# A STUDY TO FIND OUT THE EFFICACY OF CORTICAL MASTOIDECTOMY WITH MYRINGOPLASTY IN CHRONIC SUPPURATIVE OTITIS MEDIA

*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**

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**Branch – IV**

**Department of ENT**

**Kilpauk Medical College,**

**Chennai -10.**


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

This is to certify that **Dr. LEKSHMY R KURUP** postgraduate student (**2010-2013**) in the department of Otorhinolaryngology,Govt. Kilpauk Medical College, Chennai, has done this dissertation titled **" A STUDY TO FIND OUT THE EFFICACY OF CORTICAL MASTOIDECTOMY WITH MYRINGOPLASTY IN CHRONIC SUPPURATIVE OTITIS MEDIA"** under the direct guidance and supervision in partial fulfillment of the regulations laid down by the Tamil Nadu Dr. M.G.R. Medical University, Chennai, for M.S., Branch – IV Otorhinolaryngology Degree Examination.

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# DECLARATION

I Dr. **LEKSHMY R KURUP** solemnly declare that the dissertation titled "**A STUDY TO FIND OUT THE EFFICACY OF CORTICAL MASTOIDECTOMY WITH MYRINGOPLASTY IN CHRONIC SUPPURATIVE OTITIS MEDIA**" is a bonafide work done by me at Govt.Kilpauk Medical College and Hospital under the guidance and supervision of

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# CONTENTS

# INTRODUCTION

WHO (World Health Organization) defines chronic suppurative otitis media as a stage in ear disease in which there is a chronic infection of the middle ear cleft in the presence of persistent tympanic membrane perforation[1]. Chronic suppurative otitis media is typically a persistent disease, insidious in onset, often capable of causing severe destruction and irreversible sequelae and clinically manifests with deafness and discharge. According to Mawson's textbook of Ear disease, it is persistent otorrhea through a non-intact tympanic membrane[3]

The global burden of chronic suppurative otitis media is estimated around 65-330 million of which 60% suffer from significant hearing impairment. It accounts for 28,000 deaths and a disease burden of more than 2 million DALYs. Incidence of CSOM is higher in developing countries because of poor socio-economic standards, poor nutrition and lack of health education. It affects both sexes and all age groups. In India, the overall prevalence rate is 46 and 16 persons per thousand in rural and urban population respectively. It is also the single most important cause of hearing impairment in rural population.

A mastoid is considered to be inflammatory when purulent exudates, granulation tissue, polypoid mucosa, cholesterol granuloma or

cholesteatoma are noted. It is mandatory that this diseased mastoid be cleared off the disease before undertaking any reconstruction.

Otologists have long realized the importance of mastoid disease in determining the success of tympanic membrane reconstruction. It is beyond doubt that the extension of pathologic process into mastoid air cell system requires exposure and removal. It is often possible to eliminate chronic progressive inflammation of the middle ear and mastoid, and at the same time have a reasonable chance to preserve residual hearing or preferably to improve hearing. Controversy has been centered on the best surgical technique to achieve this desirable result.

It is well known that chronic suppurative otitis media is a poor man's disease. Poor living conditions, overcrowding, poor nutrition and hygiene have been suggested as a basis for widespread prevalence of this disease in third world countries.

Surgery plays an important role in its management and the outcome measures are closure of tympanic membrane perforation in myringoplasty, eradication of disease and achievement of a dry and safe ear in mastoidectomy and in some cases, improvement of hearing where ossicular reconstruction or ossiculoplasty is also carried out. A mastoidectomy done along with tympanoplasty may ensure clearance of

disease, saves time, money, unnecessary hospital stay, and repeated hospital visits for the patient.

## ANATOMICAL CONSIDERATIONS OF MIDDLE EAR CLEFT:

For the purpose of description middle ear can be considered as a 6-sided cube.

**Lateral wall:** It is formed partly by bone forming the outer wall of epitympanum and hypotympanum respectively and ***mainly by the Tympanic membrane***, which separates the external ear from middle ear. It is convex towards the middle ear, the area of maximum convexity being called as umbo. Tympanic membrane is divided into two parts - the pars flaccida or shrapnel's membrane above and pars tensa below by the anterior and posterior malleolar folds. The handle of malleus is attached to the pars tensa. In the upper part of pars tensa, the short process of malleus is seen. The Politzer's cone of light extends anteroinferiorly from the umbo.

Pars tensa is classically described as having 3 layers - an outer layer of squamous epithelium continuous with skin of external auditory meatus, a middle layer of fibrous tissue consisting of radial and circular fibers and an inner layer of mucosa of middle ear.

In 1851 Toyenbee demonstrated five layers for the tympanic membrane viz. the outermost epidermis of stratified squamous epithelium, a thin dermis of fibrous tissue, an outer radiate fibrous layer, an inner circular fibrous layer and an innermost thin mucous layer. The tympanic membrane is supplied by the Alderman's nerve (auricular branch of vagus or Arnold's nerve) in the posterior half, the auricular branch of auriculotemporal nerve in the anterior half and by the Jacobson's nerve (tympanic branch of glossopharyngeal nerve) on the medial surface.

Three holes present in the bone of medial surface of the lateral wall of tympanic cavity are the opening of the posterior canaliculus for entry of chorda tympani nerve at the junction of posterior and lateral walls of tympanum. The Glasserian fissure (petrotympanic fissure) which transmits the anterior tympanic branch of maxillary artery and the canalicus (canal of Huguier) on the medial aspect of the fissure for the exit of chorda tympani nerve.

The circumference of tympanic membrane is thickened forming the fibro cartilaginous annulus, which is fixed into tympanic sulcus except superiorly at the notch of Rivinus. Annulus is continuous with the anterior and posterior malleolar fold thus making it possible to consider

attic perforations as marginal. The roof of tympanum is formed by Tegmen, which separates it from dura of middle cranial fossa.

**Floor:** It is narrow and formed of a thin plate of bone, which separates tympanum from the dome of jugular bulb. At the junction of floor and medial wall there is a small opening, which transmits the Jacobson's nerve.

**Anterior wall:** It is also narrow and formed of a thin plate of bone, which separates tympanum from internal carotid artery. It is perforated by the carotico tympanic nerves and tympanic branches of internal carotid artery. It has two openings - the lower one leading to bony part of eustachian tube and upper one transmitting tendon of tensor tympani.

**Posterior wall:** It has in its upper part, the aditus - ad – antrum opening into the mastoid antrum. Below aditus is a small depression - the fossa incudis lodging the short process of incus and its ligament. Below this fossa is the pyramid, which contains the stapedius muscle. The facial recess is a shallow space bounded medially by the descending part of facial nerve and laterally by the tympanic annulus. The sinus tympani is another deep gutter starting above at the oval window niche, medial to descending part of facial nerve and to the pyramid and passes behind the round window niche to hypotympanum. In intact canal wall

mastoidectomy this sinus is frequently missed leading to residual cholesteatoma.

**Medial wall:** Of all the walls, this is the most important and is marked by the *promontory* produced by the basal turn of cochlea. Behind and above is the fenestra vestibuli, which is reniform in shape and closed by the stapes footplate and its annular ligament. The fenestra cochlea lies behind and below the promontory and is closed by the secondary tympanic membrane. The processes cochleariformis is a projection anteriorly around which hooks the tendon of tensor tympani and it also denotes the start of the horizontal portion of facial nerve. There is a posterior extension of the promontory above the round window niche called as subiculum and another one below oval window niche called as ponticulus. The horizontal part of facial nerve runs from processes cochleariformisupto its second genu at the fossa incudis, above the promontory and oval window niche. The bony fallopian canal is deficient here in 10% of individuals and the nerve may overlie the oval window niche. The cavity of the middle ear is divided into:

- **Mesotympanum** which lies medial to the tympanic membrane
- **Epitympanum** or *attic*, lying above the level of the horizontal portion of facial nerve, medial to the horizontal part of squama (outer attic wall)

- **Hypotympanum** lying below the tympanic sulcus.

Contents of the middle ear cavity includes (i) ***air***, (ii) ***ossicles*** - malleus, incus and stapes, (iii) ***intra-tympanic muscles*** - tensor tympani and stapedius, (iv) ***tympanic plexus of nerves***, (v) ***chorda tympani nerve*** and (vi) ***the arteries and veins***.

The pneumatic air cell system arises in conjunction with the enlarging temporal bone as an outgrowth of middle ear and antrum. From the antrum, the cellular system extends into adjacent bone and is grouped as follows:

- **Periantral cells**
- **Tipcells** – superficial and deep, separated by the digastric ridge
- **Peri-sinuscells**
- **Peri-labyrinthine cells** – supra, infra and retrolabyrinthine
- **Retrofacial cells**
- **Petrosal cells**
- **Hypotympanic cells**
- **Zygomatic cells**

The extent of pneumatisation varies between individuals. In 20% of the total population mastoid air cells are totally absent - the bone being primarily sclerotic. The anatomic configuration created surgically consists of exposing, but not injuring, the important structures bordering the mastoid cavity. The posterior limit of the mastoid cavity is formed by the bone overlying the posterior dura. The major landmark is the large convex channel running from the superolateral corner to the postero-medial corner, formed by the lateral sinus.

The superior limit of this wall forms an acute angle with the tegmen, the sinodural angle. The tegmen forms the upper wall of the cavity. Inferiorly the mastoid tip forms the wall superficially with the concave digastric ridge projecting into the space medial to the tip. The cavity is limited anteriorly by the posterior wall of the external auditory canal and the vertical segment of the facial nerve lying at the base of this wall.

This portion of the facial nerve extends from the fossa incudis to the anterior end of digastric ridge. On the medial wall of mastoid cavity the lateral and posterior semicircular canals occupy the major portion. The triangle between the external prominence of these canals and the posterosuperior corner of the mastoid is known as Trautmann's triangle from which a group of antral cells invades the petrous deeply, to the region of internal auditory canal. Visualisation of the medial wall may be

confused by the presence of Korner's septum, which divides the cells into superficial and deep regions. The antrum lies approximately 15 mm deep to the Mac Even's triangle in an adult.

## FUNCTIONS OF MIDDLE EAR (PHYSIOLOGICAL CONSIDERATIONS OF MIDDLE EAR)

The tympanic membrane and ossicles not only conduct the sound but also increases the sound pressure before it is transmitted to cochlea. The increase in sound pressure provided by tympanic membrane and ossicles is necessary to overcome the impedance (resistance} to the sound transmission and is called impedance matching of the ear.

***Von Bekesy***, by measuring the amplitude of motion of different portions of tympanic membrane in response to a constant stimulus, found that at all frequencies upto 2400 cycles per second (CPS) the whole central conical portion of the do and handle of malleus moves as a unit about an axis of rotation passing through the anterior and lateral process. The amplitude is greatest near the inferior edge of the membrane. Above 2400 CPS, the membrane no longer vibrates as a stiff cone but in segments with the manubrium lagging behind the adjacent portions of the membrane.

Malleus and incus vibrate as combined unit rocking on a linear axis, which runs from the anterior ligament of malleus to short process of the incus. With sounds of moderate intensity, the anterior end of foot plate of stapes –oscillates with greater amplitude than posterior end. This is because fibres of annular ligament are larger at the anterior end than at the posterior end. With high sound levels the mode of action changes and a side to side rocking movement about an axis running longitudinally through the length of foot plate is seen. Here the volume displacement of inner ear fluids is proportionately less and this modification is by stapedial reflex and so the inner ear is protected (John Groves 1979).

**THE TRANSFORMER ACTION OF MIDDLE EAR/MIDDLE EAR IMPEDENCE MATCHING:**

Sound waves do not pass readily from one medium to another of different acoustical resistance. Between air with an acoustical resistance of only 41.5 mechanical Obms/cm2 and seawater with a resistance of 61000, the impedance mismatching is very great. Only 0.1% of energy of sound would be transmitted representing a loss of 30 db to overcome this an acoustic lever system is formed by drum and ossicles. The aerial ratio between tympanic membrane and oval window - called as the Hydraulic ratio is 14:1. A mechanical advantage of approximately 1.3 is available

since handle of malleus is longer than long process of incus. This is called ossicular chain lever ratio. The result of the two gains in the hydraulic ratio and ossicular chain lever ratio is 18.3. By definition the impedance transformation ratio is square of this figure i.e. 336. The ratio of acoustic impedance of air and water is 3880.So impedance matching due to middle ear, although very substantial, is less than ideally required (Hawkins J E 1966)

An additional virtue of middle ear mechanism is that it provides preferential conduction of sound to oval window.

**HISTORY:**

Chronic suppurative otitis media is a persistent disease, insidious in onset, often capable of causing severe destruction and irreversible sequelae and clinically manifests with deafness and discharges.

The management of chronic suppurative otitis media has witnessed a profound change over the last 100 years from the early attempts at surgical exposure of the middle ear in 1889 to the present day techniques of tympanoplasty in persistent but inactive disease and the canal-wall up or the canal-wall-down techniques in cholesteatoma surgery.

The choice of operative treatment in uncomplicated suppurative disease of ear depends to a large extend on the experience of the operator,

the extent of the disease,the preoperative hearing and whether or not the patient can be followed up post-operatively.

Though the mastoid surgery and middle ear reconstruction has progressed to such a great extend, there are group of patients in whom it is advisable not to undertake such detailed procedures because of the difficulty in postoperative care of the mastoid cavity. This includes patients with absent auditory function and patients with severe mental retardation. Here total obliterations of mastoid, middle ear and external meatus has been suggested (Rambo 1958, Gacek 1979 and Schuknechdt 1984).

***Shambaugh*** in his textbook 'Surgery of the Ear' states that the first contemplation of surgery for mastoid infection, occurred four centuries ago. According to him the first recorded successful mastoid operation was done by Jean Petit of Paris and shortly thereafter in 1776, a Prussian surgeon, who operated on a soldier with a draining ear.

The first well described technique for dealing with acute mastoiditis were set forth by ***William Wilde*** in 1853. Wilde's name is still remembered in connection with the post-aural incision. It was ***Herman Schwartze*** who outlined clearly the indication for simple mastoidectomy. The radical mastoid operation was devised by **Emmanual Zaufel** and popularized by ***William Stacke***. The procedure

was used for chronic suppuration of the ear and in cases of cholesteatoma.

**DEFINITIONS:**

***Myringoplasty*** is an operation in which the reconstructive procedure is limited to the repair of a tympanic membrane perforation (Ballenger 1985). In 1878, Berthold successfully closed a perforation with full thickness skin and introduced the term "Myringoplastik" (Gibb et al 1982).

The term, ***Tympanoplasty*** was coined by *Fritz Zollner and Horse Wullstein*. Zollner in 1951 andWullstein in 1952 began to set of similar operations to provide sound protection of round window and to reconstruct sound pressure transformation for the oval window (zollner F 1955; Zollner F 1963; Wullstein H 1960). The two basic principles of tympanoplasty had been defined, namely, sound pressure transformation of the oval window and sound protection for the round window (Shambaugh 1980).According to ***Sheehy*** (1973) the goals of tympanoplasty are two viz. elimination of disease and permanent restoration of hearing.

The work of ***Zollner and Wullstein*** found light in 1921, whenNylen introduced a mono ocular operating microscope. One year after that Holmgren introduced ocular loop. This was an important advance destined to play an increasing role in the perfection of tympanoplastic surgery. In 1953, the Zeiss operating microscope became available and during the same year Wullstein and Zollner launched the tympanoplasty methods, in the 5th international congress of Otorhinolaryngology in Amsterdam.

According to the Committee on conservation of hearing, of the American Academy of Ophthalmology and Otolaryngology 1965, Tympanoplasty can be defined as an operation performed to eradicate disease in the middle ear and to reconstruct the hearing mechanism, with or without tympanic membrane grafting (Frootko N J 1987)[24].

Ossiculoplasty can be defined as an operation performed to repair or reconstruct the ossicular chain (Nicholas J F 1987).

***Cortical Mastoidectomy***is defined as a surgical procedure in which all accessible mastoid air cells are removed, posterior canal thinned and aditus made patent. Can be broadly divided into open or canal-wall-down procedures and closed or canal wall-up procedures.

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

**Types of Tympanoplasty[2]**

***Wullstein*** has classified the more commonly encountered abnormal patterns of sound transmission into five types:

**Type I:** defines a normal middle ear with an intact mobile ossicular chain. Myringoplasty is often incorrectly referred to as type I tympanoplasty because myringoplasty does not imply removal of disease from the middle ear (Nicholas 1987)

**Type II:** Here, after clearance of disease sound transmission is through a deformed but functioning ossicular chain when it is called Type II (a). Any mechanism which joins the tympanic membrane with stapes foot plate which retains a lever advantage is also included in Type II. If this is a malleus stapes assembly, it is called Type II (b) and if it is a new construction independent of malleus it is called type II (c).

**Type III:** Is otherwise known as columella effect, where sound is transmitted directly through a mobile stapes. Membrane perforation with erosion of malleus and incus with presence of intact and mobile stapes. (Columella tympanoplasty or Myringo-stapediopexy)

**Type IV:** Is otherwise known as 'baffle effect'. Here the mobile foot plate over the oval window is left exposed. A small cavity is created called 'Kleinepauke' – as the Germans put it – in continuity with the Eustachian tube which provides sound protection for the round window.

**Type V:** Is fenestration operation done in a case with fixed stapes. Here sound enters the labyrinth by a fistula of lateral semicircular canal.

**Type VI:**In addition to all these Gercia Ibanez in 1961 described sonoinversion where round window is left exposed to direct impact of sound wave and the mobile stapes footplate is protected by a small tympanic air space in continuity with Eustachian tube.

Of all these techniques Type IV & type V as well as sono-inversion are seldom performed today. Type I & II has evolved under the modern techniques of tympanoplasty and ossiculoplasty to a very great extent. However, the columella effect is still a most useful procedure, especially in the hands of the less expert and is said to give a socially acceptable hearing, a little above the 25 dB level for the speech frequencies. (Beales H P 1978)[20].

**FUNCTIONS OF MASTOID AIR CELL SYSTEM:**

It serves as an air reservoir for middle ear and also provides resonance to the sound. Further it acts as an insulating chamber for protecting the labyrinth from temperature variations.

**ANATOMY & PATHOLOGY OF MUCOUS LINING OF MIDDLE EAR CLEFT:**

The Eustachian tube and anterior half of middle ear space are lined by pseudo stratified columnar ciliated epithelium and as the lining proceeds posteriorly it gradually merges to a single layer of cuboidal epithelium. Further as it extends into mastoid antrum and air cells it becomes flat pavement epithelium. Developmentally the level of chorda tympani nerve can be considered as the borderline between the

respiratory epithelium and pavement epithelium. In the respiratory part there are a large number of goblet cells, which secretes mucous actively if irritated by infection, allergy or negative pressure. This mucous is secondarily infected and results finally in denudation of epithelial lining- The tissue then reacts by oedema or production of granulation tissue. Infection can reach middle ear cleft via eustachian tube or an already existing perforation or by way of a retraction pocket of the tympanic membrane which gives way.

## MICROBIOLOGY OF CSOM

### TUBO TYMPANIC DISEASE :

The commonest organisms found isolated are Pseudomonas aeruginosa, Proteus species and Staphylococcus aureus . Other organisms found less commonly are E.coli, Streptococcus pneumoniae, Diptheroids, Klebsiella sps and the Bacteroides[21].

The histopathological changes seen in chronic suppurative otitis media vary with the degree and the extent of disease. The degree of inflammation seen is related to clinical activity, with the most intense changes seen in ears with continuous otorrhoea. The changes occurring are:

A ***chronic inflammatory infiltrate*** consisting of lymphocytes, plasma cells and histiocytes develops. Associated with this is increased capillary permeability of laminar propria of the middle ear mucosa, with mucosal edema.

The ***middle year epithelium undergoes transformation*** to resemble respiratory epithelium found in other sites. This consists of an increase in the number of goblet cells and ciliated cells. In addition the epithelium becomes glandular. This charge in character of the epithelium may take place in the mastoid air cells as well as in the middle ear cavity. The secretion from newly formed glands is an important part of the discharge seen in chronic suppurative otitis media.

An ***inflammatory granulation tissue*** develops during the early stages of healing after destruction of tissue. In some cases florid granulation tissue results in the gross appearances of an aural polyp.

The late stages of disease are characterized by a ***decrease in vascularity and fibrosis***. These changes are particularly well seen in mastoid air cells, in which sclerosis and new bone formation occur.

# CLINICAL PRESENTATION

## SYMPTOMS:

### *Aural discharge:*

The discharge can be continuous or intermittent, tends to be profuse, and is frequently mucoid and very rarely purulent. The increase in amount of discharge can be precipitated by upper respiratory tract infections or by entry of water. Blood stained discharge indicates florid granulation tissue and aural polyp. Persistent otorrhoea unresponsive to medical treatment indicate a so called 'Mastoid reservoir of disease with inflammation throughout the middle ear cleft.

### *Hearing loss :*

The predominant deafness is conductive in nature.

Factors that influence the degree of deafness are:

- Size and position of Tympanic membrane defect.
- Large perforations will reduce the efficiency of TM to greater degree. Posterior perforations exposing the posterior mesotympanum produce a more severe deafness owing to reduction of the 'baffle effect' on the round window. Small anterior defects often produce nearly no deafness.

- Presence of middle ear pathology such as edema and granulation tissue influence the sound conducting mechanism. The sensorineural deafness in chronically discharging ears is due to passage of bacterial toxins across the round window membrane to the cochlea and the loss is mainly in the high frequencies

## CLINICAL MANAGEMENT:

### DIAGNOSTIC STEPS:

1. Accurate documentation of the tympanic membrane defect:

   This is achieved by examination on table with Microscope

2. Culture sensitivity of the discharge is done for proper antibiotics.
3. Assessment of hearing loss:

This is done by standard Rinne, Weber tuning fork tests. Pure tone audiometry with air and bone conduction threshold estimation should be performed. Adequate masking is essential, particularly in patients with bilateral conductive or mixed hearing loss. Speech audiometry is often helpful and is required for any patient in whom surgical reconstruction is being considered .

Lateral Oblique Radiograph of Skull for Mastoids (LAW'S VIEW) Provide useful information on mastoid cellularity and the position of the sigmoid sinus and tegmen.

4. CT Scan of Nose and Paranasal Sinuses

This is done to rule out any focus of sepsis in the nose and paranasal sinuses.It is done following a diagnostic nasal endoscopy examination. If any pathology found it is cleared off before undertaking ear surgery.

5. Pure Tone Audiometry

**MEDICAL TREATMENT :**

The aims of Medical treatment in these cases is to eliminate infection and hence otorrhoea. The correction of hearing loss and re-establishment of an intact tympanic membrane may require a surgical procedure.

The removal of discharge from an ear with active CSOM is an essential prerequisite for successful treatment. This is done by suction, dry mopping or wet irrigation.

Topical agents used in the treatment of CSOM are a combination of antibiotics, antifungals, antiseptics, solvents and steroids. The systemic antibiotics like parenteral penicillin's, cephalosporins and

aminoglycosides and oral preparations like ciprofloxacin are effective in the treatment of CSOM.

**FAILURE OF MEDICAL TREATMENT:**

- Poor drainage of inflammatory exudates from the middle ear particularly with a pinhole perforation or discharging ventilation tube.
- Persistence of osteitis with mastoid granulations.
- Microbiological factors-Virulent and resistant organisms may be responsible for failure of treatment.
- Repeated re-infection via the Eustachian tube. This is due to chronic infection in the nasopharynx, adenoids, palatine tonsils or sinuses.

## SURGICAL TREATMENT:

The indications for surgical intervention in chronic ear disease are basically two fold the control of infection and the restoration of function. Since hearing improvement is not usually possible unless the disease is eliminated from the involved ear, this remains a primary consideration in surgery. With the present-day techniques, an equal consideration is given to the hearing improvement.

## GRAFTS USED IN TYMPANOPLASTY AND MASTOIDECTOMY

### Terminology (FROOTKO, 1985):

Four types of Grafts can be defined according to the genetic relationship between the donor and the host:

***Autograft:*** Tissue transplanted from one part of the body to another in the same individual.

***Isograft:*** Tissue transplanted between genetically identical individuals.

***Allograft (Homograft):*** Tissue transplanted between genetically non-identical members of the same species.

***Xenograft:*** Tissue transplanted between members of different species.

# AIMS AND OBJECTIVES OF THE STUDY

1.To determine the efficacy of myringoplasty combined with cortical mastoidectomy with respect to takeup of graft in chronic suppurative otitis media with persistent mucosal disease.

2. To determine the efficacy of myringoplasty combined with cortical mastoidectomy with respect to post operative audiological improvement in chronic suppurative otitis media with persistent mucosal disease.

# REVIEW OF LITERATURE

***Hippocrates***, "Father of Medicine" had noticed the development of intracranial complications following ear discharge, the treatment for such a disease was not well established due to lack of better understanding of the disease and the non availability of better technology. Although, the introduction of sulpha drugs by Domegkin 1953 and penicillin by Sir Alexander Fleming in 1942 reduced the mortality in case of safe type of CSOM, they could not cure cholesteatoma.

***Shambaugh*** [29] in his textbook 'Surgery of the Ear' states that the first contemplation of surgery for mastoid infection, occurred four centuries ago. According to him the first recorded successful mastoid operation was done by Jean Petit of Paris and shortly thereafter in 1776, a Prussian surgeon, who operated on a soldier with a draining ear.

| | | |
|---|---|---|
| **1736 AD** | PETIT | Described mastoid operation forMastoiditis |
| **1873 AD** | SCHWARTZE[23] | Established the indication for and methods of Simple Mastoidectomy |
| **1889 AD** | KUSTER AND STACKE | Introduced Radical Mastoidectomy. |
| **1910 AD** | BONDY | Modified Radical Mastoidectomy. |

The above procedures were developed mostly to eliminate the disease from tympano mastoid area, to prevent the development of life threatening complications and to exteriorize the cavities for the purpose of inspection and cleaning of recurrent process for the rest of the patient's life and if possible to achieve a dry ear, but functional hearing was not at all a major criterion.

| | | |
|---|---|---|
| **1921 AD** | NYLEN | Introduced monocular operating microscope in ear surgery. |
| **1922 AD** | HOLMGREN | Introduced Binocular operating Microscope. |

These were the major developments in the field of mastoid surgery:

| | | |
|---|---|---|
| **1951 AD** | ZOLLNER | Used Autologous fascia lata in tympanoplasty. He is the first man to apply the principles of middle ear transformer to the surgical reconstruction. |
| **1952 AD** | WULLSTEIN | Introduced the term tympanoplasty. He launched tympanoplasty methods using free skin grafts and he introduced absorbable gelatin sponge. |

The techniques introduced by them entirely changed the mastoidectomy results and functional results of hearing improvement were remarkable

| | | |
|---|---|---|
| **1961** | GUILFORD<br>PALVA | Developed mastoid cavity obliteration techniques. These have minimized the postoperative large cavity problems. |
| **1963 AD**<br>**1968 AD** | JANSEN<br>SHEEHY | Developed intact canal wall techniques to eliminate cavity problems. In this procedure, a normal looking external auditory canal with better hearing results can be achieved. |
| **1991 AD** | HELLSTROM et al | Repaired small perforations of tympanic membrane by application of weak acids, Sodium hyaluronate. |
| **1993 AD** | PREMCHANDRA et al | Used cultured epithelial keratinocytes to form a healthy, protective lining of open mastoid cavities. |

During evolution of various surgical procedures many techniques were recommended of which some were discarded as better methods evolved in the management of chronic discharging ears.

**Grafts used in Tympanoplasty&Mastoidectomy:**

There are four different types of grafts now available like the autograft, isograft, homograft or allograft and heterograft (Frootko 1987)[29]. In 1640 a segment of bladder was used in an attempt to close tympanic membrane perforation by ***Marcus Banzer*** (Thawley 1982). In ***Ringenberg's article*** (1978), he has mentioned that artificial drum was proposed by Leschevian in 1973 and, by Authenrinth and Bohneberger in 1815. In 1878 ***Berthold*** successfully closed a perforation with a full thickness skin graft (Gibb et al 1982). But in an article by ***Wullstein*** (1971) it is said that it is ***Heerman*** in 1960 who first used autograft temporalis fascia successfully and ***Wullstein*** first used absorbable gelatin sponge known as gel foam to promote growth of new health middle ear mucosa, to maintain a middle ear free of adhesions and to support the neotympanic membrane (Wullstein 1960). As an autograft, in the repair of tympanic membrane perforation, the **temporalis fascia is now preferred because it has a low metabolic rate, easy availability and good survival prospects.**

According to ***Ballenger*** (1977)[19] the connective tissue graft used to replace the missing fibrous element of drum is rapidly covered by proliferating squamous layer which quickly carries blood to the graft during which time it is able to survive by tissue perfusion. ***Calcattera***

(1972) stated that, transplanted tissue with lower metabolic requirements such as connective tissue has been found to be much more resistant to necrosis in the early postoperative period. The use of fresh autograft connective tissue such as vein or fascia avoids complications of storage and offers greater degree of success (Ballenger, 1977)[19].

According to ***Shambaugh*** (1980) the fascial graft may be allowed to dry before use or even compressed in a special clamp. In the dry parchment like state, it is easily cut down to size and accurately applied in the tympanic membrane defect. Drying of the temporalis fascia does not seem to impair the viability of the fascia and it makes it easier to handle. It is not advisable to dry temporalis fascia by heat, as is sometimes recommended, as the graft may be devitalized in parts leading to higher incidence of graft failure (Beales 1979)[20]

The temporalis fascia graft should not be allowed to dry but should be placed in a moist chamber if there is to be any delay in its use. The graft should not be handled with finger but should be manipulated with instruments free of fibres or lint particles (Hough 1970). It is Hough's firm belief that procedures which deliberately damages the cell or alter the chemistry of graft should be discarded. It is illogical to compromise a good result by drying the tissue until it becomes parchment like, or conversely to place it in a non physiological solution.

A variety of connective tissue homologous graft materials are in use, which include fascia, dura, and homograft tympanic membrane with or without ossicles while autologous temporalis fascia also enjoys popular support. Smyth (1980) demonstrated no significant difference in success rate between autologous temporalis fascia and homologous dura when hearing results are compared after 6 months in patients with an intact ossicular chain. Walby et al (1982) observed the effects of surgical preparation of autologous temporalis fascia in tissue culture. Scraping loose connective tissue from the fascia or allowing it to dehydrate caused significant reduction in fibroblast growth in tissue culture while both procedures completely abolished it (Shenoi 1987).

***Betow*** (1982)[21] is of opinion that, by using homografts in routine surgery of the middle ear, the structural and functional results are equivalent to those of autografts. We can use homograft fascia, perichondrium, dura, ossicles and cartilage in the same way as in autografts. He says that in cases of limited inflammation, the goals are easily fulfilled through the use of autografts. The most difficult problem however, remains in those cases in which a large part of the middle ear has been destroyed by infection, where the tympanic membrane and ossicles are missing or where a considerable part of the middle ear has to be removed because of extensive cholesteatoma. particularly after a

radical operation, it is impossible to reconstruct a good functional transmission system just by using an autograft.

It was *Betow* (1959) who attempted an enbloc homograft consisting of part of meatal skin, the tympanic membrane and the whole ossicular chain. Betow in this article gives an account of the evolution of homografts. In 1640, ***Marchius*** repaired an ear drum with a sheep's bladder, which was stretched over a piece of ivory. In 1894, ***Politzer*** pointed to the possibilities of homograft bone transplantation in ear surgery.In 1957 ***Tobeck*** reported successful transplantation of a stapes after removal of the patients stapes in 7 cases of otosclerosis. In 1959 ***Portman and Ceresia*** mentioned the experimental implantation of chilled, conserved stapes as homografts. In 1960, ***Glaninger*** also gave an account of successful transplantation of the stapes. At the same time after experimental research by Pulec in cats, the possibility of transplanting a homograft incus for restoration of the ossicular chain was later accepted as routine by many surgeons. In 1964, ***Marquet*** began with transplantation of tympanic membrane only. In 1966, he reported the use of preserved cadaver tympanic membrane. In 1969, ***Brandow and Smyth and Kerr*** reported on tympanic membrane homografts. Regarding the preservation of the homografts ***Glasscock, House and Graham*** (1972) reported the preservation of enbloc allografts in 70% ethyl alcohol and

with this a graft take rate of 70%. Betow (1982) stored them in Cialit which is 2 – (ethyl-mercurymercaptol) benzoxazole – carbonic acid sodium. He cited the advantages of cialit as its low local toxicity, strong bacteriostatic and antimycotic effect. When transplants are taken from cadavers Betow excluded as donors patients died of infectious diseases such as hepatitis, or tuberculosis.

In order to stabilize the homografts ***Seelich, Marquest and Portman*** have found a combination of concentrated human fibrinogen and factor XIII with a thrombin calcium chloride aprotinin solution to be a good adhesive (Frooto J.N.1987)

***Chiossone*** (19770 gives an account of the establishment of an ear bank which he says have proved to be insuring a regular supply of high quality homografts for the otologic surgeon (Chiossone E 1977)[22].

***Rafto*** described the tympanic membrane as a spiderweb like structure and a part of organ of hearing.

***Ambrose Pare*** in 16th century suggested surgery for mastoid infection in young king Charles of France,who was moribund with high fever and discharging ear. Berthold in 1878 did the first myringoplasty including removal of epithelium and grafting of skin.

***Albert et al***[3]conducted study on 40 patients out of which there were 27 males and 13 females. Out of all cases 33 patients had aditusblock,inspite of the fact that 8 cases were inactive during the study. They found aerobic and anaerobic cultures from mastoid antral granulation tissue.Out of 40 cases 23 turned out positive for aerobic culture and 1 turned positive for anaerobic. Culture reports surprisingly showed that 6 out of 8 inactive ears were culture positive, and out of the 8 inactive group,5 ears were dry for more than one and half years, yet three of these grew aerobes of which two had two organisms each. The conclusion was –inspection of mastoid antrum ,in all cases of CSOM,irrespective of duration of disease should form an integral part of the surgery because of the mastoid granulations blocking aditus is not always sterile .

In study conducted by ***Ashok k saha***[4] type I Tympanoplasty was done in 30 patients and cortical mastoidectomy with tympanoplasty was done in 10 patients(male -24 and female -16).Bilateral disease was seen in 30%.right ear disease was seen in 8 cases(20%) and left ear disease in 20 cases(50%).bilateral disease in 12 cases(30%). Right ear operated in 12 cases and left ear in 28cases.Youngest patient was 14 years and oldest was 56 years. Out of total 40 patients,30 patients underwent type I tympanoplasty alone whereas 10 patients with discharging year were

taken up for cortical mastoidectomy with type I tympanoplasty. Overall graft take-up was found to be 85%,in males it was 83.3% and females it was 87.55%.In this study they have concluded that, it is advisable to do cortical mastoidectomy with type I tympanoplasty especially in chronic persistent discharging years, to remove antral pathology if any.

***Werhs etal***[5] observed that it is necessary to maintain an aerated mastoid on the basis of the fact that poor Eustachian tube function is the most common cause of tympanoplastyfailures, though inadvertent block of ET orifice by graft material and middle ear adhesions also contributes.

***Hedge etal***[6] studied the relation between area of mastoid pneumatic system and period of disease. They stated that decreased pneumatisation of mastoid in patients with chronic ear disease is due to chronic inflammation,and not due to otitis media in infancy.Hence it is important to give a good aerating mastoidectomy to clear the disease process and aid in success of a good tympanoplasty.

***Adkins, White and Charleston***[7] followed up 71 cases of type I tympanoplasty for 18 months and observed the different factors influencing the success rate. The total success rate was 89%.The only factors which influenced the graft uptake in their study were the condition of the opposite ear at the time of surgery and the size of perforation. Out of the 8 cases that failed 7 patients had large to subtotal

perforations. Even though none of the contralateral ears had active disease at the time of operation, in adult population one of four and in pediatric population three of four failures occurred in bilateral chronic otitis media.

***Jackler R K, Schindler RA***[8] studied 82 patients who had chronic ear discharge,sclerosed mastoid and previous failed myringoplasty.Graft take-up was 86.6% and air-bone gap closure upto 20dB occurred in 85%.They concluded that mastoidectomy is an effective adjunct to simple tympanic membrane reconstruction alone.

In a study by ***Jackler K.R.****(1984)* ***Schindler RA***[9]to determine whether mastoidectomy is an effective means of repneumatisisng the mastoid air cell system and eradicating mastoid source of infection, he came to a conclusion that pneumatic spaces within the mastoid represented an 'air reservoir' which can be drawn upon during periods of Eustachian tube dysfunction and buffer the middle ear against the development of detrimental negative pressures. Mastoid inflammatory disease if untreated, may result in recurrent suppuration and graft failure. Small mastoid volume aside from its well known association with chronic suppurative otitis media has been shown to effect adversely graft survival following myringoplasty. According to him simple mastoidectomy is an

effective means of re-pneumatising the mastoid and eradicating mastoid source of infection.

Papers published by Scandinavian authors present a very discouraging picture of hearing improvement following tympanoplasty. Surgery is viewed as a means of preserving hearing and not improving it (Leirle et al 1965).

***Jackler*** (1984)[8,9] assessed the mastoid cavity from x-ray mastoids by noting the cross sectional area of mastoid pneumatisation, usingplanimetric method of Diamont (1940). He divided mastoids into 3 groups according to mastoid size.

1) Small 0 – 5 $cm^2$
2) Medium 5 – 10 $cm^2$
3) Large 7 – 10 $cm^2$

Jackler noticed a trend of increasingly successful results of graft take-up with larger mastoid sizes. According to him substantial hearing improvement was achieved with mastoids of all sizes. The degree of closure of air-bone gap was, however, dependent upon mastoid size. In all three frequencies (500, 1000, 2000 Hz) mastoid of 5 $cm^2$ fared better than those less than 5 $cm^2$.

Similar studies had also been conducted by ***Holmquist***[11] (1972) and he also compared his results with material published by ***Diamont***[10] (1940), healing after myringoplasty is better when mastoid is pneumatised.

**Outcome of tympanoplasty with and without cortical mastoidectomy for tubotympanic chronic otitis media authored by Habib MA, Huq MZ , Aktaruzzaman M, Alam MS etal [12]** did their study on sixty patients out of which half underwent type I tympanoplasty and group II underwent cortical mastoidectomy with type I tympanoplasty. They compared postoperative hearing outcome between the 2 groups.After tympanoplasty the mean air bone gap(ABG) closure was 9.33dB in group I and in group II it was 20.61dB.

Also it was observed that closure of ABG was greater in small to medium sized perforations in group I i.e. 10dB whereas it more in medium and large perforations in group II ie around 22dB.They **concluded on the basis of their study that tympanoplasty when done with cortical mastoidectomy is the best treatment method for chronic otitis media. They stated that when tympanoplasty alone is done there is a chance of leaving behind granulation tissue in the middle ear cleft, hence compromising with the long term results.**

***Vartiainen E, Kansanen M***[13] in their study on tympano mastoidectomy for chronic otitis media without cholesteatoma published in journal of otolaryngol Head and Neck surgery in 1992,106,page 230-234 said that **chronic otitis media even after medical treatment and made dry**, some amount of **dormant mastoiditis continues,** which has every potential to become active again. Hence cortical mastoidectomy with tympanoplasty proves to be the best treatment modality for this disease.

An article on impact of mastoidectomy on simple tympanic membrane perforation repair authored by **McGraw etal**[15] published in Laryngoscope in 2004 volume 114, page 506-511 concluded that hearing improvement was more in the mastoidectomy group than tympanoplasty alone and also said that intact canal wall mastoidectomy improves long term outcome.

***Ruhl C M etal***[16]analyzed 135 patients who underwent revision mastoidectomy with tympanoplasty, using clinical and audiological data,with an eighteen months follow up. It was found that graft take-up rate for the whole group was 90.4%.It was concluded that **an aerating mastoidectomy is indicated in those patients who have failed a prior tympanoplasty.**

***Nayak et al***[17]studied the role of **surgically created mastoid air reservoir in the success of tympanoplasty**. The study consisted of two groups with 20 patients each and the follow up period was with mean 1.7years.The result at the end of six months was supporting the mastoidectomy group with 100% graft take-up versus 60% in myringoplasty group. Hence they concluded that a mastoidectomy is necessary even in a dry ear in order to create a mastoid air reservoir, which shall possibly compensate for the damaging effects of poor eustachian tube function.Also said that mastoidectomy when combined with myringoplasty has high success rate.

# MATERIALS AND METHODS

**STUDY DESIGN:** Prospective study

**STUDY PLACE:** Department of ENT,KMC & GRH

**STUDY PERIOD:** October 2010 to December 2012

**FOLLOW UP PERIOD:** November 2010 to December 2012

**SAMPLE SIZE:** 50 patients

**INCLUSION CRITERIA:**

1.Patients with chronic ear discharge( Chronic Suppurative Otitis Media,safe type) attending ENT OPD at KMC and GRH.

2. Age group 18 to 60 yrs of age.

3. Both gender.

5.Unilateral or bilateSral disease.

**EXCLUSION CRITERIA:**

1.Patients above the age of 60yrs or below 18 yrs.

2. Chronic Suppurative Otitis media- unsafe type.

3.Deblitated and Immunocompromised patients.

4.Pregnant and lactating women

**Normal Tympanic Membrane**

**Central Perforation**

5.Patients with external or middle ear abnormalities(congenital or acquired)

## MATERIALS

In this study the procedure adopted is cortical mastoidectomy with myringoplasty for one set of patients(Group 1) and myringoplasty alone(Group 2) for another set.

The equipments used are

1. Binocular Microscope

2. Karl Storz zero degree Endoscope with camera and monitor.

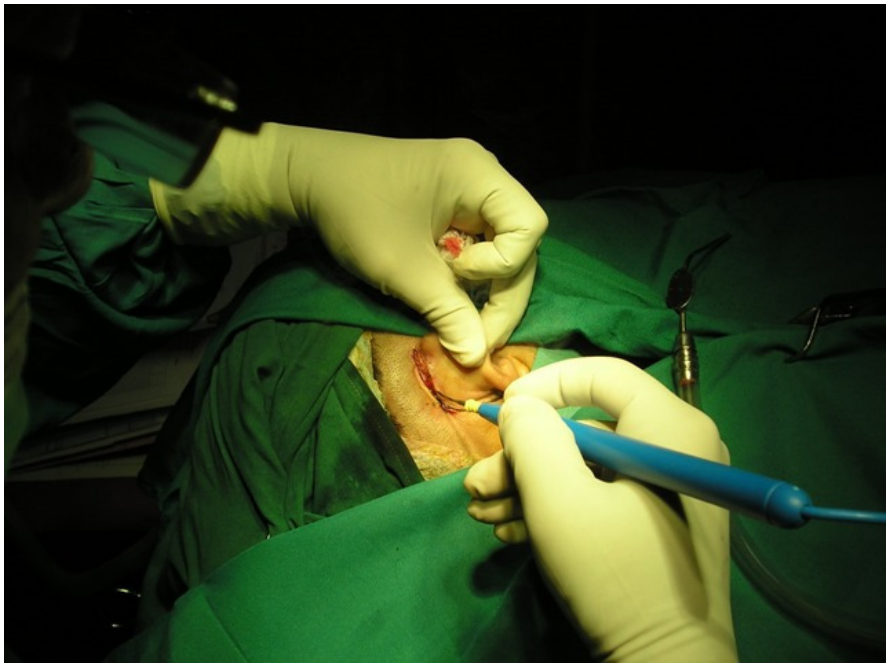
3.Middle ear Microsurgical instruments like Rosens, Plester,curette,picketc.

## METHODOLOGY

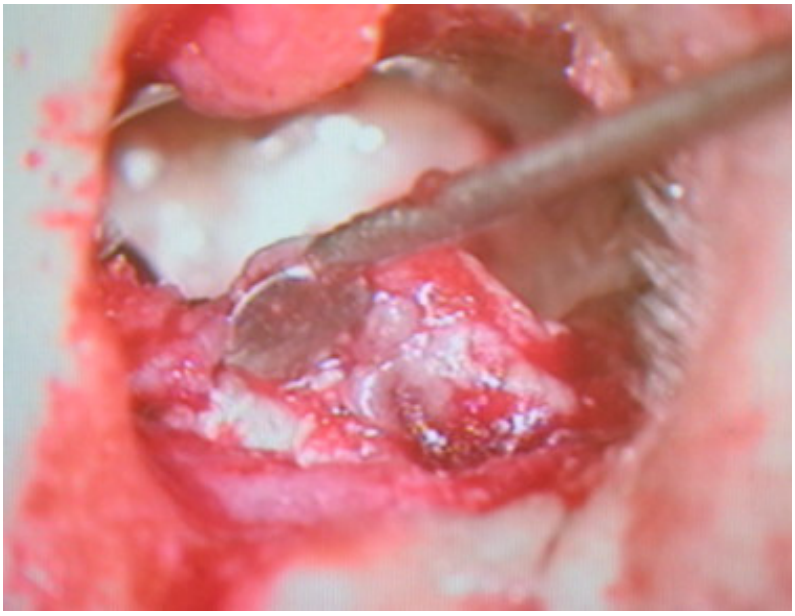
Among patients attending the ENT OPD in KMC and GRH, 50 patients of age between 18 to 60 yrs who are clinically assessed for CSOM were chosen for study.

**Assessment is based on the following criteria:**

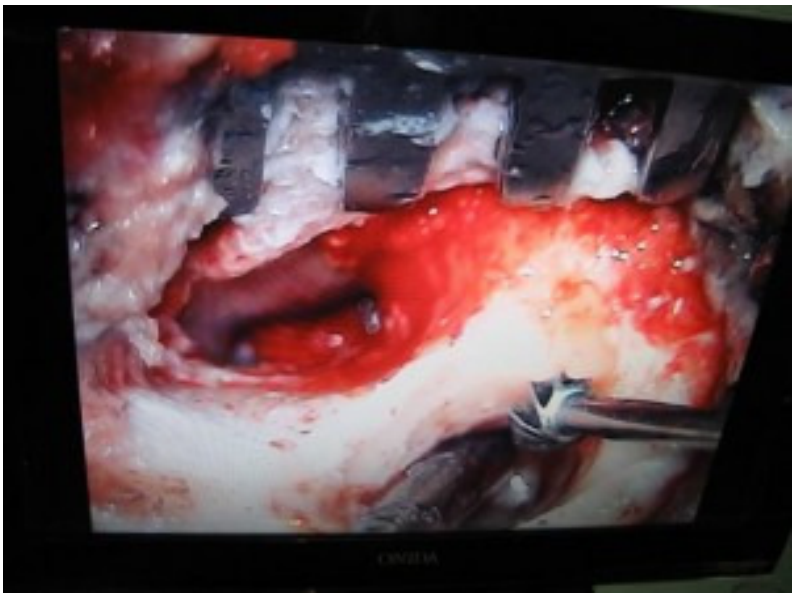
1.History of persistent otorrhea and hard of hearing.



**Post Auricular Incision**



**Tympanomeatal Flap Elevation**



**Cortical Mastoidectomy**

**Post Operative Tympanic Membrane**

2.Otoscopic evidence of chronic suppurative otitis media with central perforation.

3.Examination on table with Microscope.

4.Audiological evidence of conductive hearing loss.

For all patients *Diagnostic nasal endoscopy* was done and *CT scan paranasal sinuses* were taken for patients with sinusitis. If septic foci found patients were taken up for endoscopic sinus surgery and disease cleared. Allergic symptoms were treated with steroid nasal spray and antihistamines.

*Culture and sensitivity of ear discharge* was done and treated with appropriate antibiotics. Patients were given medical treatment for 3-4 weeks, and once the evidence of response obtained patients were randomly selected by an unrelated personnel and put into either group I i.e.Cortical mastoidectomy with myringoplasty or group II i.e. Myringoplasty alone.

The selected cases were made to undergo appropriate investigations. Routine blood investigations like Hemoglobin,total and differential count, bleeding and clotting time, chest x-ray, ECG and urine investigations were done for all patients.

X-ray both mastoids lateral oblique view were taken for all cases to assess the pneumatisation pattern of mastoid and to know the status of tegmen and sinus plate. Pure tone audiogram was done in sound proof room using Maico ma 52 clinical diagnostic two channel audiometer. Informed consent was obtained from each patient after counseling them and their relatives regarding the nature of disease and surgery. Outcome and all possible complications were also explained.

All patients were admitted one day prior to the surgery.18 cases in group I and 20 cases in group II cases were operated were done under general anesthesia. And 7 cases from group I and 5 cases from group II were taken up under local anesthesia. Temporalis fascia graft was harvested in all cases. All cases were approached through the postaural route because of its definite advantage over endural route. Less skills necessary, more exposure is attained and complications such as perichondritis never occur. An area comprising 5 cm. above the upper border of pinna and 5 cm. behind pinna was shaved off hair.

**Preparation of grafts:**

For taking temporalis fascia graft, either a separate incision in the temporal region or an extension of the classical post-aural incision to temporal region was done. Through this incision of about 2 inches length, the temporalis fascia was exposed after dissecting and retracting superficial tissues. About 3 cm circular area of temporalis fascia was cleaned off the loose connective tissues. After injecting about 2 to 3 ml. of 1% xylocaine between fascia and muscle underneath, an adequate size fascia was cut using a No.15 blade and dissected off, from the underlying muscle using periosteal elevator and non-toothed thumb forceps. Wound was closed in layers after attaining haemostasis.

**Procedure for cortical mastoidectomy:**

After harvesting Temporalis fascia graft , Mastoid cortex was exposed through a Modified William Wilde incision. Edges of the perforation freshened, tympanomeatal flap elevated and middle ear inspected for any disease. If present it was removed, and ossicular status was checked.

Mastoid antrum was entered after identifying bony landmarks. Mastoidectomy was done and aditus block, if present were removed. After confirming adequate drainage has been obtained, Graft was placed by underlay technique and tympanomeatal flap repositioned. Ear canal

was packed with medicated absorbable gelatin sponge and ribbon gauze and mastoid compression bandage applied.

**Procedure for myringoplasty:**

Same as above procedure except for entering the antrum and clearing disease from middle ear.

Postoperative intravenous antibiotics were given for 7 days and oral antibiotics continued for 2 weeks. Post aural sutures were removed on 8th post operative day.

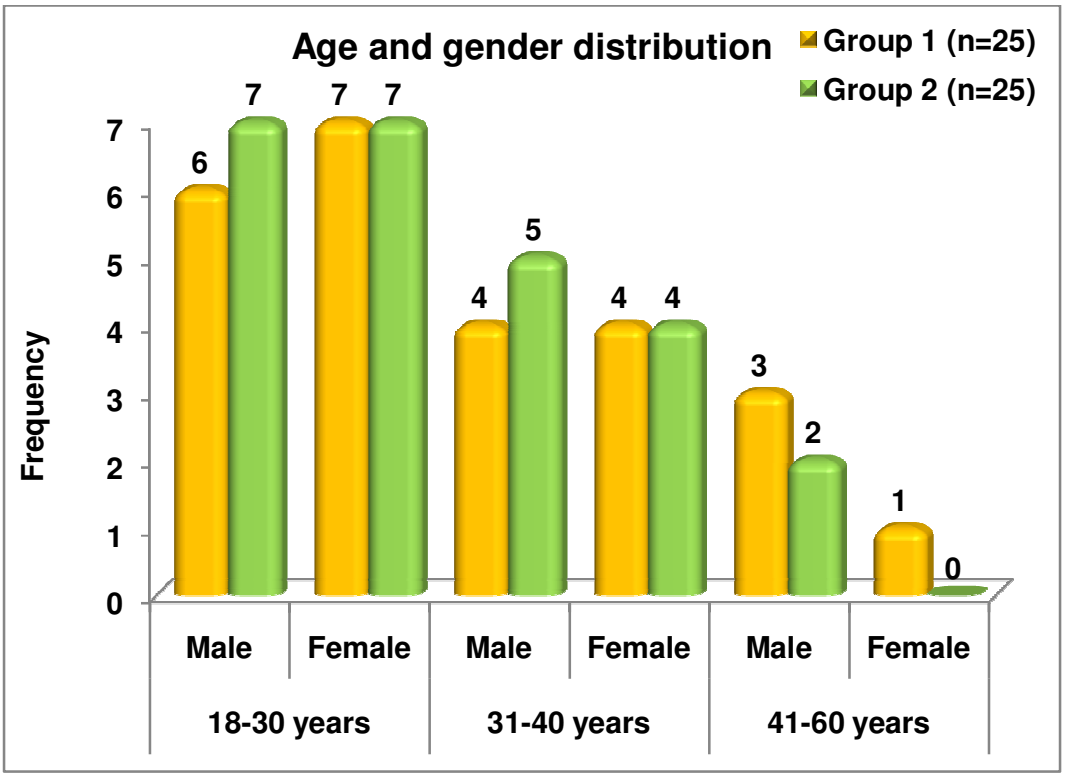
All patients were followed up weekly for first one month, biweekly for next 3 months and once month till 6 months. Post op Pure Tone Audiogram was done on first, third and sixth months and duly recorded. During every follow up cases were evaluated for persistence of discharge, take up of graft, subjective and objective audiological improvement and other complications.

# OBSERVATIONS

**Age and gender distribution:**

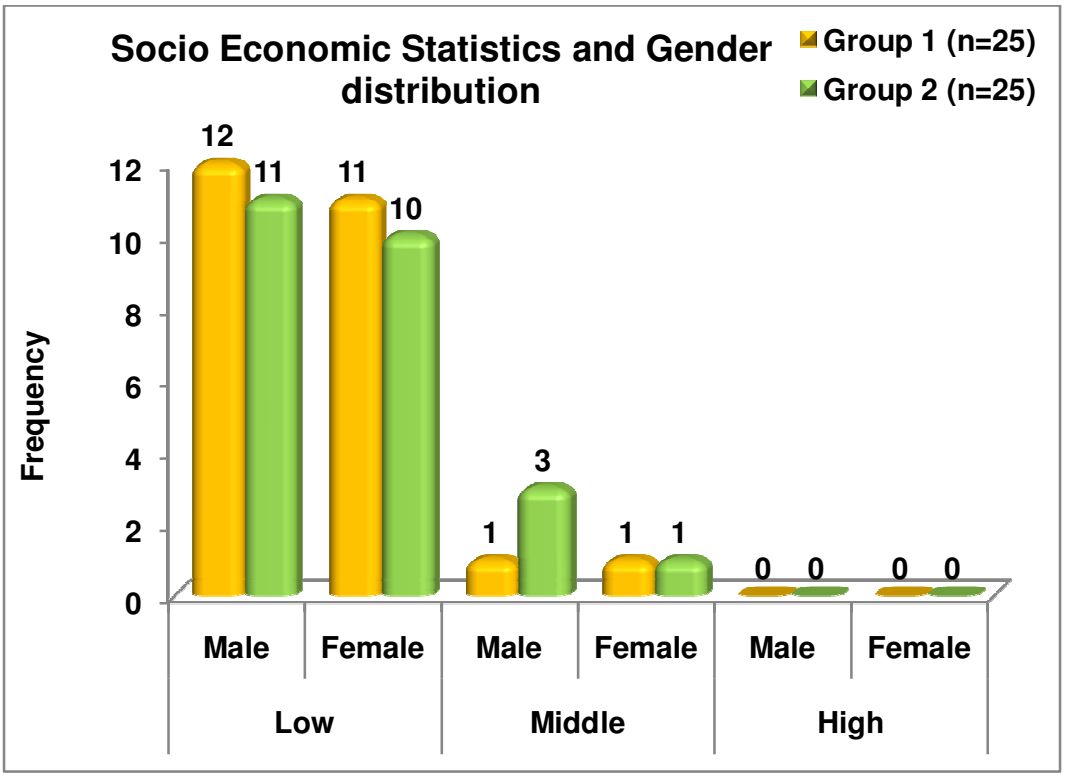
| S no | Age | Group I(n=25) | | Group II(n=25) | |
|---|---|---|---|---|---|
| | | ***Male*** | ***Female*** | ***Male*** | ***Female*** |
| **1** | 18-30 | 6 (24%) | 7(28%) | 7(28%) | 7(28%) |
| **2** | 31-40 | 4(16%) | 4(16%) | 5(20%) | 4(16%) |
| **3** | 41-60 | 3(12%) | 1(4%) | 2(8%) | 0(0%) |
| | | 13(52%) | 12(48%) | 14(56%) | 11(44%) |

In our study total number of patients were fifty. Out of which 25 patients were in cortical mastoidectomy with tympanoplasty group(Group I),of which 13 were males and 12 were females. The other 25 patients belonged to myringoplasty only (Group II) 14 males and 11 females in that group. Maximum number of patients belonged to 18 to 30 years range. Youngest patient was 18 years and oldest patient was 56 years.




**Socioeconomic status:**

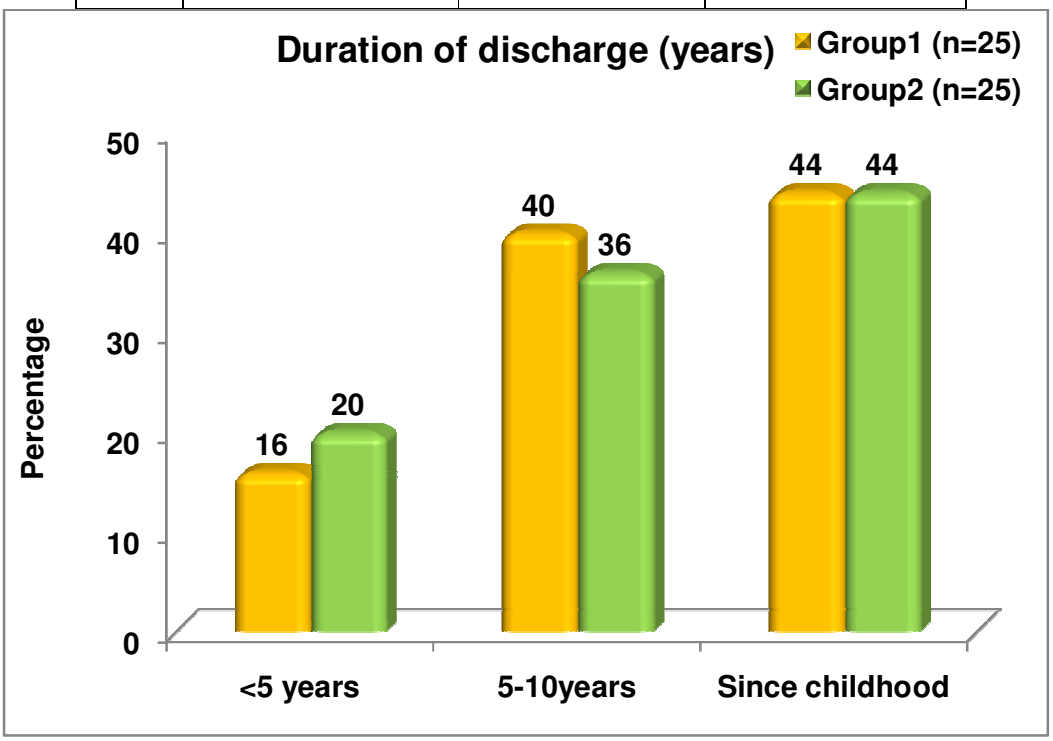
| S. No | Status | Group I(n=25) | | Group II(n=25) | |
|---|---|---|---|---|---|
| | | *Male* | *Female* | *Male* | *Female* |
| **1** | Low | 12(48%) | 11(44%) | 11(44%) | 10(40%) |
| **2** | Mid | 1(4%) | 1(4%) | 3(12%) | 1(4%) |
| **3** | High | 0(0%) | 0(0%) | 0(0%) | 0(0%) |




The population we cater mostly belongs to low socio economic strata, where in chronic otitis media is more common. The middle and high class population together constituted only 8% and 16% in group 1 and group 2 respectively where as low socioeconomic population was 92% in group 1 and 84% in group2 in our study.

**Duration of discharge:**

| S. No | Duration (years) | Group I(n=25) | Group II(n=25) |
|---|---|---|---|
| **1** | <5 years | 4(16%) | 5(20%) |
| **2** | 5-10years | 10(40%) | 9(36%) |
| **3** | Since childhood | 11(44%) | 11(44%) |




In both groups maximum number of patients had history of otorrhea from childhood(44% each).The number of patients in 5 to 10 years range were 10 in group I and 9 in group II.

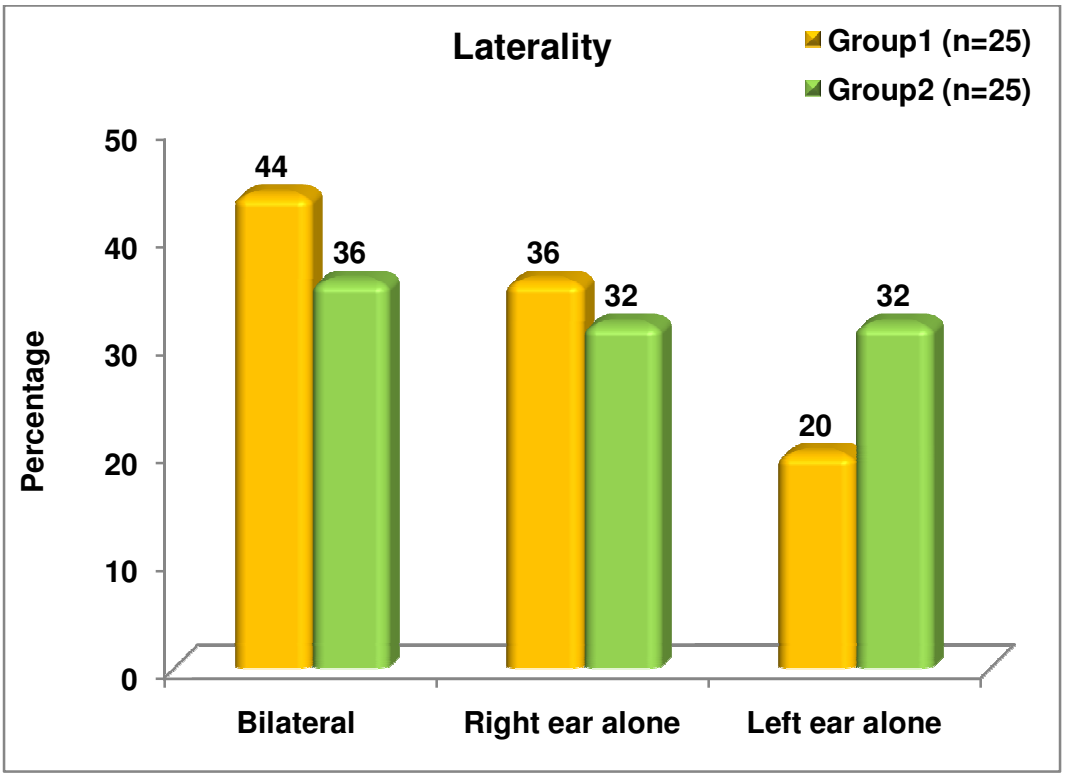
**Duration of Hard of Hearing:**

| S. No | Duration (years) | Group I(n=22) | Group II(n=21) |
|---|---|---|---|
| **1** | <1 year | 6(27.3%) | 5(23.8%) |
| **2** | 1-5years | 10(45.5%) | 7(33.3%) |
| **3** | 5-10yrs | 6(27.3%) | 9(42.9%) |

Though maximum number of patients with ear discharge belonged to since childhood period, hard of hearing was maximum in the 1 to 5 years range.

**Laterality of the disease:**

| S. No | Laterality | Group I(n=25) | Group II(n=25) |
|---|---|---|---|
| **1** | Bilateral | 11(44%) | 9(36%) |
| **2** | Right ear alone | 9(36%) | 8(32%) |
| **3** | Left ear alone | 5(20%) | 8(32%) |




In group I 11 patients had bilateral disease and 14 patients had unilateral disease of which 9 patients had right ear disease and 5 patients had left ear disease. In Group II 9 patients had bilateral disease and 16 patients had unilateral disease.

**Size of perforation**:

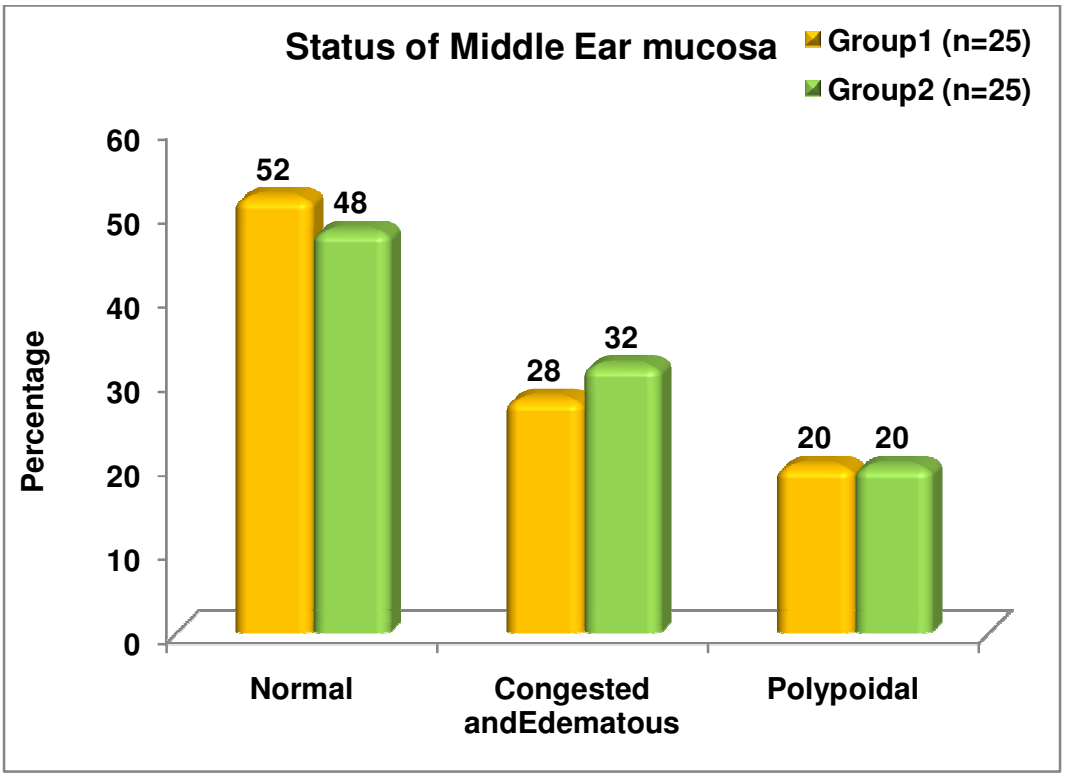
| S. No | Size of perforation | Group I(n=25) | Group II(n=25) |
|---|---|---|---|
| **1** | Small | 7(28%) | 8(32%) |
| **2** | Medium | 9(36%) | 10(40%) |
| **3** | Large | 9(36%) | 7(28%) |

In group I 36% each had medium to large perforation.Only28% had small size perforation.In group II 40% had medium sized and 32% had small size perforation. Only 28% had largeperforation. Among the cases that failed in group II 2 cases had large perforation.

**Status of Middle Ear(ME) Mucosa:**

| S. No | Status of ME mucosa | Group I(n=25) | Group II(n=25) |
|---|---|---|---|
| **1** | Normal | 13(52%) | 12(48%) |
| **2** | Congested | 7(28%) | 8(32%) |
| **3** | Polypoidal | 5(20%) | 5(20%) |

In both the groups maximum patients had normal mucosa. 20% of patients in either group had polypoidal middle ear mucosa. 28% in group I and 32% in group II had congested mucosa. This is the recorded finding of the patient at their first visit. All patients with abnormal mucosa was treated with culture sensitive local antibiotics. A few who were refractory to outpatient treatment was admitted and given intravenous antibiotics. Treatment was given for a period of 3-4 weeks and after obtaining evidence of response patients were taken up for surgery.



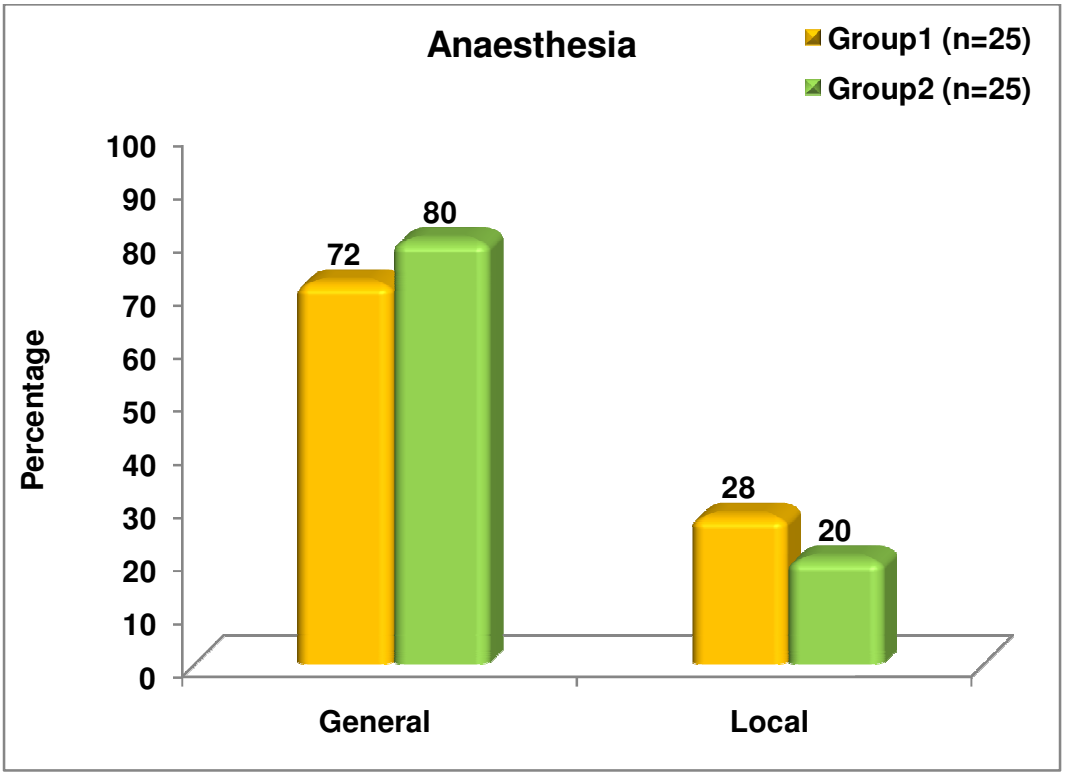

**X-Ray Both Mastoids:**

| Sclerosis in x ray mastoids | Group I | Group II |
|---|---|---|
| Bilateral | 9/11 | 7/9 |
| Right ear only | 5/9 | 4/7 |
| Left ear only | 4/5 | 5/9 |

Among group I we had 11 patients of which nine patient's x-ray mastoids showed sclerosis. And in those patients with right ear affection five out nine patients in group I and four out of seven in group II had evidence of sclerosis. Similarly four out of five in group I and five out of nine with left ear disease had radiologically sclerotic mastoid.

**Anesthesia:**

| S no | Anesthesia | GroupI(n=25) | GroupII(n=25) |
|---|---|---|---|
| 1 | General | 18(72%) | 20(80%) |
| 2 | Local | 7(28%) | 5(20%) |




72% in group I and 80% in group II were taken up for surgery under general anaesthesia and 28% in group I and 20 % among group II were done under local anaesthesia. Advantages of local anaesthesia are less bleeding and early recovery. Disadvantage is that apprehensive patients will not tolerate the procedure.

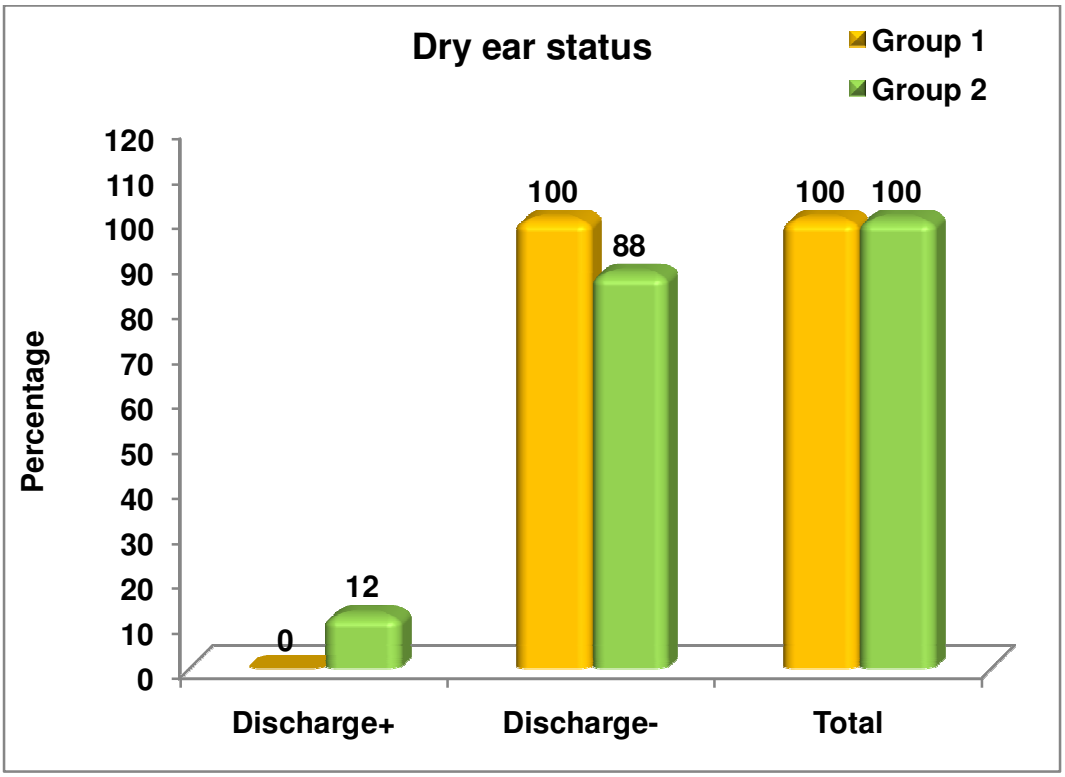
**Subsequent ear procedures:**

| | **GroupI(n=25)** | **GroupII(n=25)** |
|---|---|---|
| **Subsequent procedure** | 0 cases(0%) | 4 cases(16%) |

4 cases that failed among tympanoplastygroup,underwent revision mastoidectomy and postoperatively graft takeup was good in all cases

**Post operative dry ear status**

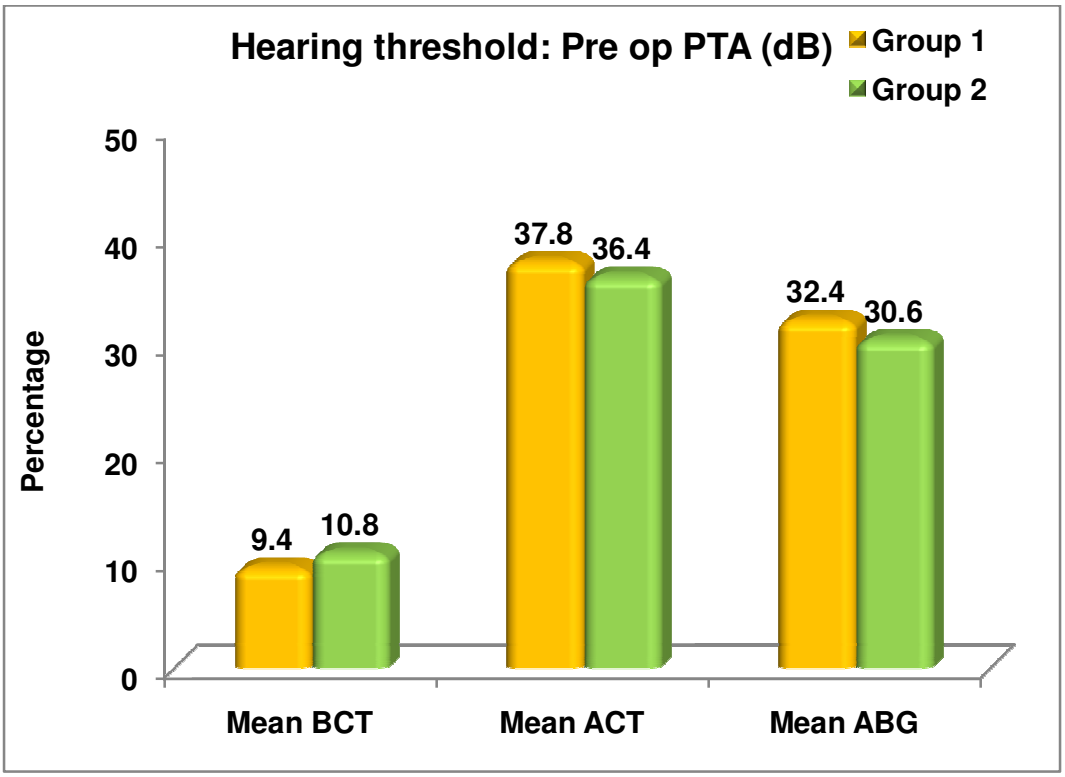
| **Dry ear status** | **Group I** | | **GroupII** | |
|---|---|---|---|---|
| | **No.** | **Percent** | **No.** | **Percent** |
| **Discharge+** | - | 0 | 3 | 12 |
| **Discharge-** | 25 | 100 | 22 | 88 |
| **Total** | 25 | 100 | 25 | 100 |




In our study 100% of patients in group I had post operative dry ear.in group II there were 4 failures of which 3 patients had discharging ears post operatively and one remained dry.

**Pre operative hearing assessment:**

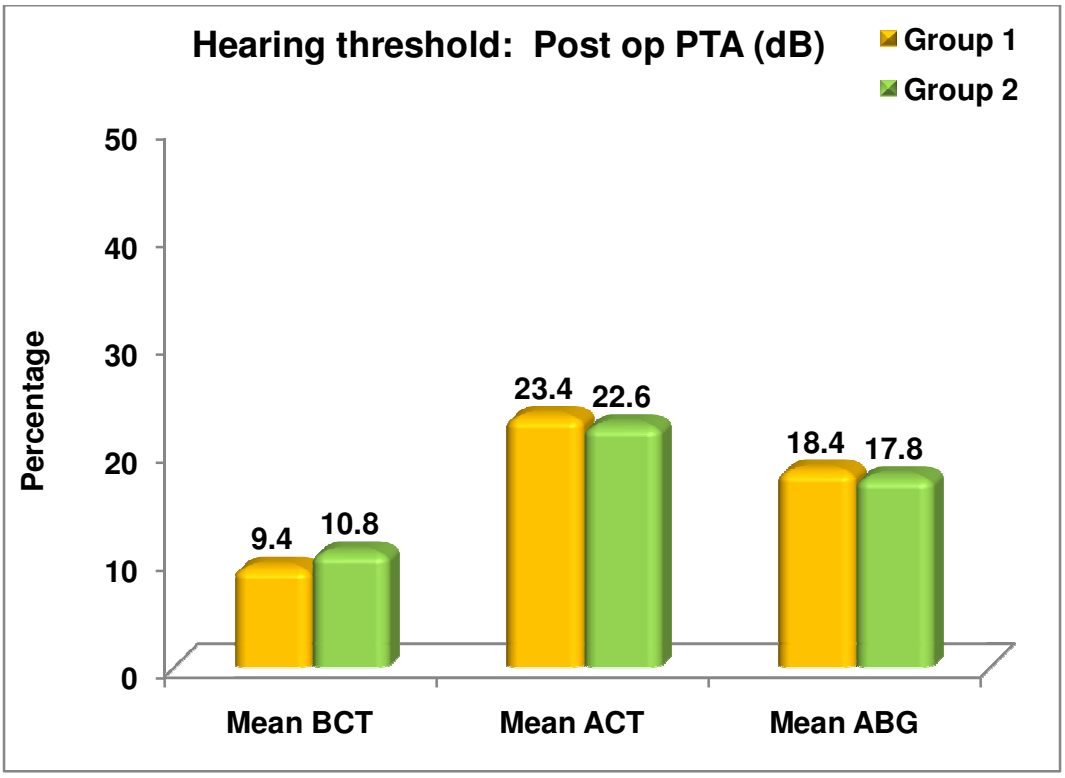
| **Hearing threshold** | **Pre op PTA(dB)** | |
|---|---|---|
| | **Group I** | **Group II** |
| **Mean BCT** | 9.4 | 10.8 |
| **Mean ACT** | 37.8 | 36.4 |
| **Mean ABG** | 32.4 | 30.6 |




Pre operative audiogram was done for all patients. Bone conduction threshold (BCT) remained within normal range. Mean air conduction threshold(ACT) in group I was 37.8dB(obtained by taking average of all 25 patients air conduction), and the same in group II was 36.4dB.

**Post-operative hearing assessment:**

| Hearing threshold | Post op PTA(dB) | |
|---|---|---|
| | Group I | Group II |
| Mean BCT | 9.4 | 10.8 |
| Mean ACT | 23.4 | 22.6 |
| Mean ABG | 18.4 | 17.8 |



**Hearing improvement:**

| Post op hearing | Group I | Group II |
|---|---|---|
| **Improved** | 21(84%) | 21(84%) |
| **Remained same** | 4(16%) | 4(16%) |
| **Decreased** | 0(0%) | 0(0%) |

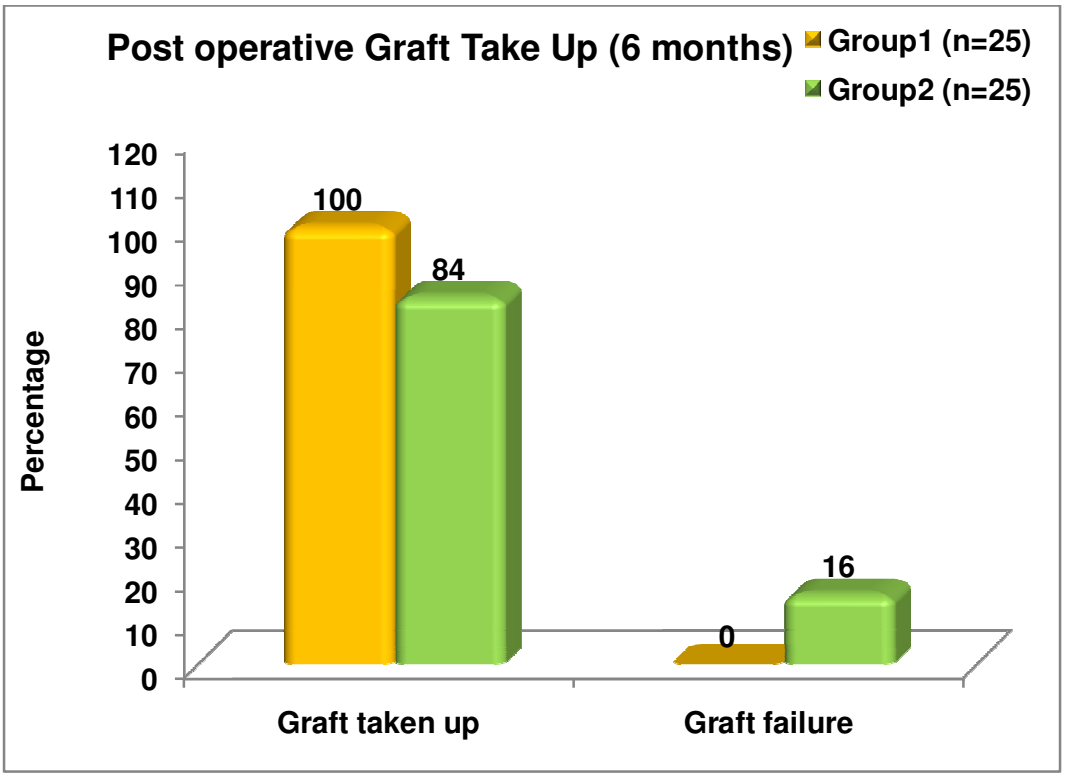
In both groups hearing improvement was comparable.

**Level of improvement of hearing threshold and graft take up in relation to ear involved:**

| Laterality | Group I(Mean AB closure) | Group II(Mean AB closure) |
|---|---|---|
| **B/L** | 13.1Db | 12.6dB(3 cases failed) |
| **U/L** | 13.2dB | 13.0dB(1 case failed) |

**Post-operative Graft Take Up(6 months):**

| | GroupI(n=25) | GroupII(n=25) |
|---|---|---|
| **Graft taken up** | 25(100%) | 21(84%) |
| **Graft failure** | 0(0%) | 4(16%) |


Post operative Graft Take Up (6 months)
Group1 (n=25)
Group2 (n=25)
Percentage
120
110
100
90
80
70
60
50
40
30
20
10
0
100
84
0
16
Graft taken up
Graft failure

**Post-operative complications:**

| S. No | Post op complications | Group1(n=25) | Group2(n=25) |
|---|---|---|---|
| **1** | Post op otorrhea | 0(0%) | 4(16%) |
| **2** | Wound infection | 1(4%) | 0(0%) |
| **3** | Perichondritis | 1(4%) | 0(0%) |
| **4** | Immediate VII N palsy | 0(0%) | 0(0%) |
| **5** | Delayed VII N palsy | 0(0%) | 0(0%) |
| **6** | Profound SNHL | 0(0%) | 0(0%) |
| **7** | Meningitis | 0(0%) | 0(0%) |
| **8** | CSF leak | 0(0%) | 0(0%) |
| **9** | Death | 0(0%) | 0(0%) |

**Size of perforation and Graft take up:**

| Size | Total | Group-I | Group-II |
|---|---|---|---|
| **Small** | 15 | 7/7 | 8/8 |
| **Medium** | 19 | 9/9 | 8/10 |
| **Large** | 16 | 9/9 | 5/7 |
| **Total** | 50 | 25/25 | 21/25 |

In group II out of 4 failures, 2 occurred in large perforations and one each in small and medium sized perforations.

**STATUS OF MIDDLE EAR MUCOSA AND GRAFT TAKE UP**

| **Middle Ear Mucosa** | **Total** | **Group I** | **GROUP II** |
|---|---|---|---|
| **Normal** | 25 | 13/13(100%) | 11/12(91.6%) |
| **Edematous** | 16 | 7/7(100%) | 6/8(75%) |
| **Polypoidal** | 9 | 5/5(100%) | 4/5(80%) |
| **Total** | 50 | 25/25(100%) | 21/25(84%) |

In Group II inspite of the ear being inactive at the time of surgery one case failed, and among the diseased mucosa cases, three of them failed. Whereas in Group I, since a mastoid disease clearance was done, all cases including the ones with diseased mucosa were taken up.

# DISCUSSION

Chronic Suppurative Otitis media is a disease of developing countries like India , Bangladesh , Nepal, Pakisthan etc.Various factors such as poor living conditions , illiteracy, low socioeconomic status and pollution play a major role in the prevalence of the disease, hence improvement in these basic parameters of life will help the society to lower the prevalence of this chronic ear disease. In our study the population we cater mostly belong to the low socioeconomic status who hardly turn up for routine follow-up so in these patients mere reconstruction of the tympanic membrane without complete removal of the disease from the mastoid antrum will not be sufficient to attain surgical success in terms of graft uptake and attainment of dry ear.

Mastoid air cells acts as a continuous source of ventilation to the middle ear, whereas the Eustachian tube supply is intermittent, this important fact is stressed upon by many of the studies that favours Mastoidectomy with tympanoplasty[3,4,5]. Various Studies found that the disease lurking behind, in the mastoid air cells may have granulations harbouring infective agents that acts a constant source of infection[3]. According to literatures chance occurrence of cholesteatoma is 2% in the antrum of safe type of disease.According to Mc Grew et al an aerated mastoid acts

as a buffering system to bring down the effects of aerodynamic changes in middle ear[15].

While the 'Mastoid reservoir of infection theory' holds good for actively discharging ear the same may not be true in the quiescent or dry ear.When active discharge is absent the question thus arises whether to routinely address mastoid surgically or not. Even though it is desirable to explore Mastoid Antrum in order to confirm the absence of the disease the procedure itself is not without disadvantages . Addition of Mastoidectomy with Myringoplasty carries several disadvantages such as increased risk of damage to the Incus , Dura , Sigmoid Sinus and Facial nerve , prolongation of surgery and higher morbidity due to bone drilling in inexperienced surgeon's hands. Thus the advantage and disadvantage of adding Mastoidectomy to Myringoplasty in non cholesteatomatous Mastoiditis have been the focus of much controversy and debate . Previous research findings provided evidences both for and against the use of Mastoidectomy in non Cholesteatomous otitis media. Most of these studies used retrospective case series, whereas ours is Prospective case study.

In our study two groups of patients were studied group I underwent Mastoidectomy with Myringoplasty whereas group II underwent Myringoplasty alone and two parameters were analysed in the

postoperative followup viz. the graft uptake rate and the hearing improvement. The sample in this group was 50 that was divided between the two groups were equally , so only approximate statistical disparity could be obtained.

Analysis of the observations shows that chance of graft giving away was more with Myringoplasty alone group though the percentage is not statistically very significant because of small number analysed. However there is no gross difference in the hearing improvement between the two groups. This points to the fact that success of the surgical closure depends on multiple factors and the status of the mastoid such as antral mucosal hypertrophy, aditus block , sclerotic changes in mastoid, altered pressure buffering capacity of the mastoid air cell system etc. has got significant influence over the successful closure of the perforations.

In our study the follow up period was upto 6 months, and majority of our patients belonged to low socioeconomic status. On the contrary to the general belief that they show a poor follow up rate most of our patient came for regular postop followup and rest came on intimation on regular basis.

MORRISON(1995) and SHAMBAUGH(1977) said the duration of ear discharge is not important but PAPERELLA (1977) pointed out that duration is important as it plays a major role in the natural history and

morbidity of the CSOM. In our study the duration didn't influence the graft takeup.

VARTIANEN[13] (1992) analysed the pitfalls in temporalis fascia Myringoplasty as seen by Medialisation with underlay technique and blunting with onlay technique. Thus in our study the failure of the Myringoplasty alone group in graft uptake is attributed to non clearance of the disease process in the mastoid antrum and lack of restoration of adequate ventilation and the pressure buffering system by avoiding Mastoidectomy.

**Total patients studied**

| Study | Year of study | Total patients in study | |
|---|---|---|---|
| | | Myringoplasty. | Cortical with myringoplasty |
| Mc Grew etal | 2004 | 297 | 131 |
| Sahaetal | 2006 | 30 | 10 |
| Habib M etal | 2011 | 30 | 30 |
| Our study | 2012 | 25 | 25 |

McGrew et al had studied the biggest series consisting of 428 patients. Our sample size was comparable to Saha and Habib et al.

**Gender distribution in various studies**

| study | Year | Total patients | Male | Female |
|---|---|---|---|---|
| Ruhl et al | 1999 | 135 | 53 | 82 |
| Mcgrew et al | 2004 | 464 | 212 | 216 |
| Albert et al | 2005 | 40 | 27 | 13 |
| Saha et al | 2006 | 40 | 24 | 16 |
| Our study | 2012 | 50 | 27 | 23 |

The sample in our study almost approximates with that of Saha and Albert et al study with small sample size for which statistical significance can be given only by approximate values. Our distribution of sample size matches with that of Habib and Saha et al with equal number of patients in each group.

**Comparison of laterality**

| Year of study | Study | Bilateral(no of cases) | unilateral( no of cases) |
|---|---|---|---|
| 2005 | Albert etal | 18 | 22 |
| 2006 | Sahaetal | 12 | 28 |
| 2012 | Our study | 20 | 30 |

In our study bilateral diseases were taken up as an important criteria that influence the surgical outcome as for other two studies , the influence was on the Myringoplasty only group with three failures and it did not influence Mastoidectomy group. In our study under group II, graft takeup in bilateral disease had a success rate of 85% and in unilateral disease it was 96%. In cortical Mastoidectomy with Myringoplasty group the success rate was 100% for both set of patients. Hence it could be deduced that bilaterality plays a role in surgical success of Myringoplasty alone patients because of lack of complete clearance of disease from Mastoid. This finding is comparable to similar findings from a study by Saha etal. Their result was 92.85% for unilateral disease and 66.6% for bilateral group.

| Year of study | Study | Status of ME mucosa | |
|---|---|---|---|
| | | Normal | Diseased |
| 1999 | Ruhl et al[16] | 9 | 126 |
| 2005 | Albert etal[3] | 24 | 16 |
| 2006 | Saha etal[4] | 21 | 19 |
| 2012 | Our study | 25 | 25 |

The polypoidal and congested nature of the middle ear mucosa affected the surgical outcome in four patients in the group II but none of the patients in the group I had any failures, again stressing upon the importance of complete disease clearance in chronic discharging ear.

**Comparison of culture reports.**

| Study | Culture report |
|---|---|
| Albert etal[3] | Staph aureus,P.aeroginosa |
| Yammamoto etal[33] | Staph aureus,Staphepidermidis |
| Our study | Klebsiella, Staph aureus |

Yammamoto, Iwanga[33] Comparison of bacteria in tympanic cavity and mastoid Antrum in chronic otitis media. American journal of Otolaryngol 1986;7: 298-301 reported gram positive bacterial growth in the middle ear and mastoid granulation but in our study Klebsiella (gram negative bacteria) is the most common organism followed by S.aureus.

**Aditus Patency**

| Study | Blocked | Patent |
|---|---|---|
| Albert et al | 33/40(82.5%) | 7/40 (17.5%) |
| Our study | 21/25 (84%) | 4(16%) |

In our study of 25 cases of Mastoidectomy with myringoplasty,21 cases were found to have blocked aditus and only 4 cases it was found patent. This is almost comparable to the data of Albert et al, where they had 33 cases with aditus block and 7 cases with patent aditus.

**Comparison of preoperative and post operative air bone Gap**

| Study | Year of study | Pre op ABG | | Post op ABG | |
|---|---|---|---|---|---|
| | | myringo | Mast+myringo | myringo | Mast+myringo |
| Mc Grew etal | 2004 | 34.1dB | 25.8dB | 16.4dB | 14.4dB |
| Sahaetal | 2006 | 29.3dB | 32.5dB | 23.3dB | 29.3dB |
| Habibetal | 2011 | 23dB | 33.7dB | 13.6dB | 13.1dB |
| Our study | 2012 | 32.4dB | 30.6dB | 18.4dB | 17.8dB |

Audiological outcome in our study is found to be same with both groups showing improvement in the post op air bone gap and there is no statistical significance of one over the other. In the study conducted by Habib et al he conclude that Mastoidectomy has got influence over the Myringoplasty.

Comparison of post operative Air Bone closure

| Study | Year of study | Post op AB closure | |
|---|---|---|---|
| | | Myringo | Mast+myringo |
| Mc Grew etal | 2004 | 17.7dB | 11.4dB |
| Sahaetal | 2006 | 6.5dB | 3.2dB |
| Habibetal | 2011 | 9.4dB | 20.6dB |
| Our study | 2012 | 13dB | 12.8dB |

The post op Air Bone closure in Myringoplasty group is around 13db and that of Mastoidectomy is around 12.8 db in comparison with that of Habib et al which showed 9.4 and 20.6 respectively favouring group I.

**Overall Graft take up**

| Study | Year of study | Graft take up | |
|---|---|---|---|
| | | Tymp | Mast+tymp |
| Palva etal | 1969 | 97% | 97% |
| Mc Grew | 2004 | 90.6% | 91.6% |
| Saha etal | 2006 | 85% | 100% |
| Athira etal | 2010 | 93.5% | 96.7% |
| Our study | 2012 | 84% | 100% |

The overall graft uptake in our study was in coherence with study by Saha et al and Athira et al, which also showed more than 95% success in group I.

**Subsequent Procedures**

| Study | Mastoidectomy+Myringoplasty | Myringoplasty |
|---|---|---|
| Mc Grew etal | 8/131(6%) | 42/297(14%) |
| Our study | 0/25(0%) | 4/25(16%) |

Holmquist and Bergstrom and Ingelstedt et al suggested functional advantage of aerated mastoid for the first time, and Richards et al and Sade et al later on substantiated it. According to them when an aerated mastoid cavity communicates with middle ear, it helps to reduce the aerodynamic changes occurring in the middle ear, by way of acting as a buffering system. This helps those patients with intermittent Eustachian tube dysfunction to better tolerate the negative pressure. They also concluded that lack of aeration and disease progression and need for subsequent procedures in myringoplasty group shows the functional impact of aeration by doing a mastoidectomy on the repair of perforation.

In our study we achieved the result that, doing a cortical mastoidectomy improves graft success rate, specially in cases of persistent mucosal

disease, which was the case for us. As supported by a retrospective study by Ruhl et al, who gave similar results, we assume by opening up the mastoid, thereby creating a connection between the mastoid and middle ear, we are able to re-create a physiological pressure buffer. A poorly pneumatised mastoid air cell system has defective pressure buffering capacity and is therefore prone to develop chronic inflammatory conditions and tympanic membrane retractions. According to Boyle's law the pressure buffering system of mastoid is recreated by the additional volume obtained by doing a Mastoidectomy. In their study radiological studies showed 73% sclerosed mastoid air cells, which would have contributed to development of chronic otitis media.

Thus Cortical Mastoidectomy should be routinely performed in all cases of Chronic Suppurative Otitis media safe type irrespective of the duration of discharge.In our series, Myringoplasty combined with Mastoidectomy offered significant improvement in the rate of closure of simple tympanic membrane perforations and reduction in the number of patients requiring subsequent procedures, but no significant improvement in hearing result.

# CONCLUSION

1. Cortical Mastoidectomy combined with Myringoplasty enhances the efficacy of graft uptake and the surgical success rate by complete clearance of the disease from Mastoid antrum and restoration of the pressure buffering capacity of Middle ear.

2. Patients from low socioeconomic strata who are hesitant for frequent follow up should be given complete disease clearance by doing Mastoidectomy with Myringoplasty as a single procedure.

3. Combining Mastoidectomy with Myringoplasty does not produce any statistical significance in the postoperative hearing results.

4. Mastoidectomy should be favoured along with Myringoplasty when there is coexistence of confounding factors such as mucosal changes, bilaterality , sclerosed and contracted mastoid.

# PROFORMA

## A STUDY TO FIND OUT THE EFFICACY OF CORTICAL MASTOIDECTOMY WITH MYRINGOPLASTY IN CHRONIC SUPPURATIVE OTITIS MEDIA.

1. Serial no:

Name: OP/IP NO:

Age/sex: Address:

Occcupation: Socioeconomic status:

Date:

## 2.PRE OP ASSESSMENT:

**a)Ear complaints and duration**

1.Discharge – serous/mucoid/mucopurulent/purulent

2.Defective hearing-Duration and amount (mild, moderate, moderately severe, severe, profound)

3.Vertigo – present/absent

4.Tinnitus – present/absent.

**b).Associated complaints**:

Headache – present/absent

Vomiting – present/absent

Nasal obstruction – present/absent

Throat pain – present/absent

mouth breathing – present/absent

Allergic Symptoms – present/absent

Frequent cold – present/absent

**c)Previous ENT Surgery**: present/absent

**d)Systemic Diseases:**

- ✓ Past h/o: DM/HTN/Hypothyroid/IHD/Renal disease/jaundice/radiation exposure
- ✓ Family H/o:
- ✓ Personal H/o(including menstrual h/o):
- ✓ Treatment H/o:

# ENT EXAMINATION:

1)Ear: Right Left

a)External ear

pinna

pre auricular

post auricular

Skin over mastoid

External auditory meatus

b)TM 1.site of perforation

2.size of perforation

3.percentage of perforation

4.Remnant of TM – present/absent

5.Tympanosclerosis – present/absent

6.Tympanic annulus – present/absent

c) Middle Ear: 1.Condition of mucosa

2.Granulation

d)Middle ear Function 1.Valsalva -normal/Abnormal

2.Seigalisation -Normal/Abnormal

e)Hearing Assessment: 1. Tuning fork test (512 Hz)

Rinne

Weber

ABC

2.Pure Tone Average:

f)Facial nerve function and Vestibular functions:

g)Discharge culture and sensitivity report –

h)X-Ray Mastoids

Nose:

Throat:

# GENERAL EXAMINATION:

Pulse: Blood Pressure: Respiratory Rate:

Build and Nourishment:

Pallor/Cyanosis/Icterus/Edema/lymphadenopathy:

**OPERATIVE FINDINGS DATE OF SURGERY:**

a)Anaesthesia – LA/GA

b)Incision

c)Procedure

d)Pathology of Mastoid

1.Type of Mastoid-Sclerotic/cellular/diploic

2.Condition of Antrum

-Size

-Mucous lining

-Air cells

c) Tegmen- intact/breached

d)Sinus Plate- intact/breached

e)Aditus – Patent/Blocked

g)ME Mucosa -Normal/Abnormal

h)Condition of Ossicles – malleus

incus

stapes

m)Tympanoplasty type:

n)Fascia used for Grafting:

o)Problems in post op peroid (if any)

# POST OPERATIVE FOLLOW UP:

**a) 4 weeks**

1.Incision site – Healed /not healed

2.Graft take up – full/partial

3.Eustachian tube function- valsalva

seigelisation

4.Subjective improvement in hearing- +/-

5.Tuning Fork Test (512 Hz)

6.Pure Tone Auiogram and pure tone average

7.Complications if any:

**b) 12 weeks**

1.Incision site – Healed /not healed

2.Graft take up – full/partial

3.Eustachian tube function- valsalva

seigelisation

4.Subjective improvement in hearing- +/-

5.Tuning Fork Test (512 Hz)

6.Pure Tone Auiogram and pure tone average

7.Complications if any:

**c) 24 weeks:**

1.Incision site – Healed /not healed

2.Graft take up – full/partial

3.Eustachian tube function- valsalva

seigelisation

4.Subjective improvement in hearing- +/-

5.Tuning Fork Test (512 Hz)

6.Pure Tone Auiogram and pure tone average

7.Complications if any:

# BIBILIOGRAPHY


1. ***Cuneyt M. Alper, Charles D. Bluestone*** page "Otitis media" chronic suppurative otitis media without cholesteatoma. no.299.

2. Middle Ear and Mastoid Surgery chapter 3,Underlay Tympanoplasty pg 12- By ***Rex S. Haberman***

***3. Mawson S, Ludman H. Disease of the Ear.*** A Textbook of Otology. 4th ed. London,Edward Arnold Publication,1979

3.***Rita ruby Anbuselvi Albert, Anandjob, Georgekuruvila,Richard, K.N.Brahmadathan And Alice John*** on "Myringoplasty-Are we justified in doing it".

4. "Evaluation of improvement of hearing in type I tympanoplasty and its influencing factors" authored by ***Ashok K Saha, D.M.Munshi, and S.N Ghosh.*** Indian journal of Otolaryngology and Head and Neck Surgery Vol 58 No 3:253-257

5. ***Wehrs RE, Tulsa OK*** aeration of middle ear and mastoid in tympanoplasty laryngoscope 1981;91:1463-7

6. ***Hedge MC, Kamath MP, Kumar S, Kumar A, Chandra S***.A study of mastoid cellularity and middle ear diseases. Indian journal of otolaryngology 2004; 10:6-9

7. ***Adkins WY, White B, Charleston SC*** Laryngoscope 1984;94:916-8

8. Myringoplasty with simple mastoidectomy: results in eighty-two consecutive patients done ***by Jackler RK, Schindler*** RA published in otolaryngol head and neck surg.1983 Feb;91(1):14-7.

9. Role of the mastoid in tympanic membrane reconstruction Laryngoscope 1984 Apr;94(4):495-500. ***Jackler RK, Schindler*** RA.

10. ***Diamont M.*** Otitis and Pneumatisation of the Mastoid Bone. Acta Otolaryngologica supplement 1940, 41;1-10.

11. ***Holmquist J*** Size of Mastoid Air Cell System in Relation to healing after Myringoplasty and to Eustachian Tube function. Acta Otolaryngologica 1972 Vol 69:89-93

12. . ***Habib M A,Huq M Z, AktaruzzamanM,Alam MS-*** Outcome of tympanoplasty with and without cortical mastoidectomy for tubotympanic chronic otitis otitis media. Mymensingh journal of Otolaryngology

13.***Vartiainen E, Kansanen M*** Tympanomatoidectomy for chronic otitis media without cholesteatoma journal of otolaryngol Head and Neck surgery in 1992;106:230-234

14.***Vartianen E etal*** Surgery of Chronic Otitis Media in Young patients. Journal of Otolaryngology 1986 Vol 100:515-519

15. ***Mc Graw etal*** " Impact of mastoidectomy on simple tympanic membrane perforation repair" Laryngoscope in 2004 volume 114,page 506-511

16. ***Ruhl CM, Pensak ML.*** Role of aerating mastoidectomy in non cholesteatomatous chronic otitis media.Laryngoscope 1999;109(12):1924-1927

17. ***Nayak D R, Balakrishnan R, Hazarika P, Mathew P T*** .Role of cortical mastoidectomy in the results of myringoplasty for dry tubotympanic disease. Indian journal of Otology.2003;9:11-5

18.***Austin D.F*** A decade of Tympanoplasty-Progress or regress. The Laryngoscope 1982, Vol.92:527-530

19.***Ballenger J J***. Surgery in chronic ear disease. In Diseases of Nose,Ear,Throat,Head and Neck.13th Edition. Edited by Ballenger;Lea and Febinger,Philadelphia.1146-1169.

20.***Beales H.P*** Management of Chronic Suppurative Otitis Media, In Scott brown's Diseases of Ear, Nose and Throat.FourthEd.Edited by John Ballantyne and John Groves 1979, 259-304

21.***Betow C***. 20 years of Experience with Homografts in ear Surgery,Journal of Otolaryngology Supplement 1982,No 5:1-28

22.***Choisson E.*** The establishment of an ear bank in Homograft tympanoplasty;TheOtolaryngologic Clinics of North America.1977, Vol 10,edited by S.George Lesinki,599-612.

23.***Cole J M Hagan P J.*** Electronic processing Of OTolaryngologicData,Archives of Otolaryngology Vol.79:380-388.

24.***Frootko N.J*** reconstruction of the Ear, In Scott brown's Diseases of Ear, Nose and Throat fifth edVol 3. 1987:238-263.

25.***Gibb A G etal***Myringoplasty A review of 365 operations. Journal of Laryngology and Otology.1982, Vol 96:915-930

26.***Hawkins J E***Hearing: Biomechanics and Neurophysiology. The Physiological Basis of medical Practice 1966 -8th Ed , 395-408

27.***Glasscock etal*** Homograft Transplants in Middle Ear-A Follow up report. The Laryngoscope 1972, Vol 82:868-881

28.***Jackler K.R.*** Role of Mastoid in Tympanic Membrane Reconstruction; the Laryngoscope 1984, Vol 94:495-500.

29.***George E.Shambaugh, Michael E Glascock.*** Tympanoplasty in Surgery of Ear,3rd Ed:425-454

30.***Tos M etal***.Tympanoplasty and age Archives of Otolaryngology 1972 Vol.96:493-498

31.***Tos M***. Late results of Tympanoplasty. Archives of Otolaryngology 1974 Vol 100:302-305

32.***Wullstein H*** Tympanoplasty. The problem of free graft and Mucous membrane Graft. Archives of Otolaryngology. Vol 71:363-368

33.***Zollner F***. The principles of plastic surgery of the sound conducting apparatus Journal of Otolaryngology 1955 vol 69:637-652.

34. **Yammamoto, Iwanga** Comparison of bacteria in tympanic cavity and mastoid antrum in chronic otitis media. American journal of Otolaryngol 1986;7:298-301

35. **Fadl FA etal** Outcome of type I tympanoplasty Soudi Medical Journal I 24(I) 58-54,2003jan

36. **Tai CF, Ho KY, Juan KH** Age and Prognosis of tympanoplasty-type I Kaohsiumg Journal of Medical science 14(9):543-7 1998 Sep

## Master chart

| sno | Age Sex | discharge (Yrs) | | HOH (yrs) | | TM status | | side | Size | MM | X-Ray Mastoid | | Ana | Pro | Pre-op | | | Post-op 3mths | | | Postop 6 mths | | | AB Cls | Graft | CoM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | R | L | R | L | R | L | | | | R | L | | | BC | AC | ABG | BC | AC | ABG | BC | AC | ABG | | | |
| 1 | f/18 | 3 | 2 | < 2 | 1 | cp | cp | R | M | E | p | p | G | C | 10 | 45 | 35 | 10 | 35 | 25 | 10 | 25 | 15 | 20 | y | - |
| 2 | f/20 | 4 | 4 | 2 | 2 | cp | cp | R | M | N | S | S | G | M | 5 | 40 | 35 | 5 | 40 | 35 | 5 | 35 | 30 | 5 | y | - |
| 3 | m/25 | 10 | - | 8 | - | cp | - | R | L | E | S | P | G | M | 15 | 45 | 30 | 15 | 40 | 25 | 15 | 35 | 20 | 10 | y | - |
| 4 | f/28 | 9 | - | 9 | - | cp | - | R | S | N | S | - | G | C | 10 | 25 | 25 | 10 | 15 | 15 | 10 | 15 | 15 | 10 | y | - |
| 5 | m/23 | sc | sc | 8 | 6 | cp | cp | L | M | E | S | S | L | C | 10 | 40 | 30 | 10 | 35 | 25 | 10 | 30 | 20 | 10 | y | - |
| 6 | f/30 | - | 8 | - | 7 | - | cp | L | S | N | P | S | G | C | 5 | 25 | 20 | 5 | 15 | 10 | 5 | 15 | 10 | 10 | y | - |
| 7 | m/29 | - | sc | - | 12 | - | cp | L | L | E | P | S | G | M | 15 | 45 | 30 | 15 | 40 | 25 | 15 | 35 | 20 | 10 | y | - |
| 8 | f/29 | 8 | 8 | 6 | 6 | cp | cp | L | S | E | S | S | L | M | 10 | 30 | 30 | 10 | 20 | 20 | 10 | 20 | 20 | 10 | y | -- |
| 9 | m/40 | sc | sc | 10 | 10 | cp | cp | L | M | P | S | S | G | C | 15 | 40 | 25 | 15 | 30 | 15 | 15 | 25 | 10 | 15 | y | - |
| 10 | f/34 | -- | sc | - | 12 | - | cp | L | M | N | P | S | G | M | 10 | 45 | 35 | 10 | 30 | 20 | 10 | 25 | 15 | 20 | y | - |
| 11 | f/35 | 2 | - | 1 | - | cp | - | R | L | E | P | P | G | M | 10 | 45 | 35 | 10 | 35 | 25 | 10 | 30 | 20 | 15 | y | - |

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | m/28 | - | 7 | - | 5 | - | cp | L | S | N | P | P | G | C | 5 | 30 | 25 | 5 | 30 | 25 | 5 | 30 | 25 | 0 | y | - |
| 13 | f/29 | sc | sc | 13 | 3 | cp | cp | R | L | P | S | S | L | C | 5 | 50 | 45 | 5 | 40 | 35 | 5 | 35 | 30 | 15 | y | perichondritis |
| 14 | f/23 | sc | - | 14 | - | cp | - | R | M | N | S | P | L | C | 10 | 40 | 30 | 10 | 20 | 10 | 10 | 20 | 10 | 20 | y | - |
| 15 | f/27 | 6 | 6 | 5 | 5 | cp | cp | L | S | N | S | S | L | M | 5 | 25 | 20 | 5 | 15 | 10 | 5 | 15 | 10 | 10 | y | - |
| 16 | m/30 | 2 | 2 | 1 | 1 | cp | cp | L | S | N | S | S | G | M | 10 | 30 | 20 | 10 | 20 | 10 | 10 | 20 | 10 | 10 | y | - |
| 17 | m/20 | 1 | - | 0 | - | cp | - | R | M | N | P | P | G | C | 5 | 40 | 35 | 5 | 30 | 25 | 5 | 25 | 20 | 15 | y | - |
| 18 | f/25 | 8 | 8 | 6 | 6 | cp | cp | R | L | E | S | S | G | C | 10 | 45 | 45 | 10 | 40 | 40 | 10 | 40 | 40 | 5 | y | - |
| 19 | f/30 | - | 9 | - | 6 | - | cp | L | S | N | P | S | G | C | 10 | 30 | 30 | 10 | 25 | 25 | 10 | 20 | 20 | 10 | y | - |
| 20 | f/28 | - | 9 | - | 5 | - | cp | L | S | E | P | S | L | M | 5 | 30 | 25 | 5 | 30 | 25 | 5 | 30 | 25 | 0 | y | - |
| 21 | m/56 | sc | sc | 11 | 11 | cp | cp | L | L | P | S | S | G | M | 10 | 45 | 35 | 10 | 35 | 25 | 10 | 35 | 25 | 10 | N | - |
| 22 | f/40 | sc | - | 12 | - | cp | - | R | M | E | S | P | G | M | 15 | 45 | 30 | 15 | 30 | 15 | 15 | 30 | 15 | 15 | y | - |
| 23 | m/38 | 2 | -- | 2 | - | cp | - | R | S | N | S | P | G | C | 5 | 35 | 30 | 5 | 25 | 20 | 5 | 20 | 15 | 15 | y | Wound infection |
| 24 | m/32 | 1 | - | 1 | - | cp | - | R | L | E | P | P | L | C | 10 | 40 | 30 | 10 | 20 | 10 | 10 | 20 | 10 | 20 | y | - |

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | m/40 | sc | sc | 13 | 13 | cp | cp | L | M | N | S | S | G | M | 5 | 40 | 35 | 5 | 30 | 25 | 5 | 25 | 20 | 15 | N | Discharge+ |
| 26 | f/33 | 6 | - | 6 | - | cp | - | R | M | P | S | P | G | M | 10 | 40 | 40 | 0 | 30 | 30 | 0 | 25 | 25 | 15 | y | -- |
| 27 | m/32 | - | sc | - | 15 | - | cp | L | L | E | P | S | L | M | 15 | 45 | 30 | 15 | 40 | 25 | 15 | 30 | 15 | 15 | y | - |
| 28 | f/29 | 8 | - | 8 | - | - | cp | L | S | N | P | S | G | M | 10 | 40 | 30 | 10 | 25 | 15 | 10 | 25 | 15 | 15 | y | - |
| 29 | f/28 | sc | sc | 12 | 12 | cp | cp | R | L | P | S | S | G | C | 15 | 40 | 25 | 15 | 30 | 15 | 15 | 30 | 15 | 10 | y | - |
| 30 | f/20 | 2 | 2 | 0 | 0 | cp | cp | L | S | N | S | S | G | C | 10 | 35 | 25 | 10 | 25 | 15 | 10 | 25 | 15 | 10 | y | - |
| 31 | m/35 | sc | - | 12 | - | cp | - | R | M | N | S | P | L | C | 10 | 45 | 35 | 10 | 40 | 30 | 10 | 30 | 20 | 15 | y | - |
| 32 | m/38 | 10 | - | 8 | - | cp | - | R | L | E | P | P | L | C | 5 | 35 | 30 | 5 | 30 | 25 | 5 | 25 | 20 | 10 | y | - |
| 33 | m/32 | sc | sc | 10 | 10 | cp | cp | L | M | P | S | S | G | M | 15 | 40 | 25 | 15 | 30 | 15 | 15 | 30 | 15 | 15 | N | Discharge+ |
| 34 | f/29 | sc | sc | 12 | 12 | cp | cp | L | M | N | P | P | G | M | 10 | 40 | 30 | 10 | 30 | 20 | 10 | 30 | 10 | 20 | y | - |
| 35 | m/30 | 7 | - | 7 | - | cp | | R | S | E | P | P | G | M | 10 | 25 | 25 | 10 | 20 | 20 | 10 | 20 | 0 | 25 | y | - |
| 36 | m/29 | sc | sc | 10 | 10 | cp | cp | L | L | P | S | S | G | C | 15 | 45 | 30 | 15 | 35 | 20 | 15 | 35 | 20 | 10 | y | - |
| 37 | f/45 | sc | - | | | cp | - | R | M | E | S | P | G | M | 5 | 40 | 35 | 5 | 30 | 25 | 5 | 25 | 20 | 15 | y | - |
| 3 | f/20 | sc | sc | 1 | 8 | cp | c | R | L | E | S | S | G | C | 10 | 40 | 30 | 10 | 30 | 20 | 10 | 30 | 20 | 10 | y | - |

| | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | | | | 0 | | | p | | | | | | | | | | | | | | | | | | | |
| 39 | m/34 | - | sc | - | 13 | - | cp | L | L | E | P | S | G | M | 15 | 50 | 35 | 15 | 35 | 20 | 15 | 30 | 15 | 20 | y | - |
| 40 | f/50 | - | sc | - | 12 | - | cp | L | L | E | P | S | G | C | 10 | 50 | 40 | 10 | 40 | 30 | 10 | 30 | 20 | 20 | y | -- |
| 41 | f/42 | - | sc | - | 10 | - | cp | L | L | E | P | P | G | M | 5 | 45 | 40 | 5 | 30 | 25 | 5 | 30 | 25 | 15 | y | Discharge+ |
| 42 | m/29 | - | sc | - | 10 | - | cp | L | M | E | P | S | G | C | 5 | 40 | 35 | 5 | 35 | 30 | 5 | 30 | 25 | 10 | y | - |
| 43 | m/30 | 7 | - | 6 | - | cp | - | R | S | N | P | P | L | M | 10 | 35 | 25 | 10 | 30 | 20 | 10 | 25 | 15 | 10 | y | - |
| 44 | f/28 | 6 | 8 | 6 | 6 | cp | cp | L | S | N | S | S | L | C | 10 | 30 | 30 | 0 | 25 | 25 | 0 | 25 | 25 | 5 | y | - |
| 45 | f/29 | 8 | 9 | 7 | 8 | cp | cp | L | M | N | P | P | G | C | 5 | 35 | 30 | 5 | 30 | 25 | 5 | 25 | 20 | 10 | y | -- |
| 46 | f/30 | sc | - | 15 | - | cp | | R | M | P | P | P | G | M | 10 | 50 | 40 | 10 | 35 | 25 | 10 | 35 | 25 | 15 | y | - |
| 47 | m/32 | sc | sc | 11 | 11 | cp | cp | L | M | P | S | S | G | M | 5 | 45 | 40 | 5 | 35 | 30 | 5 | 30 | 25 | 15 | N | reperforation |
| 48 | m/21 | sc | - | 12 | - | cp | - | R | L | P | S | P | G | C | 15 | 45 | 30 | 15 | 30 | 15 | 15 | 30 | 15 | 15 | y | - |
| 49 | f/29 | - | 2 | - | 2 | - | cp | L | S | N | P | P | G | M | 10 | 30 | 30 | 0 | 20 | 20 | 0 | 20 | 20 | 10 | y | - |
| 50 | m/22 | 1 | - | 1 | - | cp | | R | M | E | P | P | G | C | 5 | 40 | 35 | 5 | 35 | 30 | 5 | 30 | 25 | 10 | y | - |

**Key to master chart**: L- left ear R- right ear AC- Air conduction threshold BC- bone conduction threshold ABG-air bone gap,AB Cls-Air Bone Closure,MM – middle ear mucosa Cp – central perforation. Sc- since childhood.m-male.f- female p-pneumatisation. S-sclerosed. C-Cortical mastoidectomy.M-myringoplasty P- polypoidal E- edematous. N- normal G-general anaesthesia . L-local anaesthesia.Com – complications,y-yes, N-no