A STUDY OF SURGICAL OUTCOMES IN CHRONIC SUPPURATIVE OTITIS MEDIA - TUBO TYMPANIC [MUCOSAL] DISEASE TREATED WITH MYRINGOPLASTY / CORTICAL MASTOIDECTOMY WITH TYPE 1 TYMPANOPLASTY

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CERTIFICATE

This is to certify that this dissertation entitled **"A STUDY OF SURGICAL OUTCOMES IN CHRONIC SUPPURATIVE OTITIS MEDIA - TUBO TYMPANIC [MUCOSAL] DISEASE TREATED WITH MYRINGOPLASTY / CORTICAL MASTOIDECTOMY WITH TYPE 1 TYMPANOPLASTY "** is the bonafide original work of **Dr.L.SIVASANKARI** in partial fulfillment of the requirement for MS ENT (Branch IV) examination of the Tamil Nadu Dr.MGR Medical University to be held in March 2009.

Dr. J.Mohana Sundaram M.D.,PhD.,DNB.,
Dean,
Govt.Stanley Medical College
& Hospital,
Chennai -01

Prof.Dr.Jacinth Chellaiah, M.S.,D.L.O
Professor & H.O.D,
Department of Otorhinolaryngology ,
Stanley Medical College,
Chennai - 01

DECLARATION

I, **Dr.L.SIVASANKARI**, solemnly declare that this dissertation **"A STUDY OF SURGICAL OUTCOMES IN CHRONIC SUPPURATIVE OTITIS MEDIA - TUBO TYMPANIC [MUCOSAL] DISEASE TREATED WITH MYRINGOPLASTY / CORTICAL MASTOIDECTOMY WITH TYPE 1 TYMPANOPLASTY"** is a bonafide record of work done by me in the Department of ENT, Government Stanley Medical College and Hospital, Chennai under the guidance of **Prof.Dr. JACINTH CHELLAIAH**, Head of the Department, Department of ENT, Government Stanley Medical College and Hospital, Chennai – 600 001.

This dissertation is submitted to the Tamilnadu Dr.M.G.R.Medical University, Chennai in partial fulfilment of the University regulations for the award of MS Degree (ENT) Branch-IV, Examination to be held in March 2009.

Place: Chennai

Date: **(Dr.L.SIVASANKARI)**

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CONTENTS

CONSENT FORM

I was informed and explained of the purpose and nature of the study. I am willing to participate in this study. I hereby give my full consent for the study.

Signature of the patient

Name of the patient

KEY TO MASTER CHART:

D : Duration of discharge in years

H : Duration of hearing impairment in years

W : Weight of the patient in kilograms

PS : Size of perforation

1 : medium sized

2 : subtotal

A : Approach

1 : Trans canal

2 : Post aural

AS :Status of antrum

1 : Normal

2 : Diseased

2 M : Graft uptake at the end of 2 months

1 : intact

2 : residual perforation

3 : rejection of graft

6 M : Graft uptake at the end of 6 months

1 : intact

2 : residual perforation

3 : rejection of graft

1 Y : Graft uptake at the end of one year

1 : intact

2 : residual perforation

3 : rejection of graft

PTA 1 : Puretone average at the end of 3 months in decibels

PTA 2 : Puretone average at the end of 6 months in decibels

PTA 3 : Puretone average at the end of 1 year in decibels

PRE ABG : Pre-operative Air bone gap

1 : Excellent

2 : Good

3 : Fair

POST ABG : Post-operative Air bone gap

1 : Excellent

2 : Good

3 : Fair

ATR : Application of Belfast rule of thumb

C. Mas - Cortical Mastoidectomy

t.1 - Type 1

T.Plasty - Tympanoplasty

ABBREV1ATIONS :

ABG	:	Air bone gap
IS	:	Incudostapedial
RW	:	Round window
CP	:	Central perforation
TM	:	Tympanic membrane
T.FASCIA	:	Temporalis fascia
Hz	:	Hertz
dB	:	Decibels
KHz	:	KiloHertz
CSOM	:	Chronic suppurative otitis media
PORP	:	Partial Ossicular Replacement Prosthesis
HL	:	Hearing loss
Pre-op	:	Pre operative
Post-op	:	Post operative
GA	:	General Anaesthesia
ENT	:	Ear, Nose, Throat

INTRODUCTION

Auditory sensation is one of the vital sensations for existence. When such a great sensation is lost, life naturally loses its charm. Discharging ear and deafness are perpetual source of misery to humankind. Our country, being a developing nation with poor socio-economic status and low environmental conditions, chronic diseases of ear accounts for nearly 5% of population. Chronic suppurative otitis media is found to be the single major cause of recoverable conductive deafness. Surgery for tubotympanic type of chronic suppurative otitis media is the commonest otological surgical procedure in our country.

The goal of otologists performing middle ear surgery is to make the patient free of ear discharge, correct the conductive hearing loss, to improve hearing, as well as to provide functional benefit to the patient. Unilateral conductive hearing loss is associated with various disabilities including difficulty in sound localisation, hearing & understanding speech. This is because, listening is a binaural task, while benefit to the patient is determined by factors such as hearing in the non operated ear. Hence, the subjective evaluation of the surgical results speaks better than the objective methods which provide only the technical success of the operation.

This study discusses the various pre-operative factors which play a major role in the post-operative success of two various surgeries –

myringoplasty and cortical mastoidectomy with type1 tympanoplasty conducted in the Department of ENT in Stanley Medical College for patients presenting with chronic suppurative otitis media – tubotympanic disease. The hearing benefit is determined by Air bone gap closure and also subjective evaluation of hearing is done by applying Belfast rule of thumb.

AIM OF THE STUDY

1. To study the success rate of Myringoplasty in patients with chronic suppurative otitis media – tubotympanic (mucosal) disease with dry ears in relation to – duration of disease, size of perforation and preoperative Air bone gap.

2. To study the success of cortical mastoidectomy with type 1 tympanoplasty in patients with chronic suppurative otitis media – tubotympanic (mucosal) disease with wet and non infected ears in relation to – duration of disease, size of perforation, preoperative Air bone gap and condition of mucosa of mastoid antrum.

3. To evaluate the post-operative hearing benefit in patients with unilateral hearing loss by applying Belfast rule of thumb.

REVIEW OF LITERATURE

ANATOMY OF EAR [43]

Temporal bone

The temporal bone contains the sensory organs of hearing and balance, and structurally contributes to the cranial vault. The temporal bone consists of five parts: the squamous, the mastoid, the tympanic, zygomatic and petrous segment. It contains portions of the carotid artery and jugular venous drainage system, and is intimately related to the dura of the middle and posterior fossa. Anteriorly, it articulates with the condyle of the mandible. Posteriorly, and superiorly, the mastoid air cell system communicates with the middle ear. The facial nerve passes through the temporal bone en route to the muscles of facial expression

Ear

Both functionally and anatomically, it can be divided into three parts.

A. External Ear - that portion external to the tympanic membrane. It serves chiefly to protect the tympanic membrane, but also collects and directs sound waves and plays a role in sound localization. The skin of the external ear normally migrates laterally from the umbo of the malleus in the tympanic membrane to the external auditory meatus (at a rate of 2-3 mm per

day). This is a unique and essential mechanism for maintaining patency of the canal.

- **The Auricle** - elastic cartilage covered with closely adherent skin. The configuration is intricate, and extremely difficult to duplicate.
- **External Auditory Canal**
    - **Lateral Portion** - cartilagenous with thick, loosely applied skin containing ceruminous and sebaceous glands.
    - **Medial Portion**- very thin skin directly over bone, no skin appendages. Curves anteriorly and medially in adults, which may obscure the anterior tympanic membrane. It comprises two-thirds of the total canal in adults, less in infants and children.

B. The Middle Ear - This is an air-containing space which communicates with the nasopharynx via the eustachian tube. It is normally sealed laterally by the tympanic membrane. Its function is to transmit and amplify sound waves from tympanic membrane to the stapes footplate converting energy from air medium to a fluid medium of the membranous labyrinth. The relationship of the three ossicles is depicted below.

- **The tympanic membrane** is an ovoid, three-layered structure consisting of squamous epithelium laterally, respiratory mucosa

medially, and an intervening fibrous layer. It normally has a conical shape, with the apex maintained medially by the support of the malleus. The fibrous layer thickens laterally to form the annulus, an incomplete ring which is attached to surrounding bone. Superior to the lateral process of the malleus, this ring is deficient, and this area is known as the pars flaccida. The majority of the drum is composed of the pars tensa.

- **Ossicles** - three small bones which are involved in sound conduction. From lateral to medial, these are the malleus, the incus, and the stapes. The handle and lateral process of the malleus is attached to the tympanic membrane. The long process of the incus can often be seen through the posterior superior quadrant of the membrane. The stapes is attached to a foot plate which is in direct contact with the fluid of the inner ear.
- **Spaces** - the middle ear cleft is wider than the tympanic membrane, and is conventionally divided into spaces in reference to the annulus.
    - **Epitympanum** - superior to the tympanic membrane. Contains the body of the incus and the head of the malleus. Communicates with the mastoid via the aditus.
    - **Mesotympanum** - on a level with the ear drum. The oval and round windows, located posterosuperiorly on the medial wall, communicate with the inner ear. The long process of the incus

projects into the posterior quadrant to articulate with the stapes which sits in the oval window. The facial nerve, usually covered by a bony canal, crosses the posterior superior quadrant superior to the stapes, then courses inferiorly between the middle ear and mastoid air cells.

- **Protympanum** - in this anterior recess of the middle ear, the eustachian tube exits to communicate with the nasopharynx. This tube runs in close proximity to the carotid artery.
- **Hypotympanum** - the jugular bulb curves through the hypotympanum. It is usually covered by bone, but may be dehiscent and extend into the middle ear space.

C. Inner Ear - consists of a fluid-filled labyrinth which functions to convert mechanical energy into neural impulses. The bony labyrinth is subdivided into smaller compartments by the membranous labyrinth. Fluid surrounding the membranous labyrinth is called perilymph; fluid within is called endolymph. There are three main divisions of the bony labyrinth.

- **Vestibule** - just medial to the oval window, and contains the utricle and the saccule, two organs of balance. The vestibule is an antechamber, leading to both the cochlear and the semicircular canal.

- **The Cochlea** - a snail-shaped chamber anterior to the vestibule. It bulges into the middle ear and its bony covering is the promontory. The cochlea also communicates with the middle ear via the round window. In this organ, sound waves are converted into neural impulses.
- **The Semicircular Canals** - three in number; project posteriorly from the vestibule. These organs detect angular acceleration. They consist of superior, posterior and lateral, or horizontal canals.

The nerve fibres from labyrinth make up the auditory nerve which consists of a cochlear nerve , superior and inferior vestibular with both afferent and efferent fibres from the respective sensory end organs. This nerve enters the cranial cavity via IAC.

PHYSIOLOGY OF EAR [43]

SOUND AND SOUND WAVES:

Sound is generated in nature, whenever an object vibrates in an elastic medium, commonly air. The vibrating object sets up disturbance in surrounding molecules of air in the form of successive waves of compression and rarefaction, termed as Sound waves.

HEARING MECHANISM:

A sound signal in the environment is collected by pinna, passes through the external auditory canal and strikes the tympanic membrane. Vibrations of tympanic membrane are transmitted to stapes footplate through ossicular chain. Pressure changes in the labyrinthine fluid, caused by stapes footplate moves basilar membrane. Hair cells stimulated, acts as transducers and convert mechanical energy in to electrical impulses which travel along auditory nerve.

THEORIES OF HEARING : [18]

Von Helmholtz Resonance Place theory

The basilar membrane is constructed of segments that resonated in response to different frequencies, and that segments were arranged according to location along the length of basilar membrane. According to

this theory, high frequencies are perceived at the base and low frequencies at the apex.

Rutherford's telephone theory:

The entire cochlea responds as a whole to all frequencies instead of being activated on a place by place basis. Here, all aspects of stimulus waveform would be transmitted to the auditory nerve, and then frequency analysis is accomplished at higher levels in the auditory system

Von Bekesy's travelling wave theory:

Bekesy found basilar membrane is not under tension but its elasticity is essentially uniform. Because the basilar membrane gets wider starting from the base to apex, gradation of stiffness increases from base to apex. Sound transmitted to cochlea develops a special kind of wave pattern which always travel from base to apex called travelling wave.

The normal human middle ear couples sound from low impedance sound energy in the ear canal through the tympanic membrane and ossicles to the relatively high impedance of fluid within the cochlea.

Traditional teaching of middle ear mechanisms includes, [40]

Catenary lever:

The attachment of tympanic membrane at the annulus, amplifies the energy at the malleus because of elastic properties of stretched drumhead fibres. Because the annular bone surrounding the tympanic membrane is immobile, sound energy is directed away from edges of the drum and towards the centre of the drum. The malleus receives the redirected sound energy from the edge of the drum because of central location of manubrium. The Catenary lever provides atleast two fold in sound pressure at the malleus.

Ossicular lever:

It is based on the concept that malleus and incus acts as a unit. The malleus and incus rotate around an axis running between the anterior malleolar ligament and the incudal ligament. The ossicular lever is the length of the manubrium of the malleus divided by the length of long process of incus (1.3: 1) Since the malleus and tympanic membrane acts as a coupled system, some believe that ratio should be reduced to 1.15: 1 Together, Catenary and ossicular lever provide a sound pressure advantage of 2.3 :1

Hydraulic lever:

It acts because of size difference between tympanic membrane and stapes footplate. Sound pressure collected over area of tympanic membrane and transmitted to area of stapes footplate results in increase in the force proportional to the ratio of the areas (also called area ratio) The average ratio has been calculated to be 20.8:1 Acoustic transformer theory predicts a middle ear gain of approximately 27 – 34 dB, which is a product of action of the Catenary, ossicular and hydraulic levers.

Latest reports of human middle ear sound transmission modifies in to,

Ossicular coupling:

It is the sound pressure gain that occurs through the actions of tympanic membrane and ossicular chain. The pressure gain provided by the normal middle ear with ossicular coupling is frequency dependent. The mean middle ear gain is approximately 20 dB at 250-500Hz,it reaches a maximum of about 25 dB around 1 KHz, and it decreases at about 6 dB per octave at frequencies above 1 KHz.

The changes in gain above 1 KHz are caused portions of tympanic membrane moving differently than other portions, depending on the frequency of vibrations. At low frequencies, the entire tympanic membrane

moves in one phase. Above 1 KHz, the tympanic membrane divides in to smaller portions that vibrate at different phases. Another factor is the slippage of ossicular chain at frequencies above 1 – 2 KHz. Slippage is due to the translational movement in rotational movement of the ossicles or flexion in the ossicular joint

Acoustic coupling:

It is the difference in sound pressure acting directly on the oval and round window. Movement of tympanic membrane produces a sound pressure in the middle ear that is transmitted to the oval and round windows. The pressure at each window is different because of the small distance between the windows and different orientation of each window relative to tympanic membrane. In normal ears this is negligible. In diseased ears the difference becomes significant and affects hearing.

Stapes – cochlear input impedance:

Stapes footplate motion is normally impeded by several anatomical structures including the annular ligament, cochlear fluids, cochlear partition and the round window membrane. When the round window membrane is filled with fluid or fibrous tissue, round window impedance increases, resulting in an increase in stapes- cochlear input impedance.

Middle ear aeration :

Ossicular coupling is impaired when the air space of both the middle ear and mastoid cavity is reduced. The difference in sound pressure between the external auditory canal and the middle ear facilitates tympanic membrane motion. The minimum amount of air required to maintain ossicular coupling within 10dBof normal has been estimated to be 0.5ml.

CHRONIC SUPPURATIVE OTITIS MEDIA

DEFINITION: [43]

It is the chronic irreversible inflammation of the mucoperiosteal lining of middle ear cleft.

AETIOLOGY: [43]

1. Acute otitis media and otitis media with effusion:

Childhood otitis media and otitis media with effusion can cause long term changes of the tympanic membrane. Histological degeneration of tympanic membrane occurs in the outer and inner fibrous layer of lamina propria and in the sub mucosal layer. These changes reduce the elastic properties of tympanic membrane, making it more susceptible to chronic perforation or retraction.

2. Genetics and race:

Its role is controversial.

3. Environment:

The prevalence of chronic otitis media is higher in lower socio economic groups. The reason for this is multifactorial.

4. Eustachian tube dysfunction:

Eustachian tube dysfunction is more common in patients with chronic otitis media than in normal individuals. It is not known however, if the eustachian tube function is initiating factor or is the result of chronic otitis media.

5. Cranio facial abnormalities:

The tensor veli palatini muscle is hypoplastic in cleft palate children and predispose to eustachian tube dysfunction.

6. Autoimmune disease: [43]

Chronic otitis media is seen in 29 % of the patients with ankylosing spondylitis

7. Immune deficiency: [43]

Abnormalities of humoral (eg.hypogammaglobulinemia) and cell mediated immunity (eg. HIV infection,lazy leucocyte syndrome) manifests as chronic otitis media.

TYPES: [43]

1. TUBOTYMPANIC (MUCOSAL) DISEASE:

A) INACTIVE MUCOSAL (DRY PERFORATION)

There is permanent perforation of pars tensa, but the middle ear and mastoid mucosa are not inflammed. Perforation may be completely surrounded by remnant of pars tensa or a part of perforation may extend to fibrous annulus. Lamina propria around the perforation is thickened due to proliferation of fibrous tissue. Muco- cutaneous junction is located at the margin of perforation or the squamous epithelium can migrate medially in to the middle ear. At the time of tympanoplasty, the ingrown squamous epithelium recognised by its velvety appearance should be excised.

B) ACTIVE MUCOSAL (PERFORATION WITH OTORRHOEA)

There is chronic inflammation within the mucosa of the middle ear and mastoid with varying degrees of oedema, sub mucosal fibrosis, hypervascularity & infiltration with lymphocytes, plasma cells & histiocytes. Areas of mucosa may ulcerate with proliferation of blood vessels, fibroblasts & inflammatory cells leading to formation of granulation tissue. There is production of mucopurulent discharge which discharges via the tympanic membrane perforation. This disease is often associated with resorption of parts or all of the ossicular chain (resorptive osteitis)

2. ATTICO ANTRAL (SQUAMOSAL) DISEASE [43]

A) INACTIVE SQUAMOUS EPITHELIAL (RETRACTION / ATELECTASIS)

A retraction pocket consists of an invagination into the middle ear space of a part of the ear drum, and may be fixed when it is adherent to the structures in the middle ear or free when it can move medially or laterally depending on the state of inflation of middle ear. Epidermization is more advanced type of retraction and it often remains quiescent and does not progress to cholesteatoma or active suppuration.

B) ACTIVE SQUAMOUS (CHOLESTEATOMA):

The hallmark of cholesteatoma is retention of keratinous debris. Histologically, the squamous epithelial lining or matrix of cholesteatoma is similar to that of skin. The matrix is usually surrounded by a layer of inflammed, vascular, sub epithelial connective tissue. A cholesteatoma can be filled with keratin and be quite dry, or be associated with active bacterial infection leading to profuse malodorous otorrhoea. Molecular mechanisms by which cholesteatoma trigger remains questionable.

BACTERIOLOGY OF CHRONIC OTITIS MEDIA: [6]

The widespread prevalent gram negative aerobe particularly in tubotympanic type has cast serious doubt on the role of nasopharynx, as a source of infection. Among other microbes found causing chronic otitis media are Staphylococcus aureus, Proteus, Pseudomonas aeruginosa and E. coli. The most exciting development in the field of microbial flora is the discovery of presence of non sporing anaerobes. The main species isolated include B.melaninogenicus and B.fragilis.

AUDIOLOGICAL ASSESSMENT: [38]

The hearing loss in CSOM can be attributed to four basic dysfunctions.

1. Impairment of tympano – ossicular impedance matching mechanism

2. Reduction of the baffle effect of the round window

3. Underlying middle ear pathology such as mucosal oedema, granulations, cholesteatoma, osteitis and ossicular necrosis which impairs the tympano-ossicular mechanism.

4. Underlying cochlear dysfunction.

ROUND WINDOW BAFFLE EFFECT: [38]

Sound waves striking the tympanic membrane do not reach the oval and round windows simultaneously. There is a preferential pathway to the oval window because of the ossicular chain. Thus, when oval window is receiving wave of compression, the round window is at the phase of rarefaction. If the sound waves were to strike both the windows simultaneously, they would cancel each other's effect with no movement of perilymph and no hearing. This acoustic separation of windows is achieved by the intact tympanic membrane and a cushion of air in the middle ear around the window. This effect is called round window baffle effect. In CSOM, this effect is reduced more so in the posterior quadrant perforations.

The audiological assessment should commence by assessing the hearing with tuning forks (256,512 & 1024 Hz) [38]

If Rinnes test is negative with 256 Hz, mild deafness i.e. 10 – 20 dB loss.

If Rinnes test is negative with 512 Hz, moderate deafness i.e. 20 – 30 dB loss.

If Rinnes test is negative with 1024 Hz, means severe deafness i.e. >30 dB loss.

PURE TONE AUDIOMETRY:

A pure tone audiometry with appropriate masking for air and bone conduction is carried out. In bilateral ear disease, the worse hearing ear is chosen for treatment.

SPEECH AUDIOMETRY:

Two parameters are studied.

1. Speech reception threshold: It is the maximum intensity at which 50% of the words are repeated correctly by the patient. SRT is within 10 db of the average pure tone threshold.

2. Discrimination score: It is the percentage of phonetically balanced monosyllabic words heard correctly, when presented at different intensities.

IMPEDENCE AUDIOMETRY:

It is an objective test widely used in clinical practice and is particularly useful in traumatic ossicular discontinuities and otosclerosis. It is a battery of tests consists of : 1. Tympanometry

2. Acoustic reflex measurements

3. Eustachian tube function tests

EUSTACHIAN TUBE FUNCTION TESTS:

Although there is no Gold Standard test to evaluate the function of Eustachian tube, the following tests indicate patency of the tube.

1. Valsalva manoeuvre

2. Toynbee manoeuvre

3. Frenzel manoeuvre

RADIOLOGICAL ASSESSMENT:

It should include a lateral oblique view of both the mastoids. The influence of disease on the mastoid air cell system, symmetry of mastoids, bony erosions, level of sinus and tegmen plates can be obtained Can be classified in to

1. Cellular
2. Sclerotic – in CSOM
3. Diploeic

REPORTING OF HEARING RESULTS: [21]

AIR – BONE GAP:

The difference between the air conduction (AC) and the bone conduction threshold (BC) at the same frequency is called an Air Bone Gap. This is useful in identifying type of hearing loss & in comparing the post operative hearing benefit. Hearing results are typically classified based on the post-operative Air Bone Gap. Classification based on air bone gap are usually stratified as,

EXCELLANT - < 10 dB

GOOD - 11 TO 20 dB

FAIR - 21 to 30 dB

Initial hearing results may diminish with time; therefore results should be reported at 1 , 3 , 5 years.

REPORTING PROTOCOL AFTER MIDDLE EAR RECONSTRUCTIVE SURGERY: [1]

KARTUSH MERI (MIDDLE EAR RISK INDEX): [17]

RISK FACTOR	RISK VALUE
OTORRHOEA (BELLUCI)	
1. Dry	0
2. Occasionally wet	1
3. Persistently wet	2
4. Wet, cleft palate	3
PERFORATION	
1. Absent	0
2. Present	1
CHOLESTEATOMA	
1. Absent	0
2. Present	1
OSSICULAR STATUS	
O: M+I+S+	0
A: M+S+	1
B: M+S-	2
C: M-S+	3
D: M-S-	4
E: Ossicle head fixation	2
F: Stapes fixation	3
MIDDLE EAR GRANULATIONS	
No	0
Yes	1
PREVIOUS SURGERY	
None	0
Staged	1
Revision	2

PROGNOSIS / RISK	MER INDEX
Best prognosis	0
Mild risk	2
Moderate risk	5
Severe risk	7
Worst prognosis	12

BELFAST RULE OF THUMB: [21, 42]

Smyth and Patterson developed Belfast Rule of Thumb based on analysis of the relationship between patients perceived subjective benefit and post operative audiometric changes. The subjective perception of operative success compared with the degree of symmetry indicated that least satisfied patients were those, whose degree of symmetry differed by more than 15 dB or less.(The degree of symmetry is the difference in hearing between the ears.)The results showed that patients were likely to report significant benefit if the average air conduction threshold (for 0.5,1,2 kHz) was less than or equal to 30 dB or the interaural difference less than or equal to 15 dB .The reason behind this theory is that because the skull does not greatly attenuate the transfer of sound energy, speech impinging on the poorer hearing will be heard mostly by the better ear, unless the difference in air conduction thresholds is 15 dB or less.

CHRONIC OTITIS MEDIA – TUBOTYMPANIC DISEASE

INACTIVE MUCOSAL TYPE: [43]

May remain inactive, heal or become active. Tympanic membrane may fails to heal as a result of failure of blood supply to perforation edges due to endarteritis, but there be other factors related to repair mechanism at cellular level. It may progress towards activity as provoked by upper respiratory tract infection, water ingress if contaminated by bacteria / irritants. Increased mucous production provides culture medium for opportunistic organism to flourish.

Pure tone audiometry is done to assess the hearing. Degree of air bone gap depends on the size of perforation, erosion of ossicles, and significant granulation tissue around the ossicles. If surgery is contemplated, microscopic examination is important. Three ways of managing this could be – surgery, hearing aid, conservative treatment.

Objectives of surgery would be-

1. To decrease the patient's hearing disability and not just the closure of air bone gap

2. If only the symptom is hearing impairment, the chances of improving hearing should be considered carefully, not just hearing in operated ear but overall hearing ability of the patient.

3. With history of intermittent activity, closure of tympanic membrane may minimise future activity.

EUSTACHIAN TUBE AND SURGERY: [29, 44]

An aerated middle ear is necessary for middle ear function. Sometimes reconstructive middle ear surgery that appears technically successful at the time of surgery subsequently has poor outcome because of non aeration of middle ear. A functioning eustachian tube is necessary for aerated middle ear. Numerous methods of assessing eustachian tube function have been tried, but no reliable test has been found. If the contra lateral ear is atelectatic, suggesting poor eustachian tube function, it is unlikely that the eustachian tube function normal in the operated ear. In actively inflammed ears, it is possible for eustachian tube function to improve when the middle ear mucosa reverts to a more normal state after closure of tympanic membrane.

SURGERIES COMMONLY DONE IN INACTIVE MUCOSAL TYPE:

1. **Myringoplasty**

2. **Tympanoplasty**

MYRINGOPLASTY:

DEFINITION:

It is the surgical procedure of closure of a tympanic membrane perforation without any other work in the tympanic cavity or mastoid process. The definition is unrelated to the size of perforation, the approach, the condition of mucosa, or the tubal function.

ANATOMY AND EMBRYOLOGY OF THE TYMPANIC MEMBRANE: [13]

The tympanic membrane develops from three sources: ectoderm of the first branchial (pharyngeal) groove, endoderm of the tubotympanic recess from the first pharyngeal pouch, and mesoderm of the first and second branchial (pharyngeal) arches. During the fourth week of gestation the first pharyngeal pouch extends laterally to become the tubotympanic recess. This recess is lined with endoderm. It continues to expand creating the middle ear cleft and later the mastoid. It envelopes the ossicles and their tendons and covers them with an epithelial lining. The endodermal lining of the tubotympanic recess comes into contact with the ectodermal lining of the first branchial groove to form the first branchial membrane. Mesoderm from the first and second branchial arches then migrates between this membrane to create a three layered structure which becomes the tympanic

membrane.

The tympanic membrane is oval in shape with dimensions of approximately 8 mm X 10 mm. It is oriented at approximately 55 degrees with the floor of the meatus. The greater part of the circumference is thickened, and forms a fibro cartilaginous ring (also known as the annulus or annular ligament) which is attached to the tympanic sulcus at the medial end of the meatus (scutum). The annulus and sulcus are deficient superiorly which is known as the notch of Rivinus. The anterior and posterior malleolar folds extend to the lateral process of the malleus from the two ends of this notch. The triangular area created above these folds is known as the pars flaccida, because it lacks the middle fibrous layer that gives tensile strength to the rest of the membrane. This makes it vulnerable to retraction under negative pressure. The rest of the membrane is called the pars tensa.

The handle of the malleus is firmly attached to the inner surface of the TM as far as its center, which projects towards the tympanic cavity giving the TM a conical shape. The point of the cone is called the umbo. The membrane is approximately 130 microns thick. It is a three layered structure consisting of an outer ectodermal layer composed of keratinizing squamous epithelium, an intermediate mesodermal fibrous layer (which consists of a superficial layer of radial fibers and deep layer of circular fibers), and an inner endodermal mucosal layer. The epidermal layer has

migratory properties which gives the TM, its self cleaning ability. The epidermis migrates centrifugally from the umbo outward in a posterosuperior direction at about 131 microns per day. Within the epidermal layer of the TM are Langerhans' cells, which are involved in the immune response as antigen-presenting cells, mast cells, and T lymphocytes.

The blood supply to the outer surface of the TM is derived from the deep auricular artery and the inner surface is supplied by the anterior tympanic artery. Both of these arteries are branches of the internal maxillary artery. The deep auricular artery ascends in the substance of the parotid gland, behind the temporomandibular articulation, pierces the cartilaginous or bony wall of the external acoustic meatus and arborizes on the outer surface of the TM. The anterior tympanic artery passes upward behind the temporomandibular articulation, enters the tympanic cavity through the petrotympanic fissure, and ramifies upon the inner surface of the tympanic membrane.

Somatic sensory nerve fibers to the TM come from the auriculotemporal branch of the mandibular nerve, the auricular branch of the vagus nerve, and the tympanic branch of the glossopharyngeal nerve.

HISTORY OF MYRINGOPLASTY: [13, 25]

Surgery of the TM dates back as far as the 17th century when Banzer (1640) described the first attempt at repair of a TM perforation with a pig's bladder. Over the next century, most of the advances in otologic surgery were focused on the mastoid to treat life threatening infections. In 1853, Toynbee placed a rubber disk attached to a silver wire over a perforation. He reported significant improvement in hearing with this method. Later, Yearsley (1863) placed a cotton ball over a perforation and in 1877; Blake proposed the paper patch which is still used today for preoperative evaluation of potential hearing improvement. Roosa (1876) and Okneuff (1895) performed the earliest treatment of tympanic membrane perforations with chemical cautery. The term myringoplasty was coined by Berthold in 1878, but the first myringoplasty was performed by Marcus Bancer in 1640. Berthold placed a court plaster against the tympanic membrane for 3 days to remove the epithelium, and then applied a thick skin graft. Despite success reported in two cases, little more was heard of myringoplasty until Schulhof and Valdez mentioned it in 1944, and then not again until 1952 when Wullstein published a method of closing perforations with a split thickness skin graft. Only a year later Zollner described his experiences with a similar graft; Wullstein and House then advised a full thickness graft taken from behind the ear. The first medial graft tympanoplasty was performed by Shea (1957). He was performing a stapedectomy and by chance, discovered that a medial vein graft was

successful in repairing an accidental tear. In 1961, Storrs later replaced the vein graft with temporalis fascia for use in medial grafting. Over the past three decades temporalis fascia has been the most commonly used grafting material in tympanoplasty operations, although tragal perichondrium, periosteum, loose areolar tissue, fat, vein, alloderm, homograft TM, and homologous dura are also employed.

CLASSIFICATION: [33]

1. ONLAY TECHNIQUES:

A) Removal of drum remnant epithelium without covering the graft

B) Elevation and outward dissection of drum remnant epithelium and ear canal skin, creating various skin flaps and covering the graft edges with the elevated skin flaps. Mesodermal graft is partly placed under the skin flaps.

C) Sandwich techniques, with complete removal of drum remnant epithelium and ear canal skin, placement of fascia on the annulus, and covering the fascia with ear canal skin

2. UNDERLAY TECHNIQUES:

A) Techniques without tympanomeatal flaps. The graft is placed under the drum through the perforation without tympanotomy.

B) Techniques with tympanomeatal flaps and tympanotomy

C) Sandwich techniques, with graft placed under the fibrous annulus and drum remnant, and perforation covered with ear canal skin in a manner similar to onlay sandwich technique

GRAFT MATERIALS FOR MYRINGOPLASTY: [42]

Autografts:

Temporalis facia, cartilage, fat, periosteum, perichondrium, vein, duramater, fascia lata

Allograft:

Duramater, Tympanomeatal flap

Xenograft:

Bovine jugular vein, Calf ceacal serosa

PROCEDURE: UNDERLAY TECHNIQUE [13]

Myringoplasty is usually performed under general endotracheal anaesthesia although patients who are reluctant to undergo general anaesthesia may be given local anaesthesia supplemented with intravenous sedation. Nitrous oxide should be avoided as it can shift the graft position. Muscle relaxants should also be avoided if possible. The post auricular and

canal skin are initially injected with 1% lidocaine with 1:200,000 concentration of adrenaline to assist with haemostasis.

Myringoplasty is performed via a post auricular approach if the external auditory canal is narrower or tortuous or through transcanal approaches if canal is wide enough. The post auricular incision is made approximately 1 cm behind the post auricular crease, temporalis fascia graft is harvested, cleaned of residual muscle, and placed on a block to allow drying. In transcanal approach, it is harvested by a separate incision superiorly. A T-shaped incision is made in the periosteum overlying the mastoid. The periosteum is elevated and moved anteriorly into the ear canal. A self-retaining retractor is placed to retract the canal skin and the ear forward. The canal incision is designed to create a laterally based canal skin flap or vascular strip. The horizontal incision is cut first approximately 2 to 5 mm lateral to the annulus from the 12 to the 6o'clock position (right ear). The vertical incisions are made next. The superior limb follows the tympano-squamous suture line and the inferior limb follows the tympanomastoid suture line. The margins of the perforations are freshened to separate the inner mucosal and outer cutaneous layer.

The undersurface of the TM is then abraded with a round knife to increase adhesion. A tympanomeatal flap is then elevated anteriorly. The undersurface of the flap should be inspected for any skin that has turned over the edge of the perforation and is subsequently removed. The status of the middle ear is then inspected for disease. The ossicles are gently

manipulated to evaluate for mobility. The round window reflex may be inspected at this time.

The eustachian tube and middle ear are then packed with Gel foam. The fascia graft is shaped to the proper size needed for the perforation. It is then carefully tucked into position under the anterior tympanic membrane remnant and onto the posterior canal wall. Care is taken to obtain the maximum amount of circumferential overlap of the graft with the TM. The annulus is placed back into position posteriorly and the vascular strip is carefully moved into its anatomic place. Gel foam is placed over the drum remnant, graft, and vascular strip and the external canal is filled with an antiseptic ointment impregnated ribbon gauze wick. The post auricular incision is closed subcutaneously with absorbable suture staples are applied to the skin. A mastoid dressing is placed to provide light pressure and protection. When patient recovers, from anaesthesia can be shifted to post operative ward.

DISADVANTAGES & ADVANTAGE OF UNDERLAY TECHNIQUE [13]

DISADVANTAGES:

1. Middle ear becomes narrow
2. Medialisation of the graft
3. Anteriorly, the graft may loose contact from the remnant tympanic membrane leading to anterior perforation.

ADVANTAGE:

Middle ear can be inspected for disease.

DISADVANTAGE OF OVERLAY TECHNIQUE:

1. Blunting of anterior angle
2. Epithelial pearl formation
3. Lateralization of the graft
4. Middle ear is not inspected.

TYMPANOPLASTY: [13]

DEFINITION:

Tympanoplasty is an operation performed to eradicate disease in the middle ear and to reconstruct the hearing mechanism, without mastoid surgery, with or without tympanic membrane grafting.

Wullstein in 1956 classified tympanoplasty into 5 types. It was established to predict outcomes.[42]

Wullstein classification of tympanoplasty is as follows:

Type I: It is performed when all three ossicles are present and mobile and involves repair of a TM perforation or retraction without ossicular chain reconstruction.

Type II: It is performed when the malleus is eroded and involves grafting the tympanic membrane to an intact incus and stapes or remnant of the malleus

Type III: It is indicated when the lateral ossicles are eroded. The stapes must be intact and mobile. Tympanic membrane / graft or if a PORP is used is placed in contact with the stapes superstructure (MYRINGOSTAPEDIOPEXY)

Type IV: When absent or eroded superstructure of stapes. Graft or tympanic membrane is placed over round window exteriorizing mobile stapes footplate. Resulting middle ear consists of the hypotympanum and the Eustachian tube orifice only (includes CAVUM MINOR)

Type V: When the stapes footplate is fixed.

Va - involves grafting over a fenestration created in the lateral semicircular canal.

Vb – involves stapedectomy / platinectomy with a fixed footplate and no ossicles.

Farrior's classification:

Type I: Performed in cases with an intact ossicular chain or myringoplasty.

Type II: Myringoincudopexy

Type III: Interposition of a bone graft between the intact stapes and handle of malleus

Type IV: Myringostapediopexy

Type V: Fenestration of the lateral semicircular canal.

Modified Wullstein classification:

Type I: Intact ossicles

Type II: Minor ossicular defects

Type III: Severe ossicular defects, but stapes arch intact

Type IV: Cavum minor

TYPE II TYMPANOPLASTY could be, [42]

1. INTERPOSITION: placing an Ossicle, a bony or cartilaginous graft, or any other prosthesis between the stapes or stapedial arch and the malleus handle or drum.

2. TRANSPOSITION: refers to procedures in which an Ossicle is still partly attached to its origin. They are seldom used. They consist of transposition of incus, transposition of neck of malleus or transposition of the entire malleus on to the head of the stapes.

ACTIVE MUCOSAL TYPE: [43]

Active mucosal disease may remain active, becomes inactive or progress to complications. Continuing activity may be the result of infection with a particular virulent or persisting organism. Impaired immunity may play a role. In developing country like ours, nutrititional and environmental factors including hygiene may play a role.

Continuing activity of chronic otitis media is likely to result in damage to ossicular chain and potentially to inner ear. Significant ossicular involvement causes substantial deterioration in hearing results. The inflammatory reaction in the middle ear associated with granulation tissue is agreed to be the most likely factor for ossicular damage. The nonspecific changes in bone associated with the inflammatory reaction include osteoclastic and osteoblastic activity which results in resorption and remodelling of bone. Permanent damage occurs mainly to long process of incus and stapes superstructure where there is abundant osteoclastic activity and osteoblastic influences appear weak. The same process may play a part in development of sclerotic mastoid.

In early stages, mild conductive hearing impairment occurs, and causes significant handicap only if the disease is bilateral. As the disease advances slowly, the patient appears to adapt to the loss, so that thresholds of 30 – 40 dB are common with little complaint from the patient. In mucosal

disease, the size of perforation in the pars tensa is relevant to the hearing loss but other important factors such as presence of granulation tissue, mucus, adhesions and tympanosclerosis are also of important in determining the hearing level. If the ossicular chain loses its continuity, there is substantial impairment with hearing thresholds increasing to 50 – 60 dB HL .In bilateral disease, this constitutes a significant handicap and hearing rehabilitation including reconstructive surgery may be a priority for the patient.

MANAGEMENT:

The initial stage in management is thorough aural toilet. This is most effectively carried out with microscopic suction clearance, since it allows the assessment of extent of ear pathology.

The literature on antibiotic treatment of CSOM is limited, but some studies do indicate that ototopical antibiotics for CSOM are more efficacious than antiseptics alone and more efficacious than oral antibiotics. The data also suggest that their efficacy may be enhanced by the addition of a steroid. The Cochrane Database published a systematic review of 9 randomized controlled trials in which systemic antibiotics were compared with topical antibiotics or antiseptics for the treatment of chronically discharging ears with underlying eardrum perforations in more than 800 patients of all ages. The analysts found that quinolone antibiotic drops were

better than oral or injected antibiotics, including systemic quinolones, for drying the ear. The advantage of nonquinolone topical antibiotics (without steroids) or antiseptics over systemic treatment was less clear. No benefit was seen when systemic antibiotic treatment was added to topical antibiotic treatment.

Systemic treatment of CSOM has traditionally relied on parenteral antibiotics aimed at P.aeruginosa. At least short-term control can be achieved in upwards 0f 90% of patients with culture-directed parenteral therapy.

CORTICAL MASTOIDECTOMY: [33]

DEFINITION:

This is an operation performed to remove disease from the mastoid antrum & air cell system (when present) and widening the aditus ad antrum, with preservation of an intact posterior bony external auditory canal wall, without disturbing the existing middle ear contents.

PROCEDURE:

Post aural approach is preferred. Mastoid cortex is exposed. Identify the middle fossa plate, first by drilling the temporal line in an anterior to posterior direction. Identify the sigmoid sinus by drilling a line at the probable posterior extent of pneumatisation. These structures are consistent reliable landmarks even in contracted or anomalous mastoid. A third line is drilled parallel and just posterior to the posterior wall of external auditory canal. This creates a triangle of attack. The cortical bone in the triangle is removed, taking care to deepen the cavity evenly and gradually. Never make a deep, narrow hole. The edges should always be rounded to provide adequate visibility. The deepest part of cavity should be towards the antrum which is just posterosuperior to the external auditory canal. The safest way is to follow the middle fossa plate anteriorly with gradual saucerisation. While drilling the sinodural angle, care should be taken not to injure the superior petrosal sinus.

Once the antrum has been opened, the dome of lateral semicircular canal is identified on its floor. Short process of incus identified, the antrum is widened to identify the aditus. Posterior wall of external auditory canal is thinned out and mastoid air cells are systematically exenterated.

MYRINGOPLASTY / TYMPANOPLASTY:

When the ear is dry and ossicular chain is intact, myringoplasty is performed. With disease in middle ear and with ossicular abnormalities, tympanoplasty is considered according to the status of ossicles.

MATERIALS AND METHODS

Study design : Prospective study

Study place : Department of ENT,Stanley medical college

Study period : From Mar 2007 to Aug 2008

Sample size : About 60 patients

Follow up period : one year

INCLUSION CRITERIA:

1. Age: 10 – 50 years
2. Sex: Both male & female
3. Condition of ear: Both dry & wet ears.
4. Tuning fork tests &

   Pure tone audiometry : shows conductive hearing loss.
5. Patients with elimination of focal sepsis.

   E.g. Adenoidectomy

   FESS

EXCLUSION CRITERIA:

1. Patients with external auditory canal or middle ear cavity abnormalities, either congenital or acquired.
2. Patients with cholesteatoma or postero-superior marginal retraction
3. Tuning fork test and pure tone audiometry revealing mixed or sensorineural hearing loss.
4. Prior attempted tympanic membrane / middle ear / mastoid repair.

METHODOLOGY :

This study was conducted in a group of 60 patients in the department from period March 2007 – August 2008 with a follow up period of one year.

Minimum age in the study was 15 and maximum was 50 years. Minimum duration of discharge was 1year and maximum was 15 years. Minimum duration of hearing impairment was 6 months and maximum was 10 years. Both males and females were included in the study. For all patients, under study ear swabs were taken from middle ear and for patients with culture positivity were treated with specific antibiotics prior to surgery.

All cases were admitted, pre-operative examination done under microscopy, subjected to endoscopic eustachian tube evaluation (those with normally looking pharyngeal end of eustachian tube orifice were taken up

for study) and hearing assessment done with tuning fork tests and pure tone audiogram. All patients were informed about their need for a follow up period of one year. Informed written consent to undergo surgery was obtained from all patients. Mastoid shaving and local preparation was done in the ward prior to surgery. All cases were done under GA. Premedication and local infiltration was same for all cases.

About 30 patients with dry ear for more than 6 weeks and with no active infection as per microbiological report, with only conductive hearing loss, were subjected to **myringoplasty** and considered as **Group A.** About 22 patients with unilateral disease and 8 patients with bilateral disease were taken up for study. For patients with bilateral disease, worse ear was taken up for surgery. For all Group A patients hearing evaluation was done with tuning fork tests, pure tone audiogram. Pharyngeal end of eustachian tube and condition of paranasal sinuses were evaluated by nasal endoscopic evaluation.

All patients were taken up for surgery under GA. Trans canal approach was followed in 21 cases and in 9 cases with narrow external auditory canal post- aural approach was followed. 4 quadrant local infiltration was given with 2% xylocaine with adrenaline premixed solution. Temporalis fascia graft harvested by a separate incision over supra auricular region for patients done through trans - canal approach & in patients done

through post-aural approach, graft was harvested via the same incision. Incision made in the posterior canal wall skin from 6 o'clock position to 12 o'clock position and tympanomeatal flap was elevated. Temporalis fascia graft kept by underlay technique. All cases were followed up for 2, 6 months and 1 year for graft uptake and post-operative hearing evaluations done at 3, 6 months and 1 year. Results of hearing benefit, compared with pre-op and post- op air bone gap and for unilateral disease Belfast rule of thumb applied.

About 30 patients with wet ear and with no active infection as per microbiological report & with conductive hearing loss were subjected to **cortical mastoidectomy with type 1 tympanoplasty** and considered as **Group B.** About 18 patients with unilateral disease and 12 patients with bilateral disease were taken up for study. For patients with bilateral disease, worse ear was taken up for surgery. Otoscopic evaluation showed oedematous middle ear mucosa in all patients. For all 30 patients hearing evaluation was done with tuning fork tests, pure tone audiogram. Pharyngeal end of eustachian tube and condition of paranasal sinuses were evaluated by nasal endoscopic evaluation.

All patients were taken up for surgery under GA. Local infiltration give to the post-aural region and over 4 quadrants of external auditory canal. Post-aural approach was followed in all cases. Post aural William Wilde's

incision made. Temporalis fascia graft harvested through the superior aspect of the incision as the first step, incision deepened and mastoid cortex exposed. Pinna retracted anteriorly, incision made in the posterior canal wall skin from 6 o'clock to 12 o'clock position and tympanomeatal flap was elevated. Granulations present in the tympanum removed in all cases, mobility of ossicular chain were checked. Mastoid cortex was drilled out in all cases. For about 21 patients granulations noted in antrum and aditus ad antrum removed and in 9 patients antrum found free of disease. For all patients, temporalis fascia graft kept by underlay technique, tympanomeatal flap repositioned and post-aural wound closed in layers. The following are the parameters, which were taken up for study.

1. Duration of discharge
2. Duration of hearing impairment
3. Size of perforation
4. Condition of mastoid antrum
5. Graft take up rate at the end of 2, 6 months and 1 yr
6. Pre-op & Post-op Air bone gap
7. In unilateral disease – application of Belfast rule of thumb

Eventhough socio-economic status does influence the disease, all the patients attending Stanley Medical College Hospital belongs to lower socio-economic group. Hence this parameter is not included in this study.

RESULTS AND OBSERVATION

Total number of cases registered in this study was 67 patients, who came to the ENT Department with Chronic suppurative otitis media – tubotympanic type, from March 2007 to August 2008.Among them 7 patients did not turn up for follow up and hence they were not included in the study.

The overall graft take up rate in both the surgeries was 88.33%. The overall hearing benefit was 90%, excellent with < 10dB ABG in 51.67% and Good with < 20dB in 38.33%.There was no post operative complications, deterioration in hearing or sensorineural hearing loss in all 60 patients.

In **Group A** ,18 were females & 12 were males,22 patients had unilateral and 8 had bilateral disease,23 had medium sized central perforation and 7 had subtotal perforation,10 had good pre-op Air bone gap of 10to 20 dBHL 20 patients had a fair pre-op Air bone gap of 20 to 30 dBHL.

1. Overall graft take up rate was 86.6%.

2. Otoscopic evaluation of 23 patients with medium sized perforation at the end of 2 months,revealed18 to be intact,5 residual perforation in the antero - inferior quadrant. In 7 patients with subtotal perforation,4 were intact,1 with residual perforation & 2 grafts got rejected because of post-op

wound infection. Otoscopic examination at the end of 6months & 1 year revealed – for all 23 patients with medium size perforation, tympanic membrane was intact and out of 7 patients with subtotal 2 were with residual perforation & 2 with rejection of graft and with the same pre operative status. Hence the size of the perforation does have a role in graft take up rate. This is stastistically significant by applying chi square test with p value < 0.05

PERFORATION- SIZE	TM STATUS		
	INTACT	REJECTION	RESIDUAL PERFORATION
MEDIUM SIZED n=23	IOO% n=23	NIL	NIL
SUBTOTAL n=7	42.9 % n=3	28.6 % n=2	28.6 % n=2

3. In 10 patients with good pre-op ABG, the post-op ABG was excellent. In 20 patients with fair pre-op ABG, the post-op ABG results were, excellent in 9, good in 8 and fair in 3 patients accounting for 63.3% in excellent, 26.7% in good and 10% in fair groups.By applying Chi square test, these results are stastistically significant.Hence for the patients with lesser pre-operative Air bone gap have a better post-operative hearing.

PRE-OP	TOTAL	POST – OP ABG

ABG	CASES	EXCELLENT	GOOD	BAD
GOOD	10	100 % n=10	-	-
FAIR	20	45 % n=9	40% n=8	15% n=3
TOTAL	30	63. 3% n=19	26.7% n=8	10% n=3

4. The relationship between unilateral disease and post-operative Air bone gap is as follows.

DISEASE	POST-OP AIR BONE GAP		
	EXCELLENT	GOOD	FAIR
UNILATERAL	N= 16	N=5	N=1
TOTAL %	72.7%	22.7%	4.5%

5. When Belfast rule of thumb was applied to 22 patients with unilateral disease,19 of them with medium sized perforation, felt subjectively better and out of 3 of them with subtotal perforation, 2 felt better &1 patient felt hearing same as the pre operative status. These results are stastistically significant with p value<0.05, implies that Belfast rule of thumb interpret the post-operative hearing benefit in a better way than the Air bone gap ,which tells about only the technical success.

PERFORATION SIZE	APPLICATION OF BELFAST RULE OF THUMB	
	GOOD	BAD

MEDIUM SIZED n=19	100% n=19	-
SUBTOTAL n=3	66.7 % n=2	33.3% n=1
TOTAL %	95.7%	4.3%

6. The correlation coefficient between the duration of discharge and the pre-op ABG is 0.4172 and that between the duration of hearing impairment with pre-op ABG is 0.3821 and is statistically significant. The correlation coefficient between the duration of discharge and the post-op ABG is 0.4544 and that between the duration of hearing impairment with post-op ABG is 0.4489 and is statistically significant , implies that the patients with lesser duration of discharge and hearing impairment had better post-operative hearing than the patients with longer duration of disease and hearing impairment.

7. The other parameters, such as age, sex, weight does not have influence on the outcome of results in this study.

AGE GROUP (in years)	MALE	FEMALE	TOTAL	GRAFT TAKE UP RATE
10 - 20	5	3	8	87.5%
21 - 30	7	8	15	93.33%
31 - 40	1	3	4	75%
41 - 50	0	3	3	66.67%

SEX	Postop ABG		
	EXCELLENT	GOOD	FAIR
MALE n=12	66.7% n=8	25% n=3	8.3% n=1
FEMALE n=18	61.1% n=11	27.8% n=5	11.1% n=2
TOTAL n=30	63.3%	26.7%	10%

8. The type of approach does not have a significant p value with graft intake in this study. Applying chi square test, the Pearson value is 0.

APPROACH	GRAFT STATUS		
	INTACT TM	RESIDUAL PERFORATION	REJECTION
TRANSCANAL n=21	90.5% n=19	4.8% n=1	4.8% n=1
POSTAURAL n=9	77.8% n=7	11.1% n=1	11.1% n=1
TOTAL %	86.7%	6.7%	6.7%

In **Group B ,**16 were females & 14 were males,18 patients had unilateral and12 had bilateral disease.18 had medium central perforation and 12 had subtotal perforation,9 had good pre-op Air bone gap of 10to 20 dBHL 21 patients had a fair pre-op Air bone gap of 20 to 30 dBHL.

SEX	**NO OF CASES**	**GRAFT TAKE UP**	**GOOD PREOP ABG**	**EXCELLENT POSTOP ABG**
MALE	14	11	3	4
FEMALE	16	16	6	8
TOTAL	30	27	9	12

1.Overall graft take up rate was 90%.

2. The relationship between Graft take up rate and size of the perforation is stastistically significant by applying chi square test with pearson value of 0.02535.

PERFORATION SIZE	INTACT TM	RESIDUAL PERFORATION
MEDIUM	100% n=18	-
SUBTOTAL	75% n=9	25% n=3
TOTAL %	90%	10%

Otoscopic evaluation of 18 patients with medium sized perforation at the end of 2 months,revealed17 to be intact,1 residual perforation in the antero- inferior quadrant. In 12 patients with subtotal perforation, 8 were intact, 4 with residual perforation. Otoscopic examination at the end of 6months & 1 year revealed – for all 18 patients with medium size perforation, tympanic membrane was intact and out of 12 patients with subtotal 3 were with residual perforation. Hence the size of the perforation do have a role in graft take up rate even when cortical mastoidectomy is done along with repair of tympanic membrane.

3. In this study, out of 18 patients with medium sized perforation, 8 had a good & 10 had fair pre-op ABG. Out of 12 patients with subtotal perforation,

1 patient had good & 11 had fair pre-op ABG, implies that 91.7 %of the patients with subtotal perforation had pre-op ABG of 20 to 30 dB.

PERFORATION SIZE	PRE OP ABG	
	GOOD	FAIR
MEDIUM	44.4%	55.6%
SUBTOTAL	8.3%	91.7%

4. Out of 30 patients, included in this procedure, 50% had excellent, 50% had good &10% had fair post-op ABG. Those with medium sized perforation had better results than those with subtotal perforation.

PERFORATION SIZE	POST OP ABG		
	EXCELLENT	GOOD	FAIR
MEDIUM	50% n=9	50% n=9	-
SUBTOTAL	25% n=3	50% n=6	25% n=3

5. On comparison of pre-op ABG & post-op ABG, all 9 patients with good pre-op ABG improved to excellent, out of 21 with fair ABG, 3 were excellent, 15 were good and 3 were fair post-operatively. This result is highly statistically significant with pearson value of 0.00006

PREOP ABG	POST OP ABG		
	EXCELLENT	GOOD	FAIR
GOOD	100% n=9	-	-
FAIR	14.3% n=3	71.4% n=15	14.3% n=3

6. Graft intake in 9 patients with disease free antrum mucosa is 100%.

ANTRUM STATUS	GRAFT TAKE UP	
	INTACT	RESIDUAL PERFORATION
NORMAL	100% N=9	-
DISEASED	85.7% N=18	14.3% N=3

7. Out of 30 patients, 21 patients had disease in the antrum & 9 had a healthy antrum.77.85% of the patients with healthy antrum and 9.5% of the patients with diseased antrum had good pre-op Air bone gap 90.5% with diseased and 22.2% with healthy antrum had fair preop Air bone gap.

ANTRUM STATUS	PRE OP ABG	
	GOOD	FAIR
NORMAL	77.8% n= 7	22.2% n=2
DISEASED	9.5% n=2	90.5% n=19

8. In patients with healthy antrum, the post-op ABG was excellent in 88.9% and 66.7% of the patients with diseased antrum had a good ABG post-operatively.

ANTRUM STATUS	POST OP ABG		
	EXCELLENT	GOOD	FAIR
NORMAL	88.9% n=8	11.1% n=1	-
DISEASED	19% n=4	66.7% n=14	14.3% n=3

9. The relationship between unilateral disease and post-operative Air bone gap is as follows.

DISEASE	POST-OP AIR BONE GAP		
	EXCELLENT	GOOD	FAIR
UNILATERAL	N=10	N=6	N=2
TOTAL %	55.6%	33.3%	11.1%

10. On applying Belfast rule of thumb to 18 patients with unilateral disease, 83.3% had better hearing, implies the post-operative hearing benefit better than assessment with Air bone gap.

SEX	APPLICATION OF BELFAST RULE OF THUMB	
	GOOD	BAD
MALE	62.5% n=5	37.5% n=3
FEMALE	100% n=10	-

11. The correlation coefficient between the duration of discharge and the pre-op ABG is 0.3803 and that between the duration of hearing

impairment with pre-op ABG is 0.3776. The correlation coefficient between the duration of discharge and the post-op ABG is 0.3794 and that between the duration of hearing impairment with pre-op ABG is 0.3729 and are statistically significant, implies that the patients with lesser duration of discharge and hearing impairment had better post-operative hearing than the patients with longer duration of disease and hearing impairment.

12. The other parameters, such as age, sex, weight does not have influence on the outcome of results in this study.

AGE GROUP (in years)	MALE	FEMALE	TOTAL	GRAFT TAKE UP RATE
10 - 20	5	4	9	88.88%
21 - 30	6	3	9	100%
31 - 40	2	7	9	88.88%
41 - 50	1	2	3	66.66%

DISCUSSION

Analysis of 60 cases undergone surgery for tubo tympanic disease is presented here and the same is compared with similar and related studies available in literature.

1. GRAFE TAKE UP RATE :

The overall graft take up rate in Myringoplasty in this study was 86.6%,which is within the range to the studies available. The graft take up rate in various studies were,

study	No of cases	year	Graft take up rate
Gibb,Chang et al	365	1982	91.4%
Black,PJ Wormald	261	1995	78%
Raj A Vidit	50	1999	84%
Kotecha et al	107	1999	82.2%
Yasuo,Mishiro et al	104	2001	94.4%
Kageyama et al	290	2001	82.1%
Alberrra et al	85	2006	86%

The graft take up rate in Cortical mastoidectomy with type 1 tympanoplasty is 90% which is also within the range to the studies available in literature.

Studies	No of cases	Graft take up rate
Yasuo,Mishiro et al	147	90%
Adnan saleem et al	85	92.95%
McGrew et al	100	91%
Rehl CMet al	135	90.4%

In this study the graft take up rate is better in medium sized perforations when compared to the subtotal perforation. In Myringoplasty series, the take up rate in medium sized perforation was 100% and in subtotal perforations the take up rate was 42.9%, rejection rate was 28.6%, reperforation rate was 28.6%.In mastoidectomy with type 1 tympanoplasty series, the graft take up rate in medium sized perforation was 100% and in subtotal perforations the rate was 75%and reperforation rate was 25%.These studies are similar to the results quoted by the study of Vartianien et al and Alberra et al.

2. GRAFT FAILURE RATE:

Graft failure rate in various studies were,

STUDIES	REPERFORATION RATE %
Alberra et al	7 to 21
Vartianien et al	10.6
Adnan ,saleem et al	7.05

In this study, in myringoplasty series the rate of residual perforation is 6.7% and the rate of rejection of graft is 6.7%. The probable cause of residual perforation is the slippage of the graft from its position and the

cause for rejection is the post operative infection of the operated site, which is same as the reason cited by the study of Vartianien et al and Kotecha et al. Study of Alberra et al also includes the efficiency of the surgeon and the surgical techniques.

3. PRE OPERATIVE HEARING:

The preoperative hearing threshold in various studies on surgeries done for chronic suppurative otitis media- tubotympanic disease were,

STUDIES	PREOP HEARING IN dB
Nepal A Bhandary et al	21 - 40
Bhusal et al	30 - 44
Saeed ,Anandhami et al	11 – 25.3
Merchant et al	0 - 40
J Lary et al	30 - 40
Duko et al	0 – 30
Mc Ardle et al	0 - 50

In this study the pre operative pure tone average in Myringoplasty series was between 30 to 40 dB with average being 38 dB and in Cortical mastoidectomy with type 1 tympanoplasty series between 30 to 55 dB with average being 42.16 dB.As the perforation size increases, the preoperative hearing threshold also increases – this is consistent with the study conducted by Mehta et al, Bhusal et al Nepal A Bhandary et al,Kageyama etal,Aiberra et al and Saeed et al.

4. POST OPERATIVE AIR BONE GAP:

In this study, in cortical mastoidectomy with type 1 tympanoplasty series, the minimum and maximum preoperative air bone gap were 25dB and 40dB.

The postoperative ABG is < 10dB in 40 %,< 20dB in 50% and 20 – 30 dB in 10%.

STUDY	POSTOP – ABG dB	%
Yasuo,Mishiro et al	< 20	81.6%
Adnan, saleem et al	< 20 <15 < 10	11.6% 28.3% 42.35%
Yaor et al	< 10	78.3%
Xia R et al	< 16.6 +/- 10.4	96.6%

In myringoplasty series, the minimum and maximum preoperative air bone gap were 15dB and 40dB.

The postoperative ABG is < 10dB in 63.3 %,< 20dB in 26.7% and 20 – 30 dB in 10%.

STUDY	POSTOP – ABG dB	%
Yasuo,Mishiro et al	< 20	90.6%
Rizer et al	< 10	84.9%
Pelva et al	< 20	69%
Black et al	< 20	77.9%

5. POST OPERATIVE HEARING BENEFIT:

Hearing improvement in various studies quoted in literature were,

STUDY	HEARING IMPROVEMENT
Adnan et al	85.88%
Rizer et al	84.9%
Raj A Vidit et al	68%
Kotecha et al	67%

In this study, the overall post operative hearing benefit based on Air bone gap was 90%with <10Db in 51.67% and <20db in 38.33%.As hearing benefit is better assessed with the subjective evaluation, in this study we have applied Belfast rule of thumb in patients with unilateral disease. In 23 patients with unilateral disease in Myringoplasty series,95.7% felt significant improvement in hearing and 4.3% felt no improvement. In 18 patients with unilateral disease in Mastoidectomy with type 1tympanoplasty series, 83.3% felt significant improvement in hearing and 16.7% felt no improvement.

6. ROLE OF CORTICAL MASTOIDECTOMY IN CHRONIC SUPPURATIVE OTITIS MEDIA – TUBOTYMPANIC DISEASE.

- Sheehy pointed out that cortical mastoidectomy is necessary for all tympanoplasty –it is ‘A GOOD PRACTICE’ and ‘IT IS BETTER TO BE SAFE THAN SORRY’.[34]
- Tos recommended Mastoidectomy for all discharging ears.[34]
- ROLE OF ADJUVANT CORTICAL MASTOIDECTOMY: [43]

Many authors suggest that a cortical mastoidectomy should be carried out at the same time as myringoplasty in active ears. Mishiro et al compared 104 ears treated by tympanoplasty alone with a previous group of 147 ears treated by tympanoplasty with mastoidectomy There was no significant difference in the tympanic membrane closure rates between groups (94% in tympanoplasty, alone and 91% in tympanoplasty with mastoidectomy) Balyan et al reported 81 ears that were actively discharging at the time of surgery treated with tympanoplasty without mastoidectomy(53 ears) and tympanoplasty with mastoidectomy (28) ears. There was no significant difference in the graft success rates between these groups (91 &86% respectively) There is no evidence that mastoidectomy increases the success rate.

- Mc Grew et al in their paper on 'Impact of mastoidectomy on simple TM Perforation repair' concluded that mastoidectomy impacts clinical course of disease in patients by reducing number of patients requiring future surgery and disease progression.[30]

- In this study, graft take up in 9 patients with disease free antrum is 100% in patients undergone cortical mastoidectomy with type 1 tympanoplasty with wet ears. Type 1 Tympanoplasty alone could be a preferable option, in these cases. But 21 out of 30 cases with wet ear

had diseased antrum. As assessment of disease in antrum is difficult pre–operatively, mastoidectomy in wet ears will be a safer option.

CONCLUSION

1. The success of Myringoplasty in terms of graft uptake and hearing improvement is better in patients with lesser duration of disease, less pre-

operative Air bone gap and with medium sized perforations when compared to subtotal perforations.

2. The success of Cortical mastoidectomy with type 1 tympanoplasty in terms of graft uptake and hearing improvement is better in patients with lesser duration of disease and less pre-operative Air bone gap. The results are better with medium sized perforations when compared to subtotal perforations and in patients with disease free mucosa of mastoid antrum.

3. In post-operative evaluation of patients with unilateral hearing loss, application of Belfast rule of thumb enables the actual hearing benefit of the patient.

LIMITATIONS OF THE STUDY

1. Smaller sample size.

2. The sample population of this study are the patients attending tertiary care centre and does not represents true population.

3. This study includes the surgical procedures done by various surgeons.

4. Follow up period of this study is one year. As hearing benefit is better evaluated at the end of 3 – 5 years, this study could have been done with a longer follow up period.

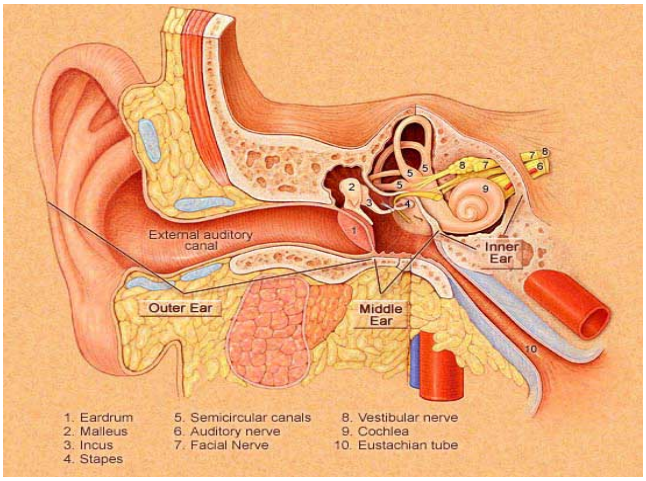


FIG 1: STURUCTURE OF EAR

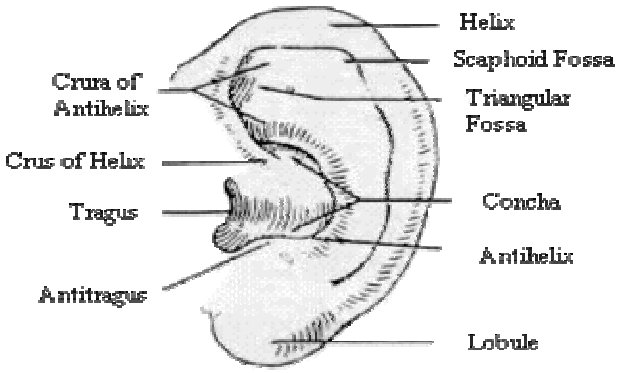


FIG 2: PARTS OF PINNA

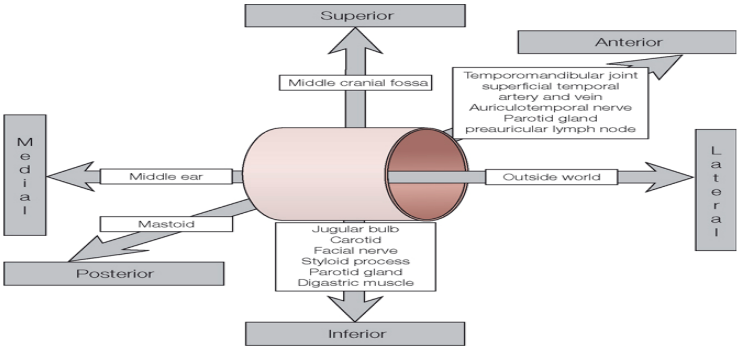


FIG 3: RELATIONS OF EXTERNAL EAR

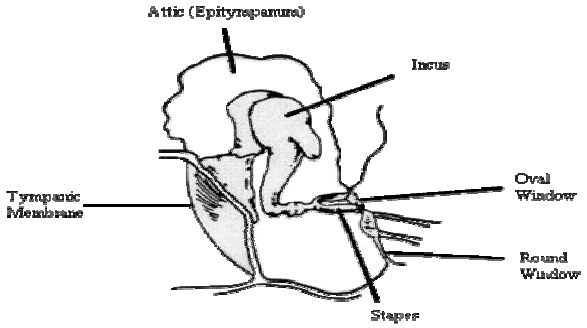


FIG 4: MIDDLE EAR

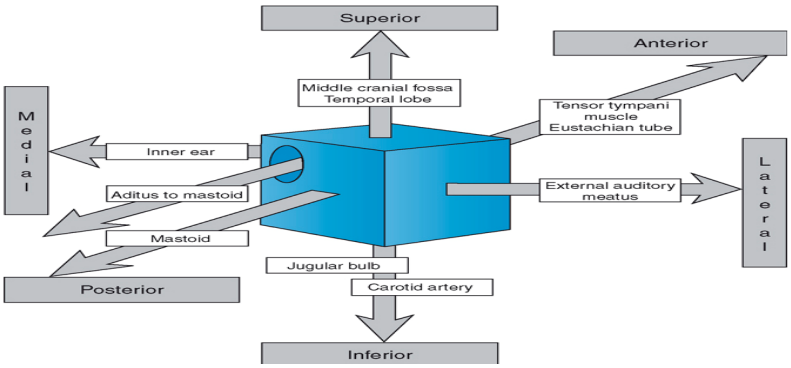


FIG 5: RELATIONS OF MIDDLE EAR

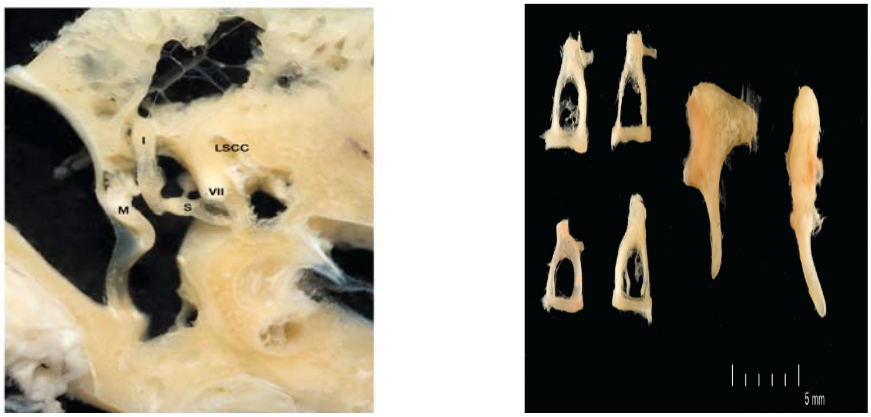


FIG 6: MIDDLE EAR OSSICLES

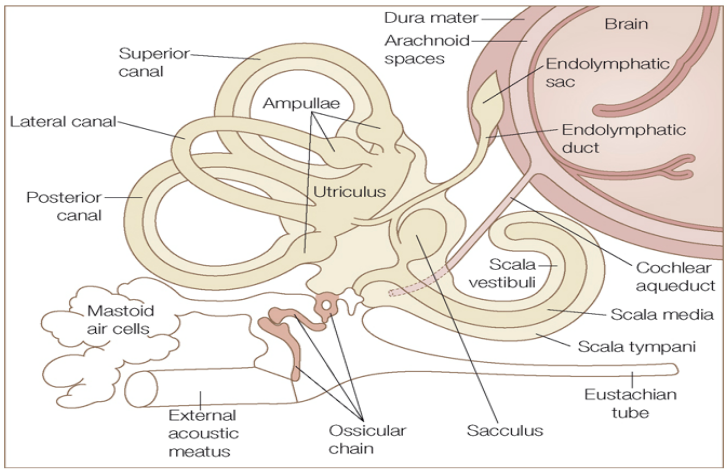


FIG 7: INNER EAR

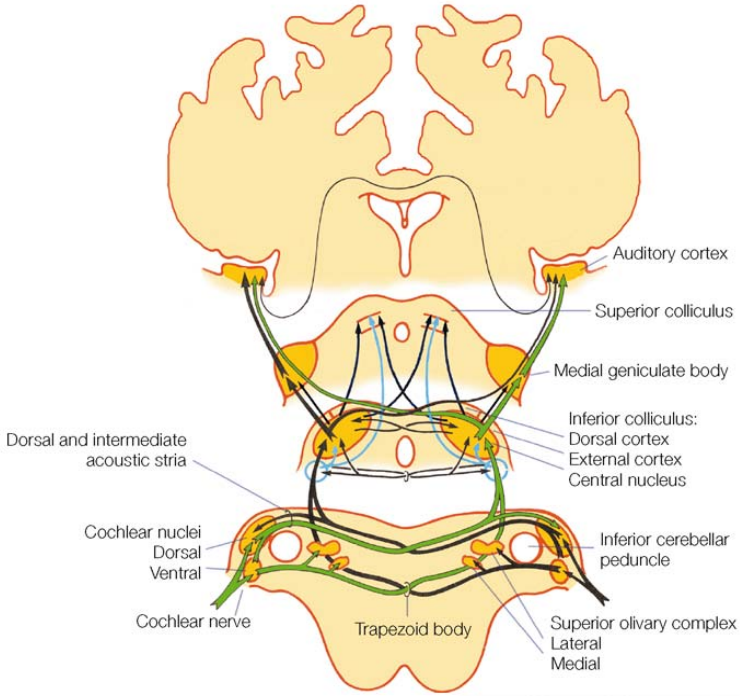


FIG 8: AUDITORY PATHWAY

FIG9: NORMAL TYMPANIC MEMBRANE

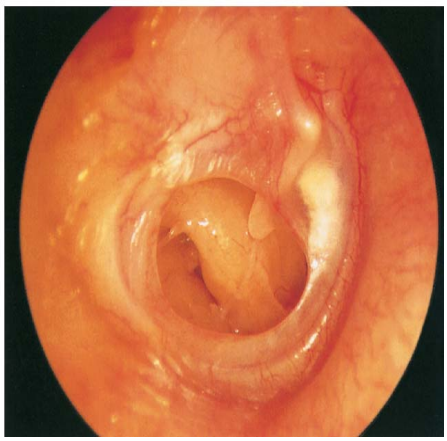


FIG 10: CP WITH MYRINGOSCLEROTIC PATCH

FIG 10: CP WITH ET ORIFICE AND RW NICHE

FIG 11: CP WITH RW NICHE AND IS JOINT

FIG12: MEDIUM SIZED DRY PERFORATION

FIG13: WET CP – SUBTOTAL PERFORATION

FIG 14: MEDIUM SIZED WET PERFORATION

FIG15: POST-AURAL INCISION MARKING

FIG16: POST-AURAL INCISION

FIG 17: EXPOSURE OF MASTOID CORTEX

FIG18: HARVESTING TM FASCIA

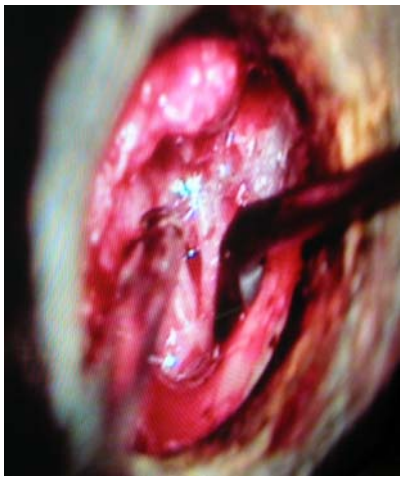


FIG19: TM FLAP ELEVATION

FIG22: DRILLING OF MASTOID CORTEX

FIG 23: MASTOIDECTOMY CAVITY

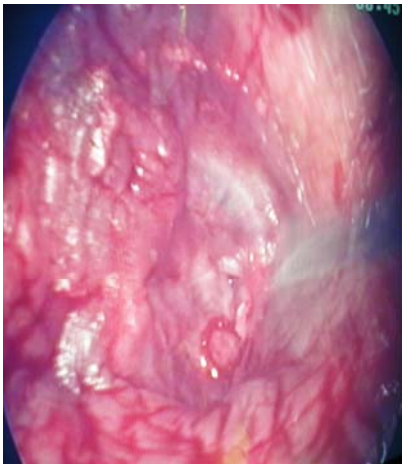
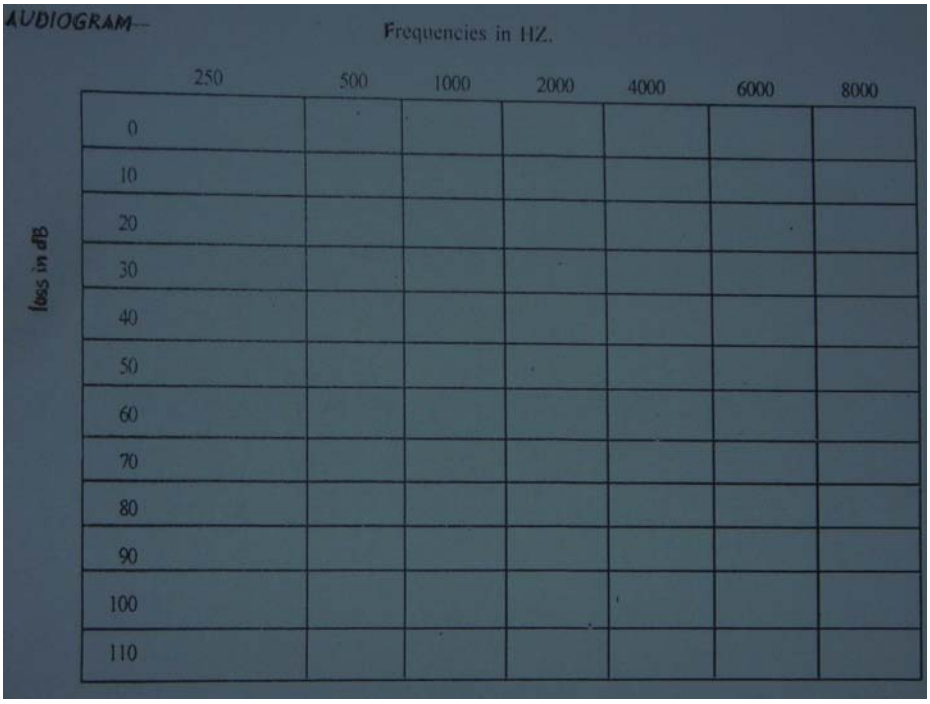


FIG 22:ENDOSCOPIC VIEW OF GRAFT IN SITU

FIG 23:NEO TYMPANIC MEMBRANE

FIG 23 :POST AURAL SCAR – 7 TH POD

FIG 24:POST AURAL SCAR – 1 YR POST-OP



AUDIOGRAM--

Frequencies in HZ.

loss in dB	250	500	1000	2000	4000	6000	8000
0							
10							
20							
30							
40							
50							
60							
70							
80							
90							
100							
110							

MODEL AUDIOMETRY CHART

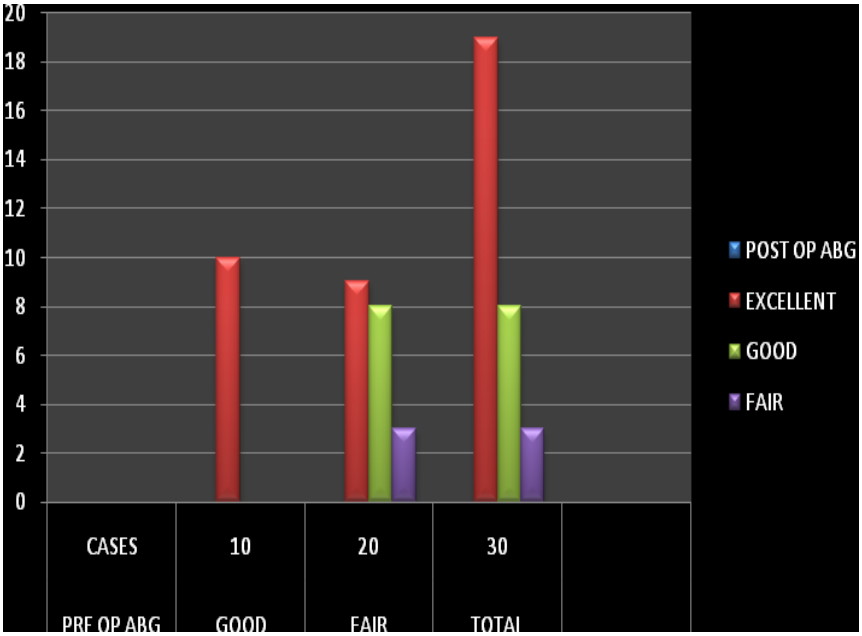


FIG 25:RELATIONSHIP BETWEEN PRE OP ABG AND POST OP ABG IN GROUP A PATIENTS

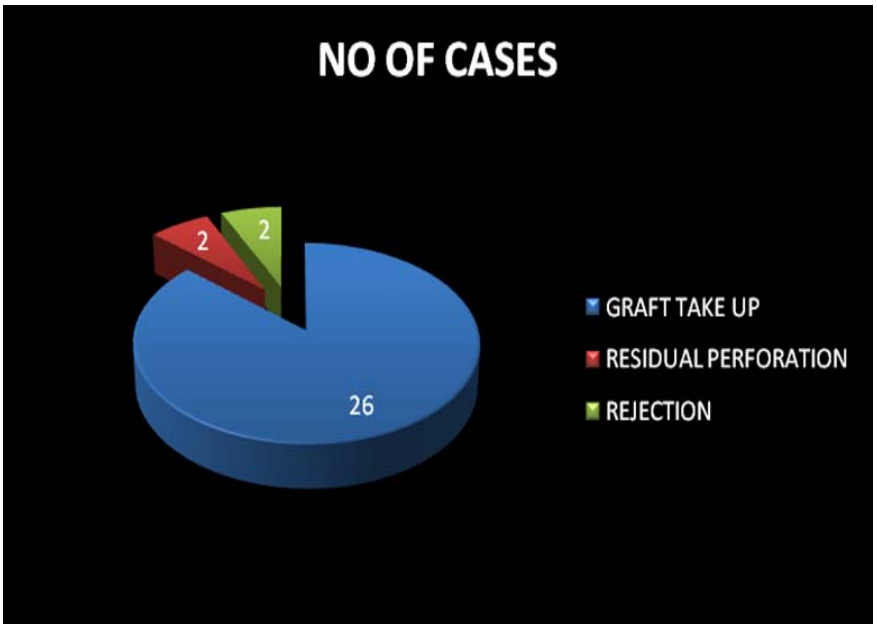


FIG 26: GRAFT TAKE UP RATE IN GROUP A PATIENTS

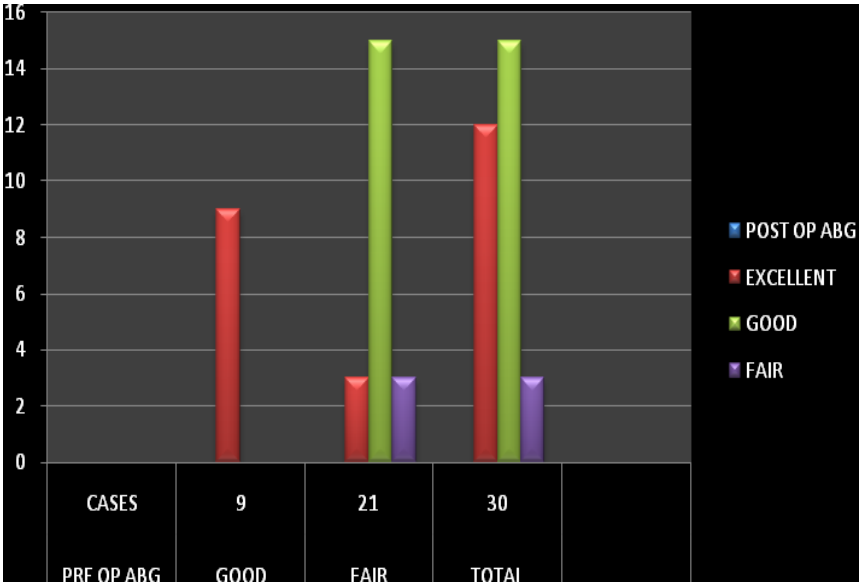


FIG 27:RELATIONSHIP BETWEEN PRE OP ABG AND POST OP ABG IN GROUP B PATIENTS

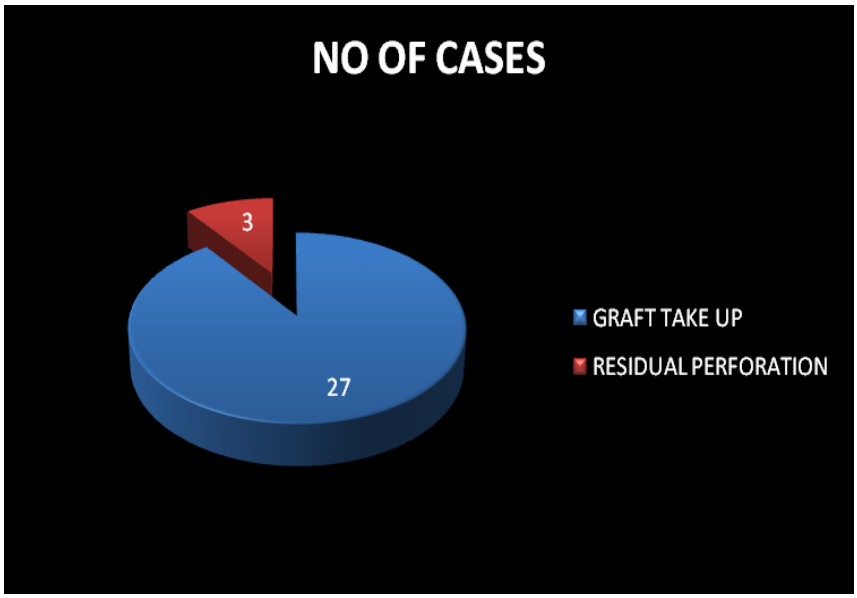


FIG 28: GRAFT TAKE UP RATE IN GROUP B PATIENTS

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PROFORMA

CASE NO :

Name :

Age : Address :

Sex : IP NO :

Occupation : Socio economic status :

PRESENTING COMPLAINTS

	Side	Duration
Ear discharge		
Hard of hearing		
Ringing sound in ear		
Swelling around ear		

H/O PRESENT ILLNESS

Ear discharge - side

duration

onset : insidious / sudden

type – watery / mucoid /mucopurulent

amount – scanty / profuse

intermittent / continous

aggravating factors / relieving factors

Hard of hearing - side

duration

onset : insidious / sudden

progression

severity : hears normal / loud conversation

associated family history

aggravating / relieving factors

Ringing sound in ear – side progression

Duration character

PAST HISTORY :

H/O DM / HT / TB / trauma / drug intake / exanthematous fever / previous surgeries

PERSONAL HISTORY :

Smoking / alcohol / occupation / nutrititional status

LOCAL EXAMINATION :

EAR Rt Lt

Pinna – size / shape / position

Congenital/acquired deformity

Pre / Post auricular region

External auditory canal

Tympanic membrane – tensa / flaccida

Fistula test

Three finger test

Facial nerve functions

Tuning fork tests – Rinne

Weber

ABC

NOSE

External contour

Anterior rhinoscopy – septum / turbinates / spurs / any mass

Post nasal examination

Cold spatula test

THROAT

Lips / gingivae / vestibule / buccal mucosa / teeth / tongue / palate / tonsils / pillars / pharyngeal wall

GENERAL EXAMINATION :

Built / nutrition / febrile / anaemia / jaundice / lymphadenopathy

PROVISIONAL DIAGNOSIS :

INVESTIGATIONS :

Under microscope :

Aural swab – culture & sensitivity

Pure tone audiometry

Diagnostic nasal endoscopy

Xray both mastoids – lateral oblique view

Routine blood / urine investigations

TREATMENT :

1. Initial conservative management :

2. Myringoplasty :

3. Cortical mastoidectomy with myringoplasty

4. Cortical mastoidectomy with type 1 tympanoplasty

POST-OPERATIVE FOLLOW UP :

1.Wound healing

2.Tympanic membrane status

3.Pure tone audiometry – Pure tone average

Air bone gap

4.Subjective evaluation