bfhs; vdf;F chipi k cz ;L vdgi j ak; mw;pn;td;

**nehahspapd; i fbahggk;**

**, l k;:**

**ehs;:**

## KEY TO MASTER CHART

<b>S.NO.</b>	<b>Serial Number</b>
M	Male
F	Female
R	Right Ear
L	Left Ear
B/L	Bilateral Ear
HOH	Hard of Hearing
S	Small
M	Medium
L	Large
ST	Subtotal
C	Cellular
SC	Sclerotic
D	Diploic
Y	Yes
N	No
PTA	Pure tone audio gram
GPA	Group-A Dry Ear
GPB	Group-B Wet Ear
dB	Decibel

### DEPARTMENT OF MICROBIOLOGY

COIMBATORE MEDICAL COLLEGE HOSPITAL, COIMBATORE - 18.

#### MICROBIOLOGY REPORT FORM

NAME : ANIL SHARMA  
AGE AND SEX : 40 YRS / M      LAB NO : M-3955  
WARD / UNIT : ENT OP      IP / OP NO : 1092484  
SPECIMEN : AURAL SWAB      DATE : 19/09/16

INVESTIGATION	REPORT
AURAL SWAB      =>	NO GROWTH  Assistant Professor Microbiology Diagnostic Laboratory Coimbatore Medical College & Hospital Coimbatore - 641 018.

# COIMBATORE MEDICAL COLLEGE HOSPITAL

COIMBATORE - 641 018.

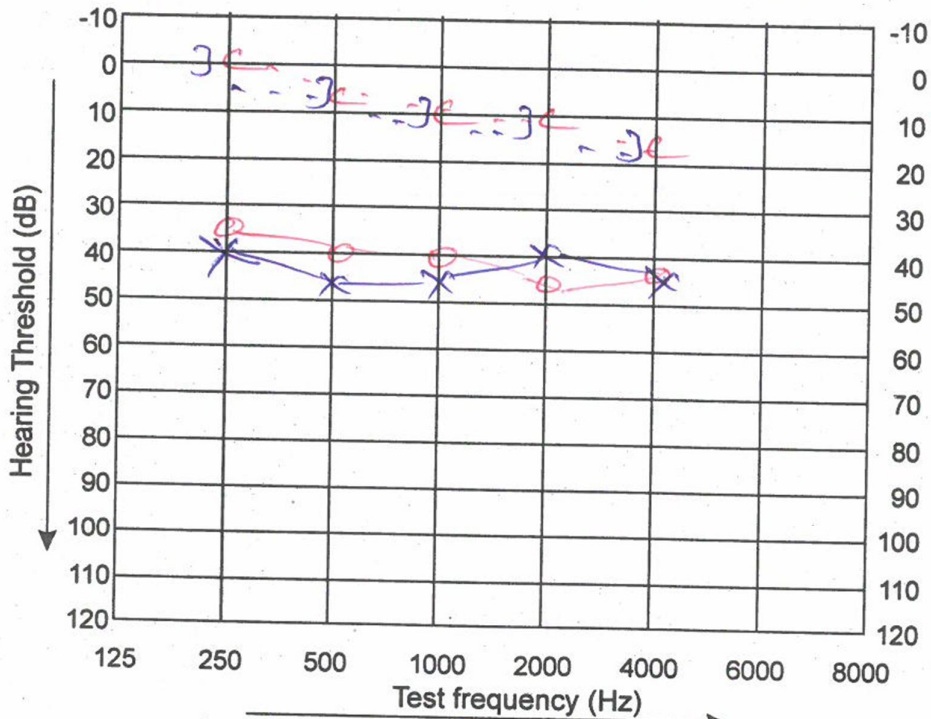
E.N.T. DEPARTMENT - AUDIOLOGY

## AUDIOGRAM

PATIENT NAME : Mrs. Beena      AGE : 32      SEX : F

IP / OP No : 153821      DATE : 23.11.16

TEST CONDITION : \_\_\_\_\_      AUDIOMETER USED : \_\_\_\_\_



WEBER  $\longleftrightarrow$

	RIGHT	LEFT
P.T.A	41.6dB	43.3dB
S.R.T.		
S.D. Score		
SISI		
TDT		

DIAGNOSIS & COMMENTS :

# COIMBATORE MEDICAL COLLEGE HOSPITAL

COIMBATORE - 641 018.

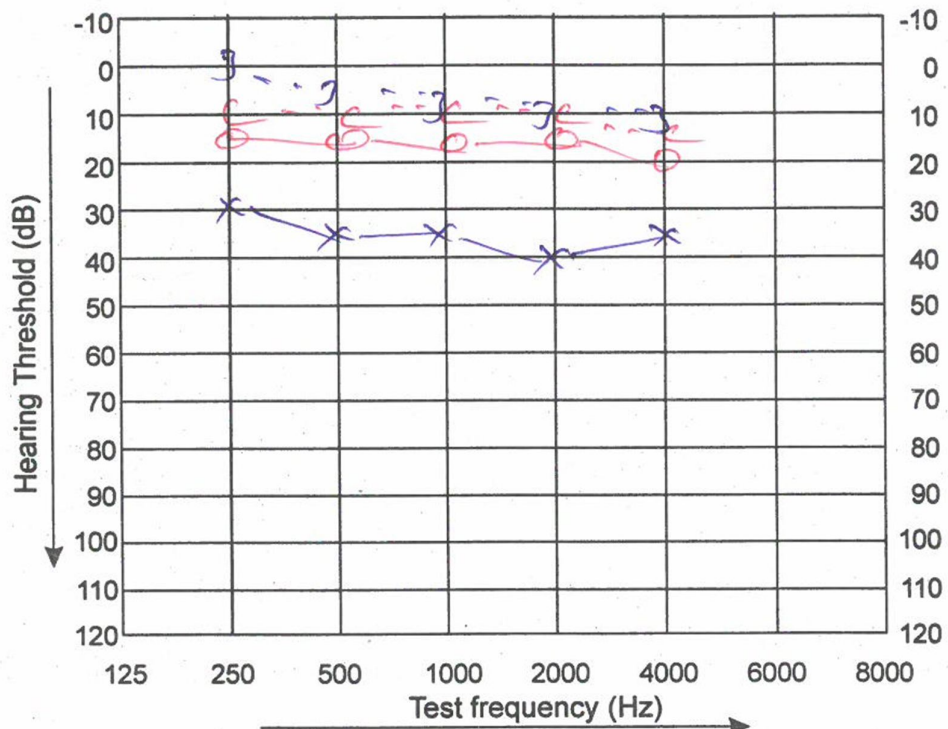
E.N.T. DEPARTMENT - AUDIOLOGY

## AUDIOGRAM

PATIENT NAME: Mrs. KAMILA      AGE: 35      SEX: F

IP/OP No: 896928      DATE: 22.10.16

TEST CONDITION: \_\_\_\_\_      AUDIOMETER USED: ELKON



WEBER \_\_\_\_\_

	RIGHT	LEFT
P.T.A	15 dB	36 dB
S.R.T.		
S.D. Score		
SISI		
TDT		

DIAGNOSIS & COMMENTS :