A STUDY OF THE EFFECT OF TENSOR TYMPANI RELEASE IN MYRINGOPLASTY ON POST OPERATIVE MIDDLE EAR COMPLIANCE

Dissertation submitted in

Partial fulfillment of regulation required for award of

M.S, DEGREE in OTORHINOLARYNGOLOGY (BRANCH –IV)

THE TAMILNADU DR.MGR MEDICAL UNIVERSITY

CHENNAI

APRIL 2012

DECLARATION

I solemnly declare that the dissertation entitled **"A STUDY OF THE EFFECT OF TENSOR TYMPANI RELEASE IN MYRINGOPLASTY ON POST OPERATIVE MIDDLE EAR COMPLIANCE"** has been done by me at the Coimbatore Medical College Hospital , Coimbatore during 2009 – 2011 under the guidance and supervision of PROF. Dr.V.ARAVINTHAN,M.S.ENT.,DNB.

This dissertation is submitted to the Tamilnadu Dr.M.G.R.Medical University, towards partial fulfillment of regulations for the award of M.S.DEGREE (BRANCH IV) in Otorhinolaryngology.

Place :
Date :

Dr.H.MADHUMITHA
M.S.(E.N.T)Post graduate,
Coimbatore Medical College,
Coimbatore.

CERTIFICATE

This is to certify that this dissertation titled **"A STUDY OF THE EFFECT OF TENSOR TYMPANI RELEASE IN MYRINGOPLASTY ON POST OPERATIVE MIDDLE EAR COMPLIANCE"** submitted by Dr.H.MADHUMITHA appearing for M.S.(E.N.T) degree (Branch IV – Otorhinolaryngology) examination in April 2012 is a bonafide record of work done by her under my guidance and supervision in partial fulfillment of regulations of the Tamilnadu Dr.M.G.R.Medical University Chennai.I forward this to the Tamilnadu Dr.M.G.R. Medical University , Chennai.

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COIMBATORE MEDICAL COLLEGE,
COIMBATORE.

THE DEAN
COIMBATORE MEDICAL COLLEGE,
COIMBATORE

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to the Dean, Coimbatore Medical College Dr.R.Vimala ,M.D., for permitting me to carry out this study in our institution.

I am greatly indebted to Dr.V.Aravinthan,M.S(E.N.T).,DNB., the Professor and Head ,Department of E.N.T.for his valuable guidance in this study.

I would like to thank Dr.S.Dhanalakshmi, M.S(E.N.T)., Associate Professor ,Department of E.N.T for her suggestions and help during this study.

I am immensely grateful to the Assistant Professors in our Department , Dr.V.Saravanan, M.S.,(ENT)., Dr.M.Nallasivam,M.S(E.N.T) and Dr.M.Vasudevan M.B.B.S.,D.L.O., for their encouragement and assistance throughout this study.

I owe a lot to both my colleagues Dr.Chithra Revi,and Dr.Sathish, my friends and family members for being a source of constant support during the entire study .

I thank Mrs.Kavitha , M.Sc ., audiologist and speech therapist of our department and Mrs.Chellathai, audiometrician for helping me in this study.

Most importantly, I express my gratitude to all the patients who participated in this study and extended their whole hearted cooperation.

CONTENTS

INTRODUCTION

Chronic suppurative otitis media is a common cause of conductive hearing loss in our country . Despite advances in public health and medical care , it continues to be prevalent, especially in the developing world . It assumes even more significance because the hearing loss occurring as its consequence is preventable .

The World Health Organisation has indicated that a prevalence rate of chronic suppurative otitis media greater than 4 % in a defined population is indicative of a massive public health problem requiring urgent attention [1], the prevalence in India being 7.8 %.[2]

Among the two types of chronic suppurative otits media, tubotympanic and atticoantral, the former is characterized by central perforation in the pars tensa surrounded by residual tympanic membrane.

Myringoplasty, the surgical technique used to restore the integrity of the tympanic membrane and to improve hearing , has undergone significant refinements over a period of time, and has now become a universally followed procedure with rewarding results.

Therefore after having become well established, the quest is now focussed towards attaining a near normal neomembrane and a post

operative middle ear status which functionally bears close resemblance to the normal state.

In long standing large central perforations medialisation of handle of malleus has been observed.This medial rotation of the handle of malleus is possibly due to the unopposed pull of tensor tympani and the loss of tensile strength of the tympanic membrane.Post operative observations after myringoplasty in these patients after the graft had taken up revealed medialisation of graft with a shallow middle ear space.This medialisation is likely to reduce the compliance and may affect air bone gap closure.[3,4] During myringoplasty for such cases, restoration of the malleus to its original position (for instance, by sectioning the tensor tympani tendon) if done along with repair of the tympanic membrane , is postulated to improve post operative results.

This study was conducted to evaluate the effect of tensor tympani tendon release during myringoplasty on post operative middle ear compliance.

OBJECTIVES

1. To evaluate the changes in post operative middle ear compliance after myringoplasty with tensor tympani tendon release in patients with dry large central perforations.
2. To compare the above results with compliance changes occurring in patients undergoing myringoplasty without tendon release.
3. To arrive at a conclusion regarding whether tensor tympani release improves audiological outcome in patients undergoing myringoplasty.

REVIEW OF LITERATURE

EPIDEMIOLOGY :

Chronic suppurative otitis media , one of the preventable causes of deafness, continues to be widely prevalent in our country.Prevalance surveys show that the global burden of illness due to chronic suppurative otitis media involves 65-300 million individuals - 60% of whom suffer from significant hearing impairment.In India , the proportion of patients with CSOM having hearing impairment is higher – 77%.

The World Health Organisation has classified countries according to prevalence of CSOM as :

Highest – more than 4%

High – 2-4 %

Low – 1-2 %

Lowest - <1 %

A cross sectional study involving school children [4,5]that can be applied to the entire population has shown the prevalence in India to be 7.8%, included in the first category above.

The global burden of hearing impairment can be potentially reduced by 4/5th if CSOM is effectively tackled.

MYRINGOPLASTY – HISTORY ,EVOLUTION :

Myringoplasty as a method of reconstruction of the tympanic membrane in cases of perforation, was established for the first time by Berthold in 1876.He used free skin grafts.Later Politzer and Tangermann (1883-84)modified this method by removing the epithelium from the perforation edges.

In the early part of the 20th century , Meschchersky, Temkin, Shambaugh used free skin flaps.In the 1970s Barteneva and Kozlov proved this technique to be unacceptable due to the large number of post operative complications, such as cholesteatoma ,necrosis ,epidermal cysts – collectively referred to as 'flap disease'.[6]

Later , by the 1980s, most of the otologists advocated the use of grafts of mesodermal origin, such as fascia, vein, perichondrium and fat, out of which temporalis fascia has found widespread use.

Once the procedure of myringoplasty became standardized, various techniques of graft placement were tried such as underlay, overlay, over underlay methods and their results were compared.

The term tympanoplasty was introduced in 1953 by Wullstein to describe surgical techniques for reconstruction of the middle ear mechanism that had been impaired or destroyed by chronic ear disease.Tympanoplasty can be

considered the final step in the surgical conquest of conductive hearing loss and represents the culmination of over 100 years of evolution of surgical procedures on the middle ear to improve hearing.

Despite the early successes and innovations ,in the early 1990s , there was strong opposition to surgery for treating conductive hearing loss.This was attributed to non availability of surgical microscopes , imperfect sterilization techniques , increased rates of wound infection in the pre antibiotic era, lack of audiometric equipments for quantitative measurements of hearing before and after surgery and possibly also because infectious complications of aural diseases took up most of the otologists' time.

But now , since the advent of antibiotics have reduced the rate of infections, equal attention is directed towards disease clearance as well as hearing restoration.

MIDDLE EAR MECHANICS IN SOUND TRANSMISSION :

The middle ear acts as a transformer, converting air borne sound vibrations of large amplitude but small force into sound vibrations of small amplitude but large force. This is established by the means of a large hydraulic ratio of the tympanic membrane compared to the stapes footplate , as well as a small lever ratio of the longer handle of malleus acting on the slightly shorter long process of incus.[7]

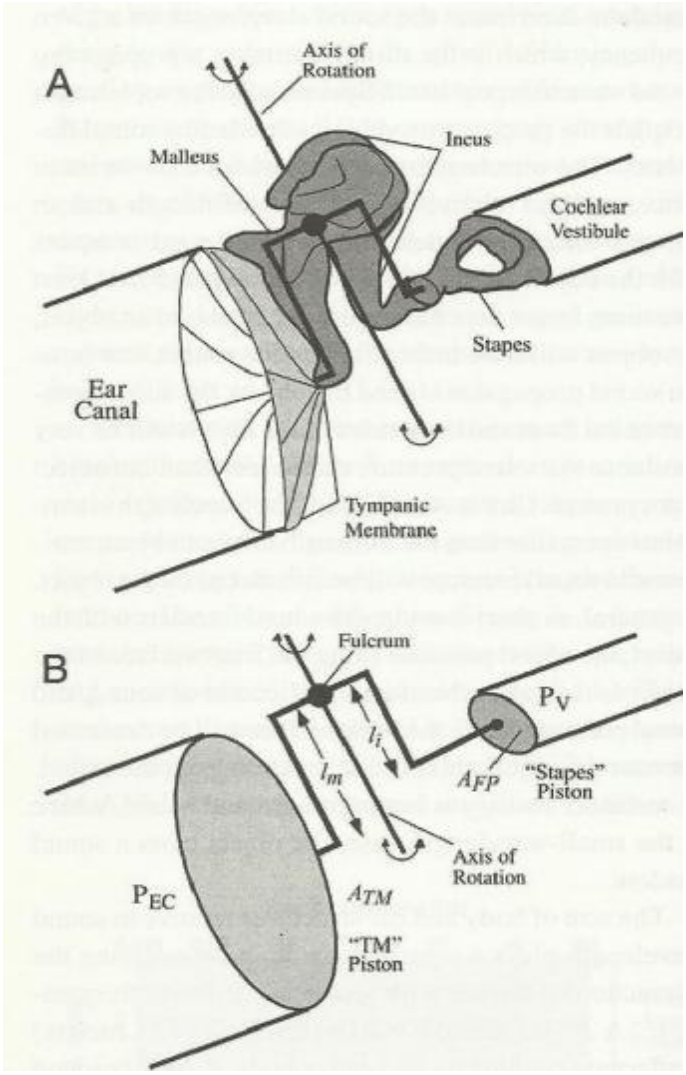


FIGURE 1

MECHANICS OF THE TYMPANO OSSICULAR SYSTEM

($A_{TM:}$ Area of tympanic membrane.

A_{FP} :Area of stapes footplate

P_{EC} :Pressure in the external canal.

$P_{V:}$Pressure in the vestibule

l_m:Length of malleus handle.l_i : length of incus long process)

Bekesy calculated the effective vibrating surface of the tympanic membrane area to the stapes footplate area to be 17:1 and the lever effect of the ossicular chain to be 1.3 :1.The total increase of pressure at the oval window is 22 times (17 x 1.3).This sound pressure transformer mechanism of the normal ear equates to approximately 27 dB gain.

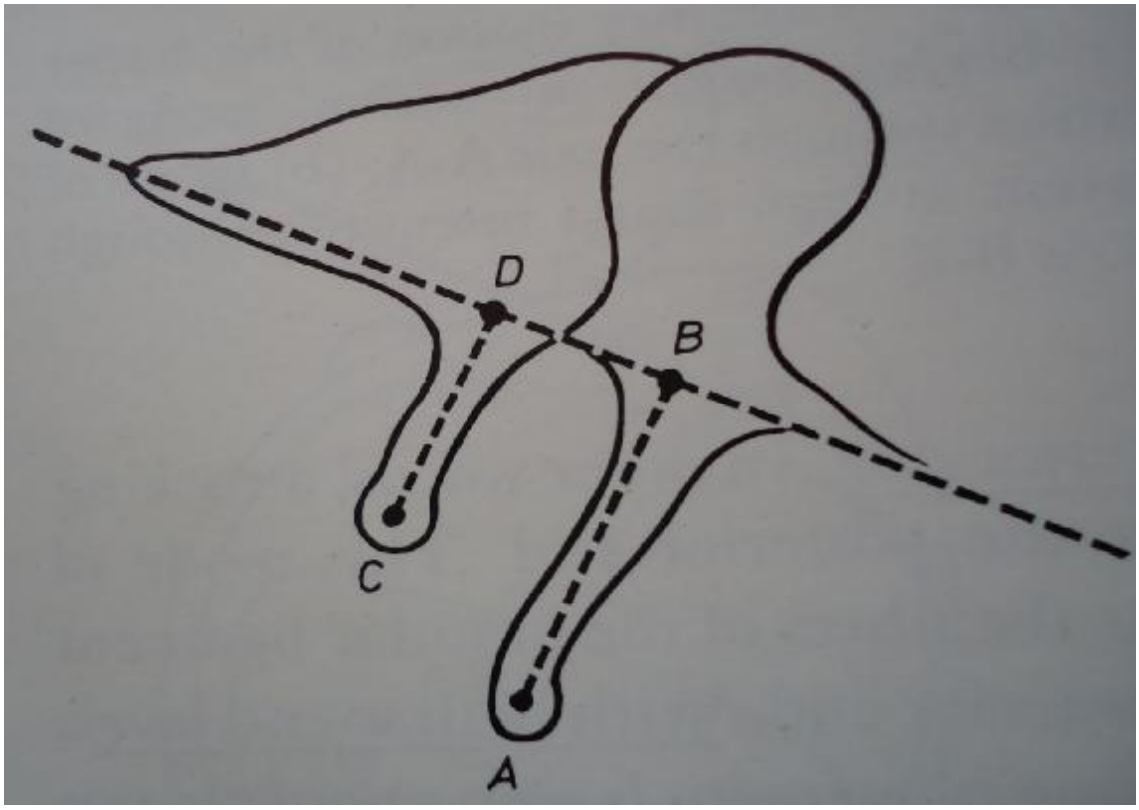


FIGURE 2

OSSICULAR LENGTH COMPARISON

For this mechanism to effectively function , the presence of the following pre requisites are essential : an intact, mobile tympanic membrane, ossicular

chain integrity and ideal mobility, middle ear cavity of normal volume and ventilation.

The round window of the normal ear at the opposite end of the cochlear duct permits to and fro vibratory movements of the non compressible cochlear fluid column in the rigid bony cochlea. The movements of the round window are largely passive in response to the movements of the stapes footplate. This is attributed to the following factors :

- the intact tympanic membrane protects the round window from competitive sounds, partly by damping and partly by a phase difference.
- the 22 times pressure increase at the oval window exceeds far exceeds any competitive pressure exerted on the round window from the tympanic cavity side.

These above mechanisms are even more relevant in this study as disturbances in them are encountered in the following aspects : large central perforation , retracted handle of malleus, a reduced middle ear space.

MECHANISM OF HEARING LOSS IN TYMPANIC MEMBRANE PERFORATIONS :

When a defect occurs in the tympanic membrane ,sound protection of the round window is lost , and there is a tendency for the sound waves to reach

both the round window and oval window at the same moment. This cancels the resultant movements of the perilymph. When the perforation is small, this effect is small. But in case of larger perforations, the transformer ratio further reduces, the cancelling effect of sound on the unprotected round window rises producing upto a loss of 40 to 45dB.

The ideal myringoplasty should therefore restore sound protection for the round window by constructing a closed and air containing middle ear,and rebuild the sound pressure transformation at the oval window by establishing communication between the graft and footplate via the mobile ossicles.

Establishing an intact neomembrane is the routine aim in all myringoplasties.In addition , in this study , avenues for establishing an adequate and well ventilated middle ear cavity are also explored because this factor is also equally important for efficient middle ear functioning.

POST OPERATIVE PROBLEMS AFTER MYRINGOPLASTY FOR LARGE CENTRAL PERFORATIONS :

Myringoplasty for perforations larger in size were observed to be technically demanding and to inversely correlate with the size of the perforation.Rehman et al [8]in their study achieved 87% success rate for medium sized perforations and 83% for large perforations. Some post operative problems were found to uniquely occur in patients operated for large central

perforations, the most notable one being high rates of graft medialisation ,and in some cases ,even adhesions of the tip of malleus handle to the promontory.

According to Shambaugh , the mechanism due to which this occurs is as follows .The medial pull of the tensor tympani muscle is ordinarily opposed by the intact tympanic membrane. In case of a chronic substantial perforation of the tympanic membrane , the unopposed action of the tensor tympani can medialise the manubrium , effectively contracting the depth of the tympanic cavity.

This fact is further supported by Ralli et al who recorded that in the normal ear , the distance between the tympanic membrane at the umbo and the middle ear mucosa at the promontory is at least 2.5mm.[9] If the inferior aspect of malleus approaches or is fixed to the promontory , a significant impairment of the conductive mechanism occurs.

Myrthe et al during their studies on tympanoplasty[10] in chronic otitis media patients with intact but severely retracted malleus suggested disconnection of the ossicular chain and autologous incus transposition to bring back the reconstructed tympanic membrane to its original position.

Another method to correct this medialisation -sectioning of the tensor tympani tendon to relocate the malleus back to its original position has also been suggested.

THE TENSOR TYMPANI – ANATOMY AND FUNCTION :

The tensor tympani musle arises mainly from the walls of the canal for tensor tympani lying above the Eustachian tube.[11,12] A small part arises from the cartilaginous portions of the tube and from the greater wing of sphenoid. The muscle runs backwards into the tympanic cavity on its medial wall just below the level of the facial nerve.

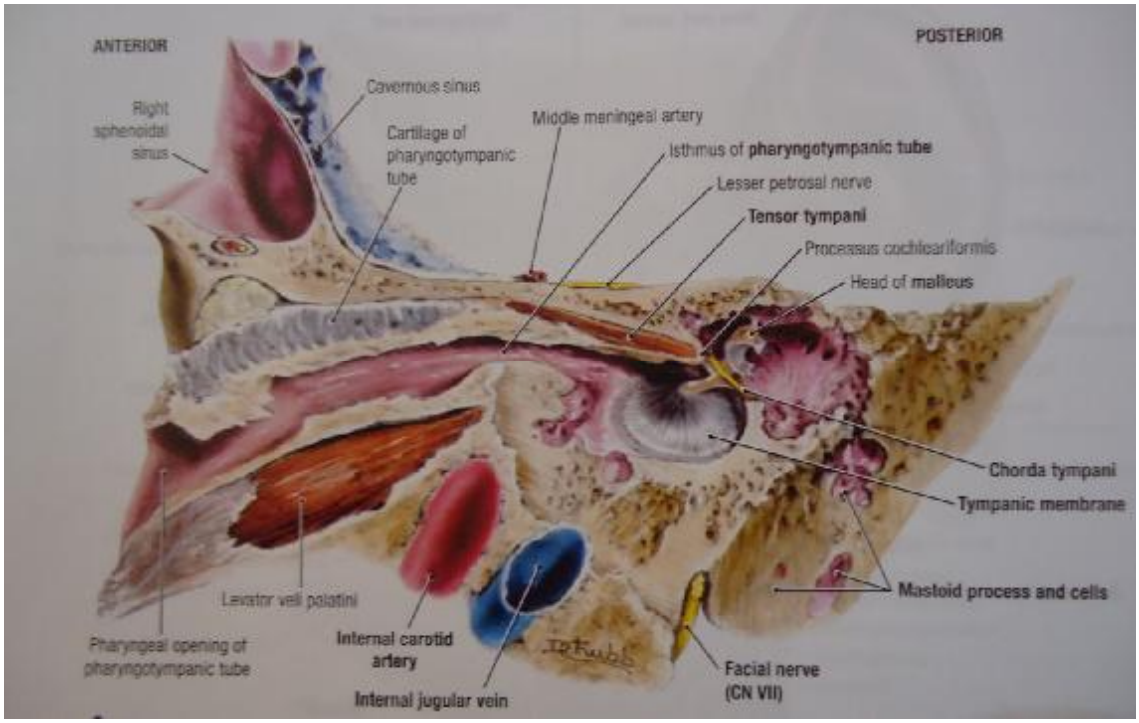


FIGURE 3

TEMPORAL BONE SECTION THROUGH THE MIDDLE EAR CAVITY

At about the level of geniculate ganglion, the muscle gives way to a tendon, which is held in a bony spoon shaped prominence – the processes cochleariformis by a transverse tendon that turns through a right angle to pass laterally to the neck of malleus below the chorda tympani. The processus partly overlies the facial nerve just posterior to the geniculate ganglion.

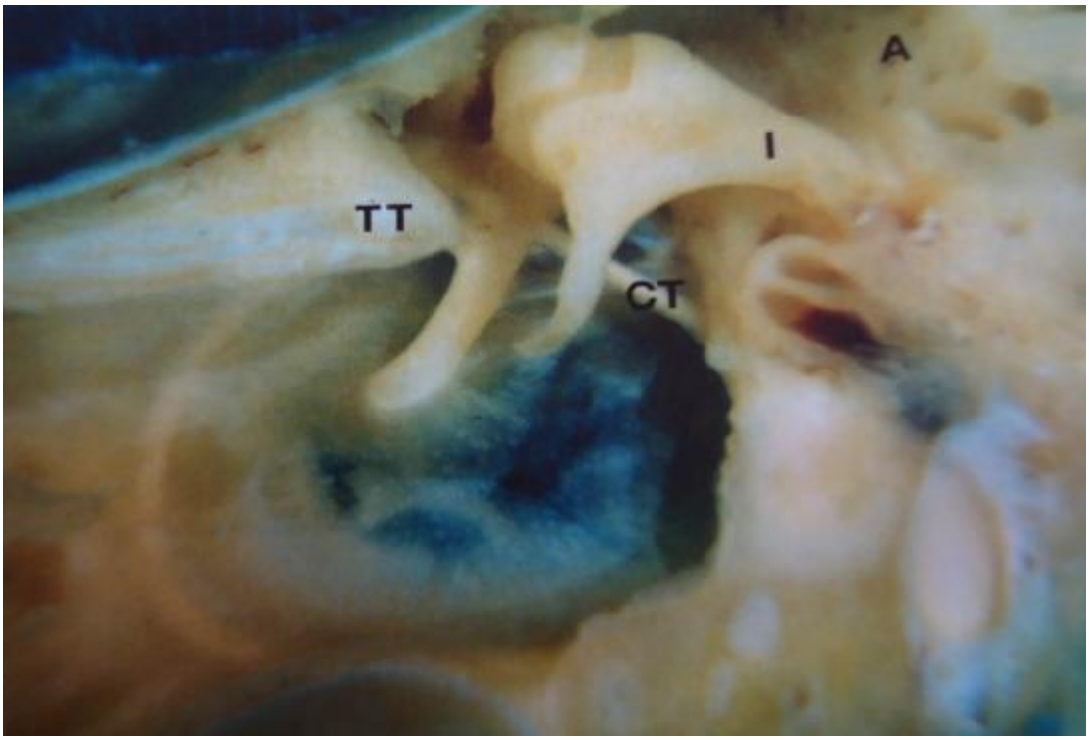


FIGURE 4

MIDDLE EAR OSSICLES AND MUSCLES AS VISUALIZED FROM THE MIDDLE EAR CAVITY.

(TT- tensor tympani ; CT- chorda tympani ; I – incus)

The muscle , from its first arch origin, is supplied from the mandibular division of trigeminal by a branch from the nerve to medial pterygoid.

THE ROLE OF TENSOR TYMPANI IN MIDDLE EAR FUNCTION - STILL CONTROVERSIAL

Conventionally , the action of the tensor tympani is said to pull the malleus medially on contraction , tensing the tympanic membrane and dampening vibration in the ossicular chain.[13,14]

However , Peter Howell [15]based on his studies , has pointed to lack of function of the tensor tympani by substantiating the following facts . First , there is virtual absence of muscle spindles in the tensor tympani , whereas they occur in both the stapedius and the tensor palati. The Golgi tendon organ is also absent in the tensor tympani , indicating that sensory receptor control has no significant role in the activity of this muscle.

Secondly, Wersall[16] found that in rabbits , neuromuscular junction blockage by anaesthesia is effective on the stapedius but not on the tensor tympani.It has also been reported that the tensor tympani cannot be conditioned , but the stapedius can.[17]Also , on comparing the morphological structure of tensor tympani and stapedius , it has been found that there is a high proportion of fat in the tensor tympani and signs of atrophy. Andersen (1975) reported that

enzyme activity is lower in the tensor tympani than stapedius.[18] It has been shown that consideration of the structure of the tensor tympani suggest that compared to the stapedius , it has no significant function in attenuation.

TENSOR TYMPANI RELEASE :

Considering the above facts , release of the tensor tympani was mentioned by Nadol and McKenna [19] as a method of lateralizing a medially rotated malleus. A similar method was also mentioned by Shambaugh and Pensak.[20]

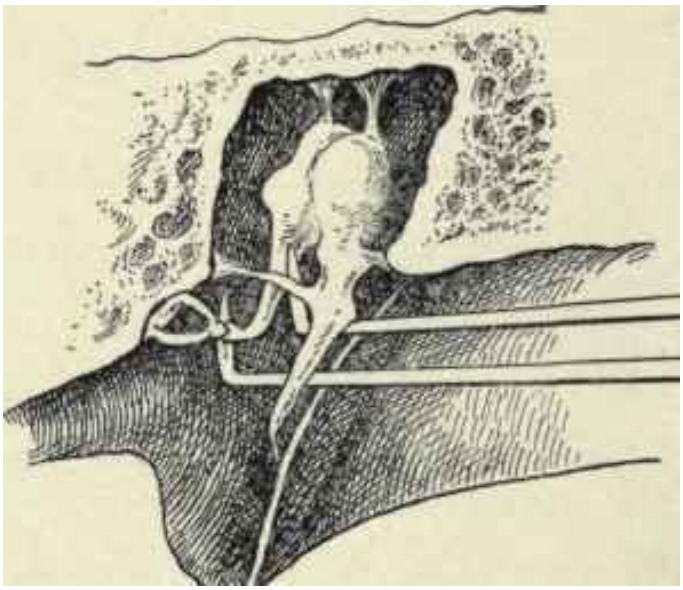


FIGURE 5

TENSOR TYMPANI RELEASE - DIAGRAMMATIC

History has left many questions unanswered in relation to the definitive role of tensor tympani. Also, in spite of just a brief mention, there are not many exclusive studies in literature evaluating all aspects of tensor tympani release

during myringoplasty. Further, chronic suppurative otitis media forms a major fraction of otological surgeries in our institution .Hence this study was carried out in an attempt to analyse the post operative results of this procedure and to evaluate whether incorporating this step during routine myringoplasty would affect hearing outcome.

STEPS IN TENSOR TYMPANI TENDON RELEASE

FIGURE 6

EXPOSURE OF TENSOR TYMPANI TENDON

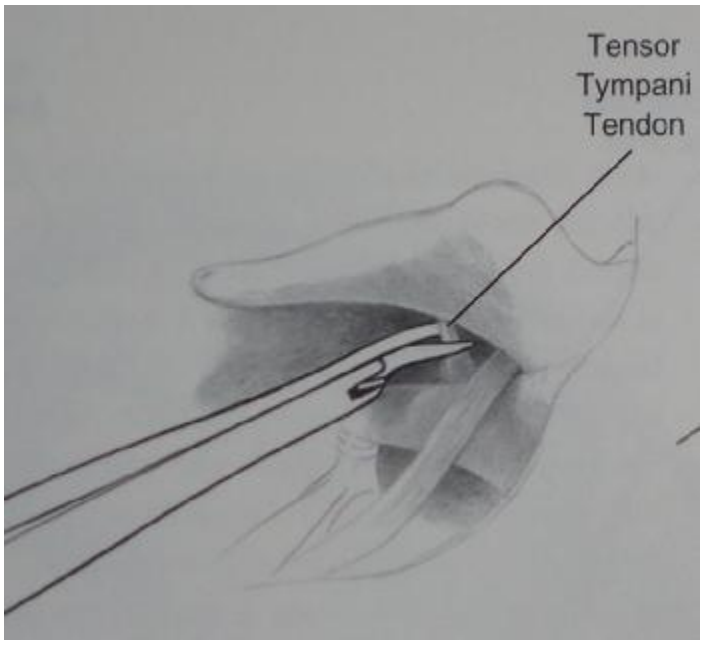
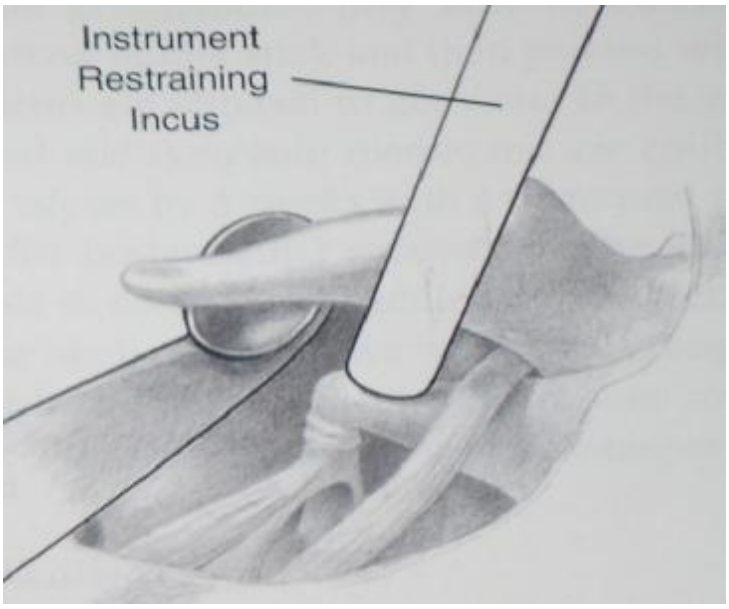


FIGURE 7

AFTER RELEASE OF TENDON



PRINCIPLES OF IMPEDANCE AUDIOMETRY:

Tympanometry , the objective test for middle ear function , measures the compliance of the tympanic cavity as a function of mechanically varied air pressure in the external ear.

The pressure in the external ear is decreased upto -200daPa and increased upto + 200 daPa and the corresponding compliance values are measured in

ml.The graph is plotted with X axis representing pressure in daPa or mmH_2O and Y axis representing admittance in mmho (or equivalent volume in ml).

Transmission of sound through the middle ear mechanism is maximal when air pressure is equal on both sides of the tympanic membrane.For a normal ear , maximal transmission occurs at or near atmospheric pressure.

PRINCIPLE :

The basic constructive principles of an electro acoustic impedance meter are the following [21,22,23]

A probe is placed in the external acoustic meatus so as to make an air tight seal.

The probe comprises three tubes :

- one is connected to a pump which alters the pressure in the meatus and measures that pressure with a manometer
- the second tube delivers a continuous pure tone sound wave , called the ‘probe tone ‘ to the meatus.
- the third tube transmits sound waves from the meatus to a microphone for conversion to electrical activity.

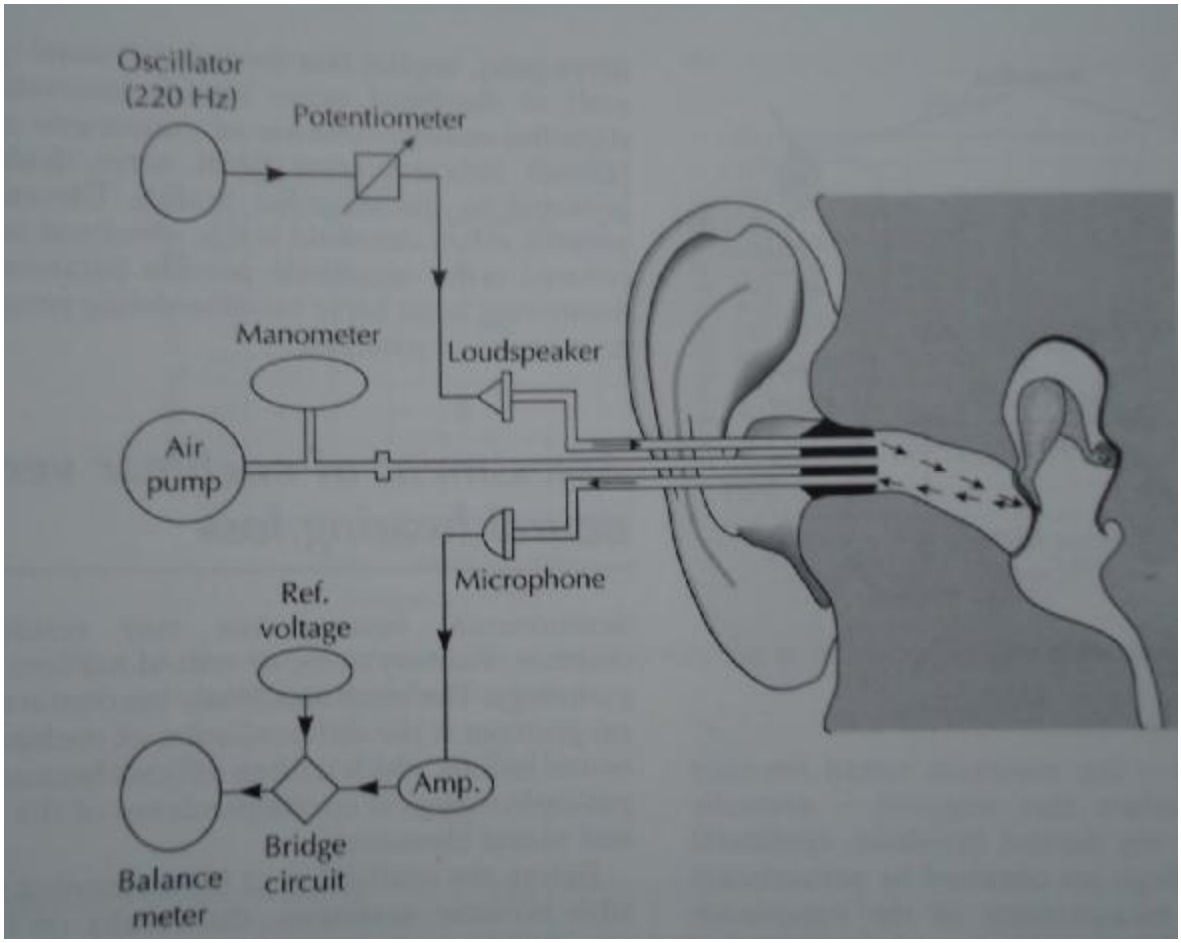


FIGURE 8

COMPONENTS OF AN ELECTRO ACOUSTIC IMPEDANCE METER

This electrical signal is amplified and rectified to direct current , and represents the sound pressure level in the external meatus. It is compared with a reference voltage delivered by the impedance meter, and the comparison registered on a balance meter.

By adjusting the intensity of the probe tone , a voltage of the reflected sound equal to the reference voltage can be produced, such that the needle in the balance meter shows a null position.

Presenting a high positive or negative air pressure to the outer ear canal will stiffen the tympanic membrane .

By gradually varying the air pressure from a positive pressure to a negative , the tympanic membrane and the attached ossicular chain will become more mobile, showing more compliance to the sound pressure waves.The sound passage to the middle ear will then be less and less reduced or impeded , and the lowest impedance will be obtained when the air pressure is equal on both sides of the tympanic membrane, thus showing the highest compliance to sound waves.

Tympanograms are classified according to :

- compliance
- pressure at maximum compliance
- rate of compliance change
- shape

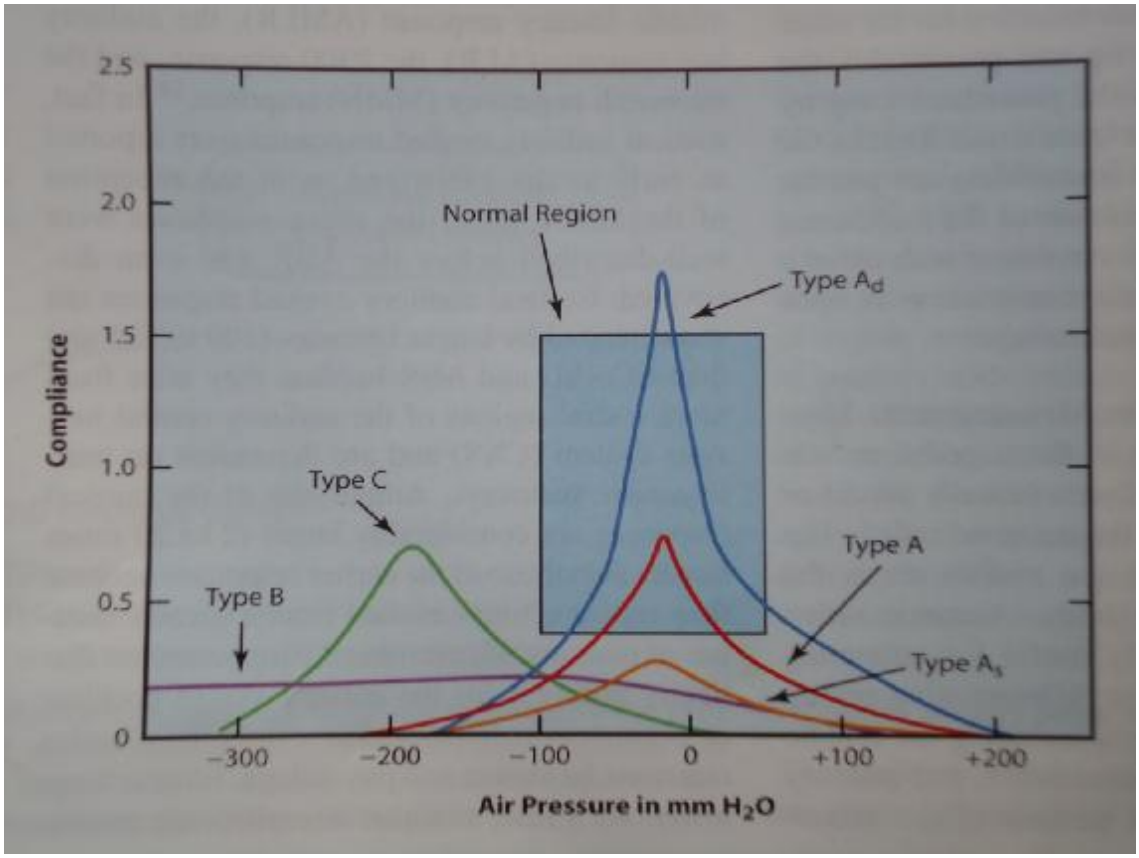


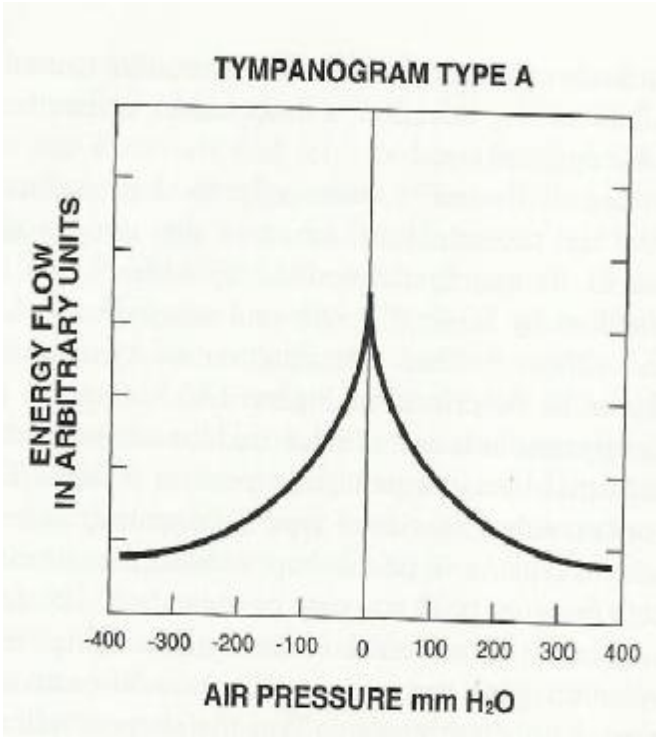
FIGURE 9

TYPES OF TYMPANOGRAM CURVES

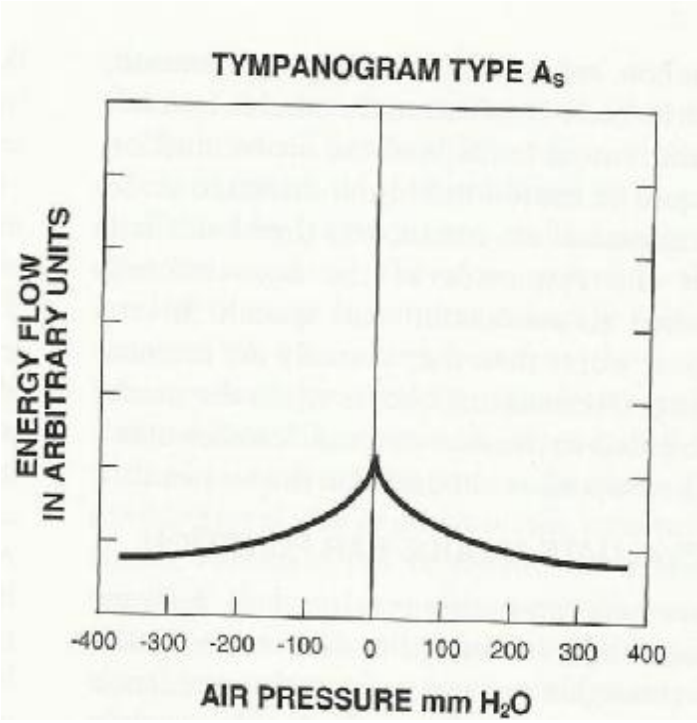
The clinical value of tympanometry is that a middle ear disorder modifies the shape of the tympanogram in predictable ways. The conventional classification designates tympanograms into the following types :

TYPE A :

The characteristically normal curve with its peak at atmospheric pressure within the range of -100 daPa to +100 daPa.

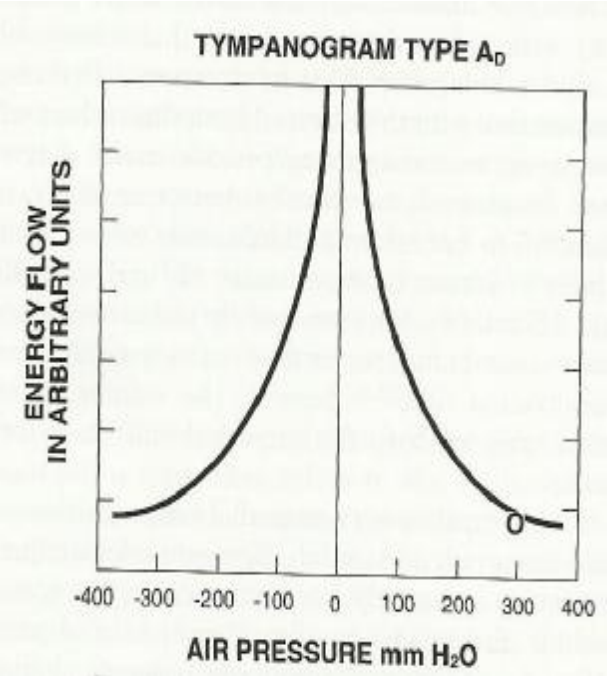

TYMPANOGRAM TYPE A
ENERGY FLOW
IN ARBITRARY UNITS
-400 -300 -200 -100 0 100 200 300 400
AIR PRESSURE mm H2O

TYPE A_S :


TYMPANOGRAM TYPE As
ENERGY FLOW
IN ARBITRARY UNITS
-400 -300 -200 -100 0 100 200 300 400
AIR PRESSURE mm H2O

The shape is normal but the height of the peak is reduced and the pressure range is normal – as in otosclerosis.

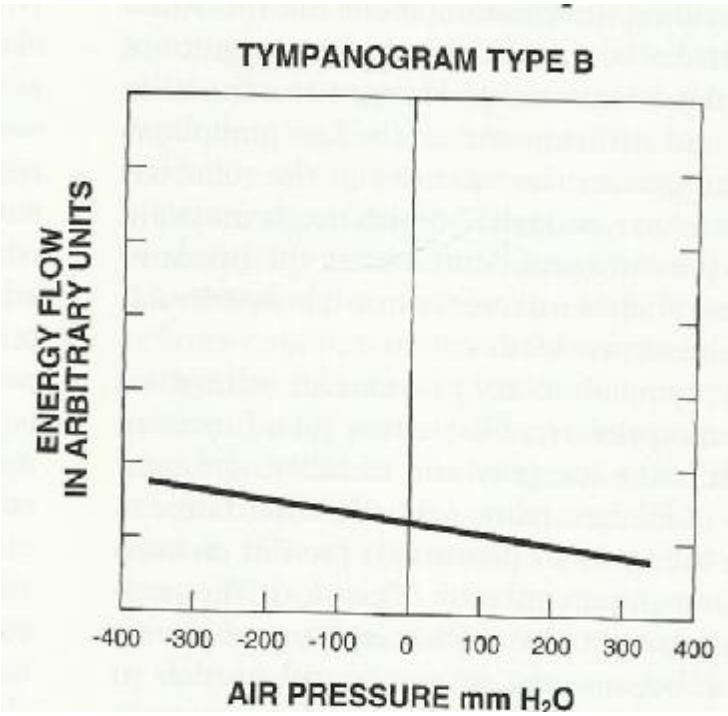
TYPE A_D :



The shape of the tympanogram is normal but the height is significantly increased as occurring in ossicular discontinuity.

TYPE B :

Flat curve , without a peak; may be seen in secretory otitis media, perforated ear drum , external canal obstruction.The compliance remains essentially unchanged over a large range of pressure variation


TYMPANOGRAM TYPE B
ENERGY FLOW
IN ARBITRARY UNITS
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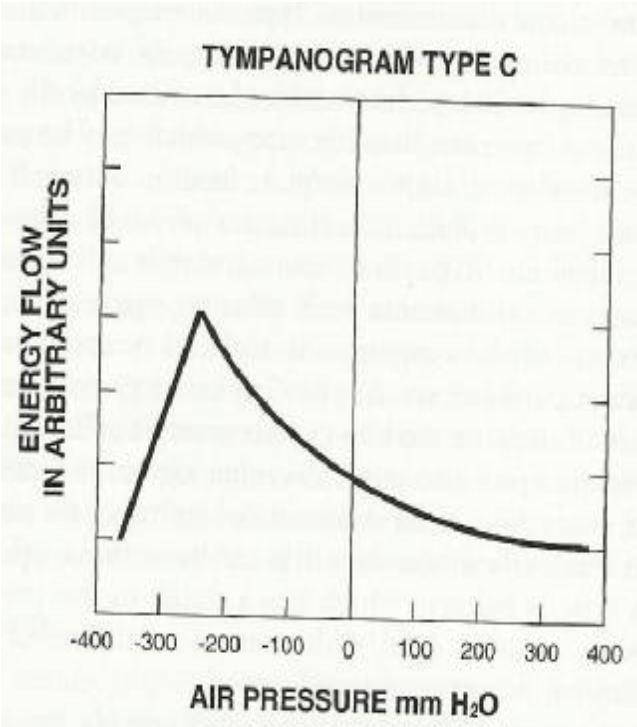
AIR PRESSURE mm H₂O

TYPE C :


TYMPANOGRAM TYPE C
ENERGY FLOW
IN ARBITRARY UNITS
-400 -300 -200 -100 0 100 200 300 400
AIR PRESSURE mm H₂O

Normal shape , but peaks at a substantially negative pressure as in Eustachian tube dysfunction

Hence , tympanometry is invaluable in assessing the efficiency of sound transmission through the middle ear.

IMPEDANCE AUDIOMETRY AFTER MYRINGOPLASTY :

Historical review doesnot find any evidence that tympanometry shouldnot be performed after tympanoplasty.[24] According to Augustine Syms (2009), tympanometry can be safely performed 4 – 6 weeks after tympanoplasty without deleterious effects on the grafted membrane.[25]

Karpinar and colleagues studied middle ear ventilation functions in patients undergoing myringoplasty alone and those undergoing myringoplasty with mastoidectomy.[26]They observed that there was no significant difference between the two groups in relation to pressure normalization.

During a study of acoustic impedance in posterosuperior retraction pockets and post tympanoplasty patients , Sudhir Bahadur[27] has reported that 60% of grafted ear drums reveal a type B curve.This doesnot necessarily indicate the presence of middle ear fluid ; it has been attributed to stiffness of the drum.

Yetiser et al[28] performed revision myringoplasties using solvent dehydrated dura mater and studied the the healing rate and compliance post

operatively. They concluded that the resulting stability and compliance were almost similar to normal.

Comprehensive studies are further needed to evaluate the factore affecting post surgical tympanometry after various middle ear and mastoid surgeries and to look for its practical implications.

MATERIALS AND METHODS

This study was carried out in the Department of ENT, Coimbatore Medical College Hospital from February 2010 to October 2011.

A total of 50 patients with chronic suppurative otitis media – tubotympanic type were included in the study. The following criteria were used for selection of patients.

INCLUSION CRITERIA :

1.Unilateral CSOM with ear dry for at least 3 months.

2.Large central perforation with medialised handle of malleus.

3.Tympanogram of the other ear – A type curve.

4.Age between 11years and 60 years.

5.No other external ear, middle ear or inner ear pathology.

EXCLUSION CRITERIA :

1. Presence of active ear discharge.
2. Hearing loss with air bone gap more than 45 dB
3. History of previous ear surgery.
4 Tympanosclerosis.
5. State of middle ear mucosa – unhealthy or polypoidal.

6. Uncontrolled systemic diseases which affect the healing process.

A total of 50 patients attending the outpatient department who met the above criteria were selected. After eliciting their complaints and history, they were subjected to detailed clinical examination of the ear ,nose and throat. The size , site of perforation , status of middle ear mucosa , position of handle of malleus were examined using otoscope and findings documented .Clinical findings were confirmed by examination under microscope.Tuning fork tests were done using 512 Hz tuning fork and findings recorded.

All patients were subjected to pure tone audiometry, and graphical recordings of their hearing thresholds were made and pure tone averages calculated.X ray mastoids both sides lateral oblique view were taken for each patient. Diagnostic nasal endoscopy was done to rule out rule out nasal and nasopharyngeal foci of infection and to assess the pharyngeal end of the Eustachian tube.

Systemic examination and investigations were done to assess fitness for surgery.Patients were explained about the surgery and informed written consent was obtained.

Patients were assigned into two groups randomly : control group and study group , each consisting of 25 patients.

OPERATIVE PROCEDURE :

Patients belonging to the control group were planned for myringoplasty by the post auricular approach under general anaesthesia.

After area preparation, sterile draping and local infiltration with 2% lignocaine and 1 in 200000 adrenaline ,Sir William Wilde post auricular incision made; temporalis fascia graft harvested.The margins of the perforation were freshened; canal wall incisions made at 6 o clock and 12 o clock positions; tympanomeatal flap elevated.Status of middle ear and ossicular chain inspected ;malleus handle skeletonised.Canalplasty done wherever necessitated. The harvested temporalis fascia graft shaped to the size appropriate for the perforation and placed medial to drum remnant and to malleus handle over gelfoam bed.Tympanomeatal flap repositioned ;ear wick placed in the external auditory canal.Post auricular wound closed in layers ;mastoid dressing applied ;patient weaned from anaesthesia.

Patients belonging to the study group were planned for myringoplasty with tensor tympani tendon release.

Steps similar to the control group were carried out ; in addition , after elevation of the tympanomeatal flap and skeletonisation of the malleus handle, the tensor tympani tendon was identified and cut using angled micro ear scissors

with endoscopic assistance if necessary , and lateralization of the malleus confirmed. Rest of the procedure completed.

POST OPERATIVE COURSE :

Patients belonging to both the study and control groups were treated similarly post operatively with parenteral antibiotics for 7 days , dressing change periodically, suture removal and ear wick removal on the 6th post operative day.They were discharged on the 6th post operative day after ensuring that the post aural wound was healthy and no abnormal ear discharge. Patients were asked to keep the ear dry and given oral antibiotics for a week.

ASSESSMENT OF RESULTS :

Patients were reviewed at intrevels of 1 week , after 1 month , then after 3 months. The graft take up was recorded in the 1st month.At the end of the 3rd momth , the graft status was again looked for ; subjective hearing improvement was enquired and recorded. Graft mobility was checked. Patients were subjected to pure tone audiometry and tympanometry with regard to :

- Air bone gap after surgery
- Type of the tympanogram
- Middle ear compliance and pressure at maximal compliance

The results were tabulated and analysed statistically using the Chi square test and conclusions drawn.

TABLE 1

AGE DISTRIBUTION OF CHOSEN PATIENTS

AGE GROUP (years)	NO.OF PATIENTS IN CONTROL GROUP	NO.OF PATIENTS IN STUDY GROUP	TOTAL NO. OF PATIENTS
11 – 20	6	1	7
21 – 30	5	12	17
31 – 40	11	3	14
41-50	2	5	7
51-60	1	4	5
TOTAL	**25**	**25**	**50**

CHART 1

AGE DISTRIBUTION OF CHOSEN PATIENTS

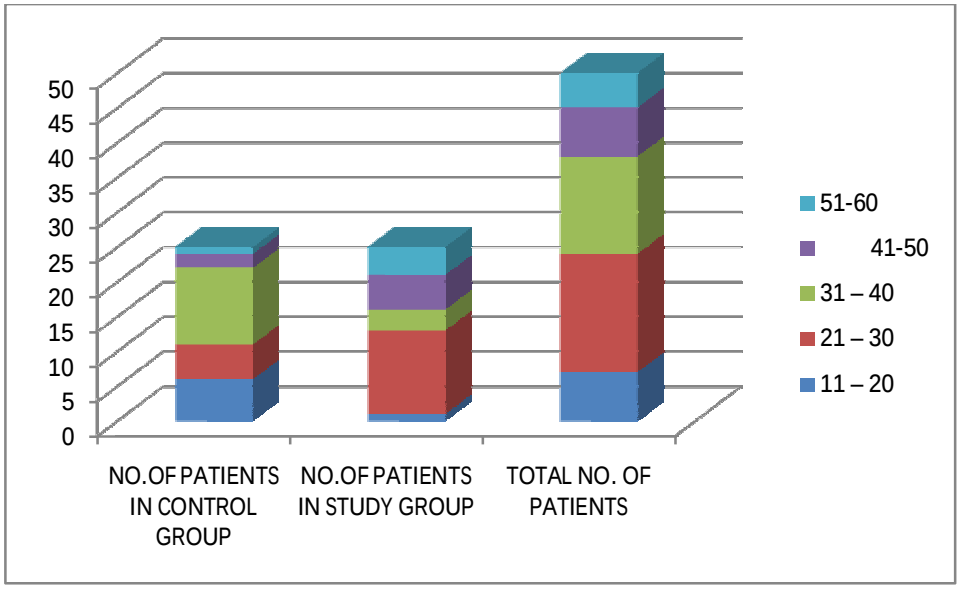


TABLE 2

GENDER DISTRIBUTION OF CHOSEN PATIENTS

GENDER	NO.OF PATIENTS IN CONTROL GROUP	NO.OF PATIENTS IN STUDY GROUP	TOTAL NO.OF PATIENTS
MALE	7	5	12
FEMALE	18	20	38
TOTAL	**25**	**25**	**50**

CHART 2

GENDER DISTRIBUTION OF CHOSEN PATIENTS

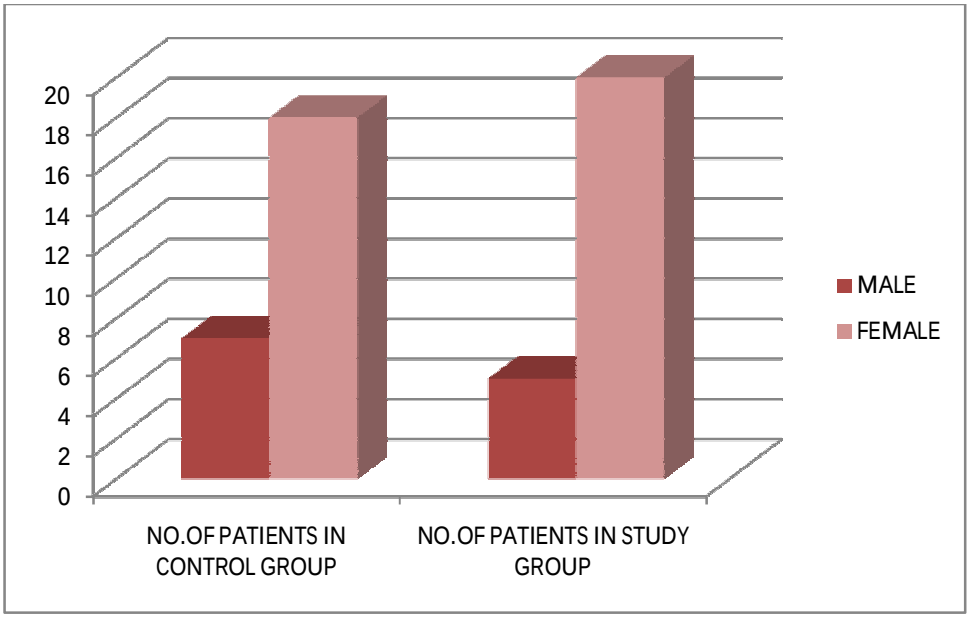


TABLE 3

POST OPERATIVE GRAFT TAKE UP

GROUP	GRAFT TAKEN UP (NO. OF PATIENTS)	GRAFT NOT TAKEN UP (NO.OF PATIENTS)	% SUCCESS
CONTROL GROUP	22	2	91.6
STUDY GROUP	20	3	86.9
TOTAL	42	5	87.5

Chi-Square = 0.224 P > 0.05

CHART 3

POST OPERATIVE GRAFT TAKE UP

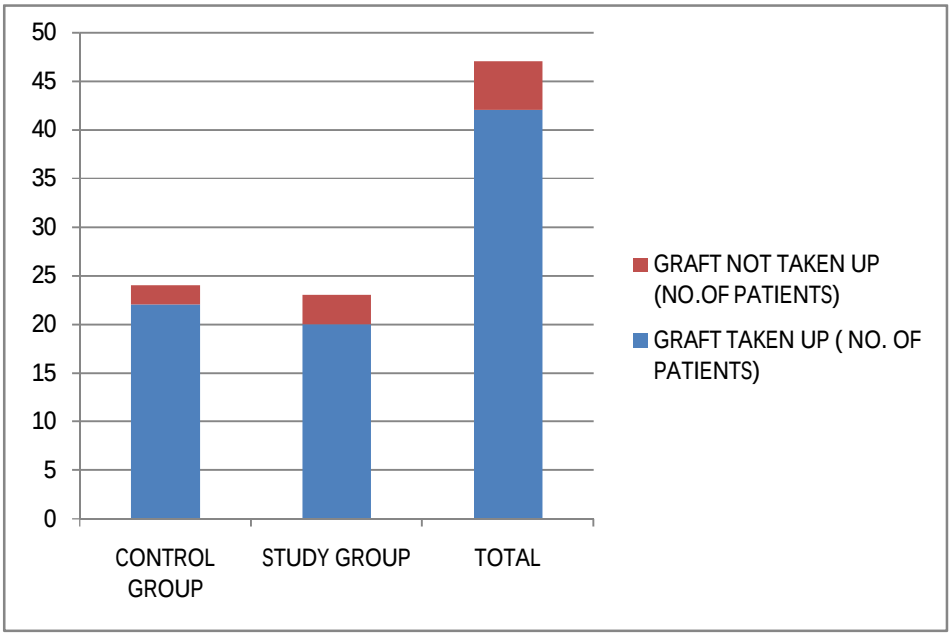


TABLE 4

COMPARISION OF POST OPERATIVE AUDIOGRAM RESULTS

POST OPERATIVE AIR BONE GAP(dB)	CONTROL GROUP	STUDY GROUP	TOTAL,
UPTO 10	5	8	13
11- 20	13	10	23
ABOVE 20	4	2	6
TOTAL	**22**	**20**	**42**

Chi-Square = 1.66 $p > 0.05$

CHART 4

COMPARISION OF POST OPERATIVE AUDIOGRAM RESULTS

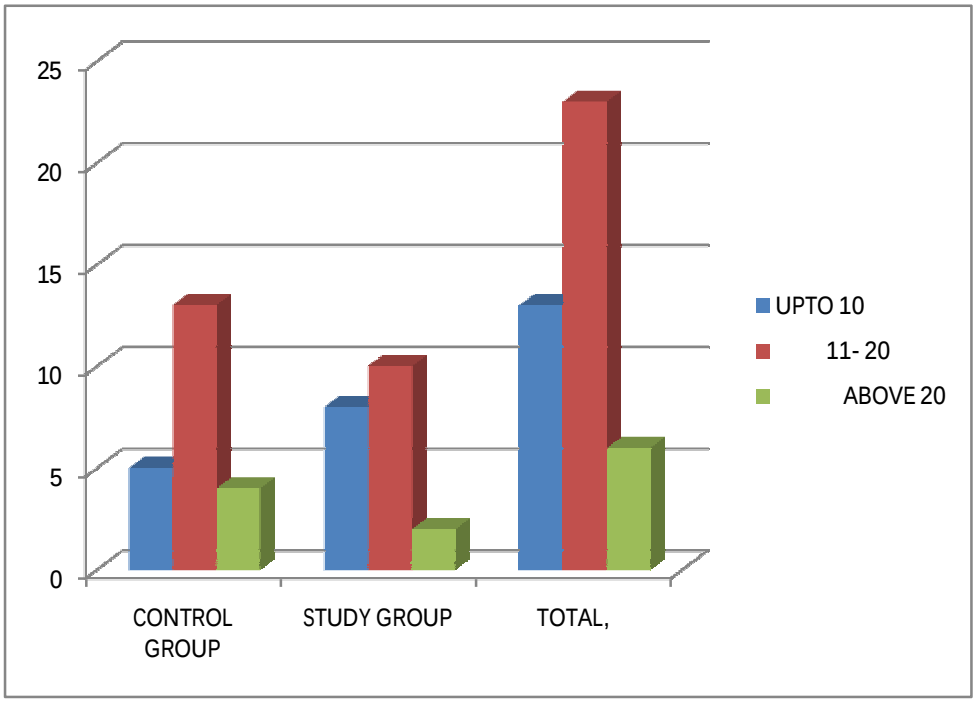


TABLE 5

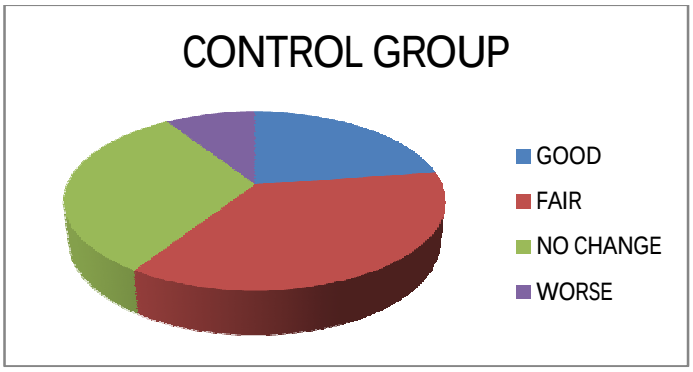
COMPARISON OF SUBJECTIVE HEARING IMPROVEMENT

PATIENT'S RESPONSE	CONTROL GROUP	STUDY GROUP	TOTAL
GOOD	5	13	18
FAIR	8	4	12
NO CHANGE	7	2	9
WORSE	2	1	3
TOTAL	**22**	**20**	**42**

Chi-square = 7.92 ; $p < 0.05$

CHART 5

COMPARISON OF SUBJECTIVE HEARING IMPROVEMENT



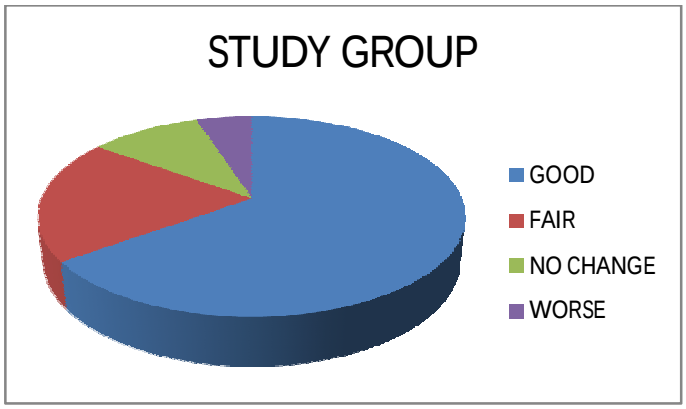


TABLE 6

POST OPERATIVE TYMPANOGRAM CURVES

TYPE OF CURVE	CONTROL GROUP	STUDY GROUP	TOTAL
A	2	3	5
A_S	5	13	18
B	15	4	19
TOTAL	**22**	**20**	**42**

CHART 6

POST OPERATIVE TYMPANOGRAM CURVES

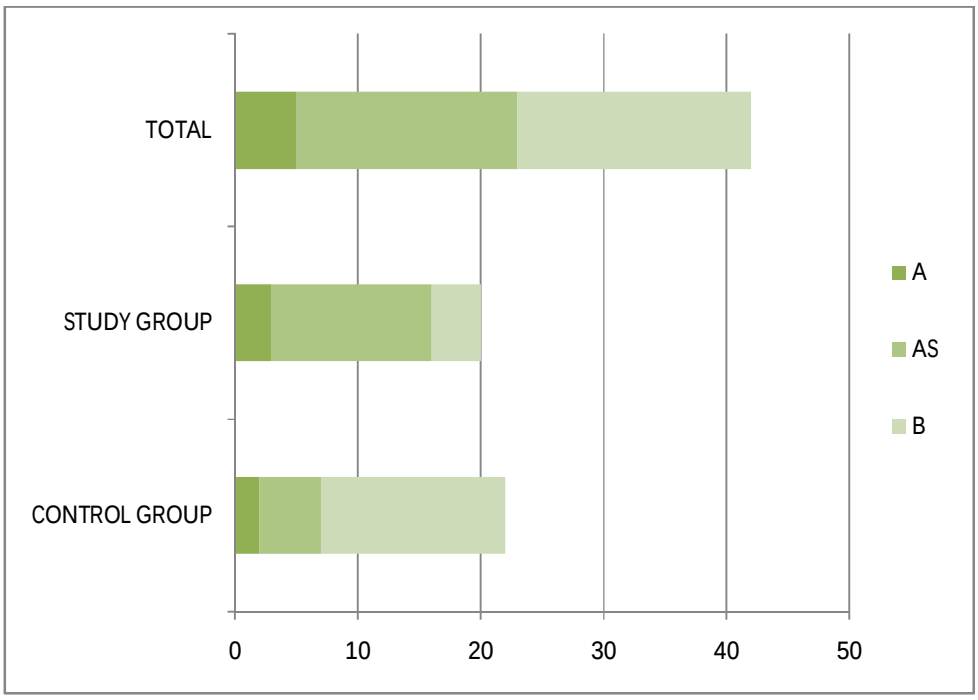


TABLE 7

COMPARISION OF POST OPERATIVE GRAFT MOBILITY

MOBILITY	CONTROL GROUP	STUDY GROUP	TOTAL
MOBILE	7	15	22
NOT MOBILE	15	5	20
TOTAL	**22**	**20**	**42**

Chi-Square = 8.507 ; $p < 0.05$

CHART 7

COMPARISION OF POST OPERATIVE GRAFT MOBILITY

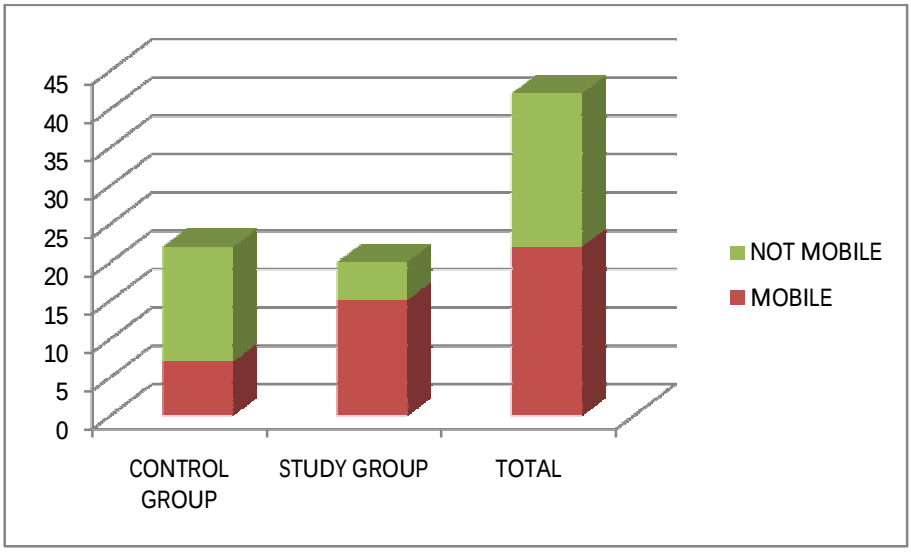


TABLE 8

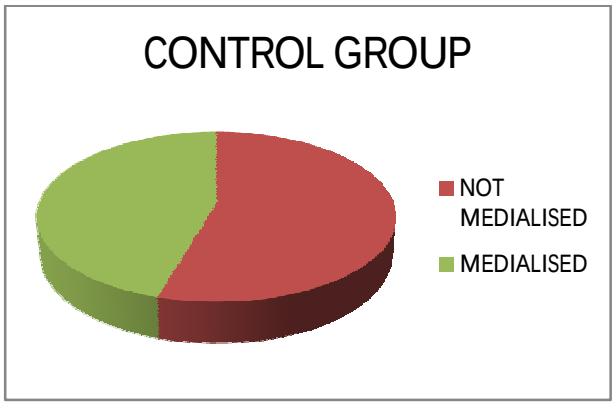
COMPARISION OF POST OPERATIVE GRAFT MEDIALISATION RATES

GRAFT MEDIALISATION	CONTROL GROUP	STUDY GROUP	TOTAL
NOT MEDIALISED	12	17	29
MEDIALISED	10	3	3
TOTAL	22	20	42

Chi-Square = 4.948 $p < 0.05$

CHART 8

COMPARISION OF POST OPERATIVE GRAFT MEDIALISATION



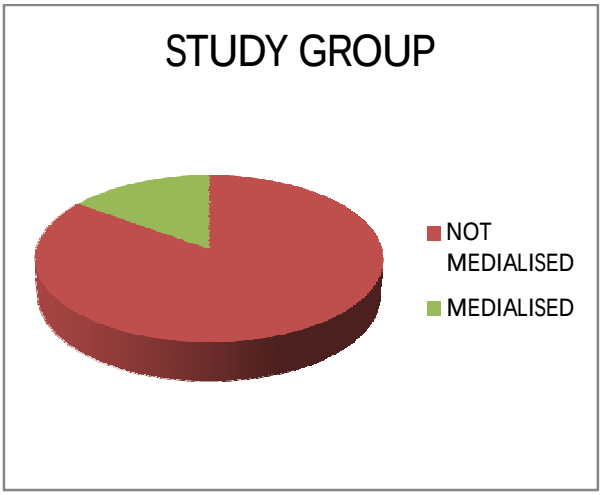


TABLE 9

COMPARISION OF POST OPERATIVE COMPLIANCE

COMPLIANCE (ml)	CONTROL GROUP	STUDY GROUP	TOTAL
Not measurable	15	4	19
Near normal range	7	16	26
Higher range.	Nil	Nil	0
TOTAL	22	20	42

Chi-square = 5.784 ; $p < 0.05$

CHART 9

COMPARISION OF POST OPERATIVE COMPLIANCE

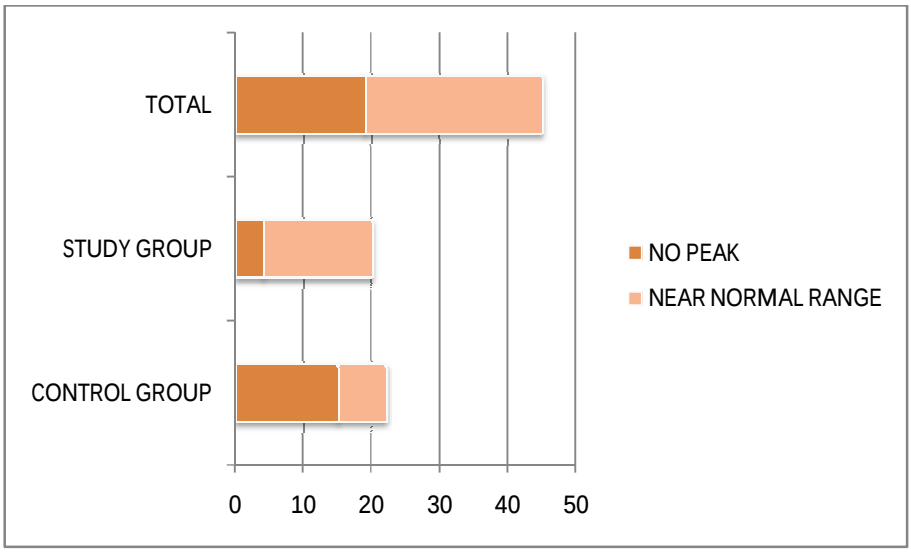


TABLE 10

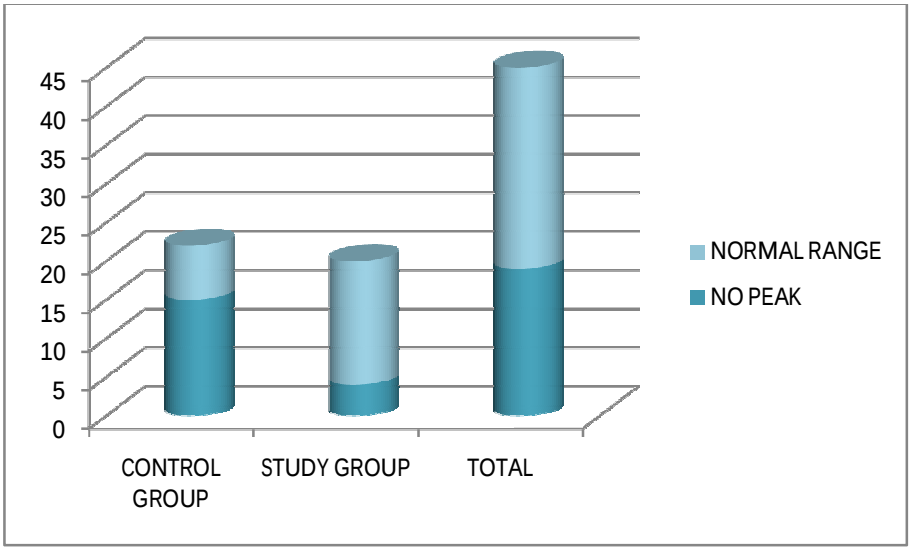
COMPARISON OF POST OPERATIVE MIDDLE EAR PRESSURES

MIDDLE EAR PRESSURE RANGE	CONTROL	STUDY	TOTAL
NO PEAK	15	4	19
NORMAL RANGE	7	16	26
HIGH	Nil	Nil	Nil
TOTAL	22	20	42

Chi-square = 5.784 $p < 0.05$

CHART 10

COMPARISON OF POST OPERATIVE MIDDLE EAR PRESSURES



RESULTS AND OBSERVATIONS

Out of the 50 patients who were included in the study , the mean age in the control group was 29.96 years (with standard deviation 11.9) which ranged be`tween 11- 55years.In the study group it was 34.36 years (standard deviation 13.8) ranging between 18 -60 years (p >0.05).

With regard to the gender distribution , the overall proportion of female and male patients were 76 % and 24% respectively.(72% females and 28% males in the control group ; 80 % females and 20 % males in the study group).

Three patients did not come for follow up (two in the study group and one in the control group) and their outcome couldnot be assessed.

The overall graft success rate was 87%(42 out of 47 grafts were found to have been taken up.In the control group 22 grafts were successful and 2 were not (92% and 8%).In the study group , the corresponding values were 22 and 3 respectively. (88 % and 12 %).The difference was found to be statistically insignificant.

The mean pre operative air bone gap of the control group was 37.59 dB and the study group was 36.85 dB. The post operatinve mean air bone gaps of the study and control groups were 14.55Db (SD :5.13) and 16.45 dB (SD 5.36)respectively.22.7% of control group patients and 40% of study group patients had a postoperative air bone gap less than 10 Db; 59% of patients

belonging to the control group and 50% of patients belonging to the study group had postoperative air bone gap in the range 11-20 dB. The percentage of control and study group patients having more than 20dB postoperative air bone gap was 18% and 10% respectively. There was no significant difference with regard to audiological outcome in both the groups $p > 0.05$.

With regard to subjective hearing improvement ,it was observed that 65% of study group patients and 22.7% of control group patients reported their hearing improvement as 'good'; 20% of study population and 36.36% of controls reported hearing improvement as fair; 10% of patients who underwent tensor tympani release and 31% of those whose tendons were not released reported no significant subjective hearing improvement; 5% and 9% respectively reported worsening. This difference in subjective hearing was statistically significant.($p < 0.05$).

The shape of the post operative compliance curves for the two groups were as follows : 9 % of control group patients and 15% of patients belonging to the study group had type A curve 22% and 65% had type As curves respectively; 68% patients belonging to control group and 20% of study population were found to have type B curves. These differences were found to be statistically significant ($p < 0.05$).

The proportion of control group patients having post operative compliance and middle ear pressures in the near normal range was 31%

whereas 80% of patients belonging to the study group had compliance in the optimal range($p<0.05$ -significant.)

Post operatively, 32% of patients in the control group had mobile neomembranes, whereas 75% of study group patients' grafted membranes had good mobility. This was statistically significant.($p< 0.01$).

Similarly , with regard to graft medialisation at the end of 3 months ,it was observed that 45 % of grafted membranes of the control group became medialised ,whereas ,the same occurred in 15% of patients belonging to the study group.($p< 0.01$).

DISCUSSION

Over the years, numerous modifications and refinements in the techniques of myringoplasty[29,30,31] have been suggested by otologists from time to time with a view to further enhance its results.[32]

This study is an attempt at evaluating the various implications of a single additional step – tensor tympani release during myringoplasty for large central perforations.

In our study , patients with similar clinical presentations were randomly designated into two groups so that selection bias is avoided. We aimed to eliminate the confounding factor of Eustachian tube dysfunction (which , by itself might affect middle ear status [33,34])to a certain extent by the following way: only patients with type A tympanograms on the normal side were included and presence of paranasal sinus pathology was ruled out by diagnostic nasal endoscopy.

Incidentally , a majority of our patients in both the groups happened to be females, reflecting the outpatient trends in our department. But gender difference has been shown not to affect the results of myringoplasty as per the study by Ashfaq et al.[35,36]

Patients from a wide age range 11 – 60 years were included. Extremes of age were avoided because of the possibility of existence of underlying septic foci in children , and the coexistence of sensorineural loss in the elderly.

The overall graft success rate in our study was 87 %.Tensor tympani tendon release was found not to affect the graft take up. This was comparable to a study result by Gersdorff et al [37] who reported closure rates of 87.7%.Rehman et al reported success rates in large central perforations as 83.3%..The closure rate for sub total perforations as reported by Yung [38] in his series of patients was higher than in our study – 92.5%. On the other hand , J.H.Black et al analysed the results of myringoplasties in children and obtained an overall graft take rate of 75.3%.[39]

On comparision , the mean post operative air bone gap of both the groups (14.55 Db in the control group and 16.45 Db in the study group) was found to be statistically insignificant , even though a higher proportion of study group patients had relatively lower post operative air bone gap. This observation was to be expected because graft medialisation rather than causing short term audiological changes , is more likely to cause implications in the long run.

On observing the patients' responses regarding subjective status of hearing during the third month, a significant proportion of study group patients reported as having good/fair improvement when compared to controls. This fact is of practical importance in day to day routine even though not documented

audiologically.This can be possibly attributed to the relatively better efficiency of the middle ear transmission in patients who underwent release.

The mean post operative air bone gap obtained in our study was similar to the range 11 – 14 Db reported by Choi et al [39] in their study on the effect of Eustachian tube function on myringoplasty results.

The post operative tympanogram curves were found to be of the As type in 65% of study patients as against 22% of controls., suggesting that tensor tympani release significantly helps in keeping the middle ear status similar to normal physiology.Even though the ideal A curve is not obtained after release, this As curve is an improvement compared to the B curve , and probably represents a transitional state where further follow up might reveal its progression to the ideal A curve over time.

During their study on the prognostic factors in tympanoplasty, Silvu Abu and colleagues [40] emphasized the key role of the handle of malleus in predicting outcomes of middle ear reconstructive surgery[41]. When the manubrium is in the usual position , it allows the proper adaptation of the myringoplasty graft and optimizes the stability of the ossicular chain.

This is the situation occurring when malleus medialisation is prevented.The fact that in our study , only 15% of study group patients went in

for graft medialisation when compared to 45% in the control group suggests that this favourable outcome is important in the long run.

Post operative graft mobility is one factor which reflects the similarity of the neomembrane and the natural tympanic membrane. Our study showed that a significant proportion (75%) of patients who underwent tensor tympani tendon release had mobile neomembranes reflecting better middle ear ventilation.

Despite our concerns about intolerability to loud sounds post operatively in patients who had tensor tympani release, there were no such specific complaints from the patients. This can probably be attributed to the study results of Howell that mainly the stapedius but not the tensor tympani plays a vital role in attenuation.

Jonndorf,Khanna and Greenfield [42] studied the vibrational displacement patterns of grafted tympanic membranes 6-7 months after grafting. They found that the neomembranes were not adequately mobile and coupling to the manubrium was poor.This aspect would be found to improve upon release of the tensor tympani tendon.

On the whole,the observations reflect restoration of middle ear function to a comparatively better physiological state in the study group.

SUMMARY

This was an experimental randomized control study involving 50 patients who attended the outpatient department of our instituton who had tubotympanic type of CSOM with large dry central perforation.They were designated into two groups – study and control with regard to the release of tensor tympani tendon during myringoplasty.Out of 47 patients (94%) who came for regular follow up ,the following trends were noted.

The graft take up rate was 87% overall, with no significant difference between control (92%) and study group.(88%).The mean post operative air bone gap in the control and study groups were 14.5dB and 16.45dB respectively, reflecting no significant difference.

Subjective post operative hearing was better in patients who underwent tensor tympani release when compared to the control group (65% reported that their post operative hearing was 'good' compared to 22% of the controls).

With regard to compliance curves after surgery, out of patients who underwent tensor tympani release, 65 % had type A_S curve , 15% had A type curve and 20% had type B curve as against the control group in which 22 % had type As curve and, 9% had type A curves 68% had type B curves.

The rates of graft medialisation and non mobility of the neomembrane were higher in the control group.(45% medialisation and 68 % non mobility in

patients without tensor tympani release , and 15 % medialisation and 25 % non mobility in patients who underwent tensor tympani release.).

80% of patients who underwent tensor tympani release had near normal range of post operative compliance as against 32% of patients without release.

CONCLUSION

From the study , it is evident that release of the tensor tympani tendon during myringoplasty for large central perforations with medialised handle of malleus has a beneficial effect in establishing post operative middle ear compliance in the range of normalcy, thereby ensuring efficient middle ear function.

Even though it doesnot significantly alter the extent of air bone gap closure at 3 months post operatively , an extended period of follow up is needed to estimate the ultimate audiological outcome.As far as medialization of the graft is concerned , tensor tympani release has a definite role in prevention of this complication.

A limitation of this study is that the period of follow up is inadequate to assess whether re – fibrosis or adhesions occur in the released tendon which might reverse the beneficial effects of release.The long term effects of the loss of attenuation function of the tensor tympani component also remain to be worked out.

With the available evidence , this procedure is worth trying in cases with definite malleus handle retraction, as this single additional step is found to significantly modify the surgical outcome in a benificial manner to a considerable extent. Further studies are needed to quantify its surgical

implications in the long run before it can be incorporated routinely during indicated cases of myringoplasty in a standardized manner.

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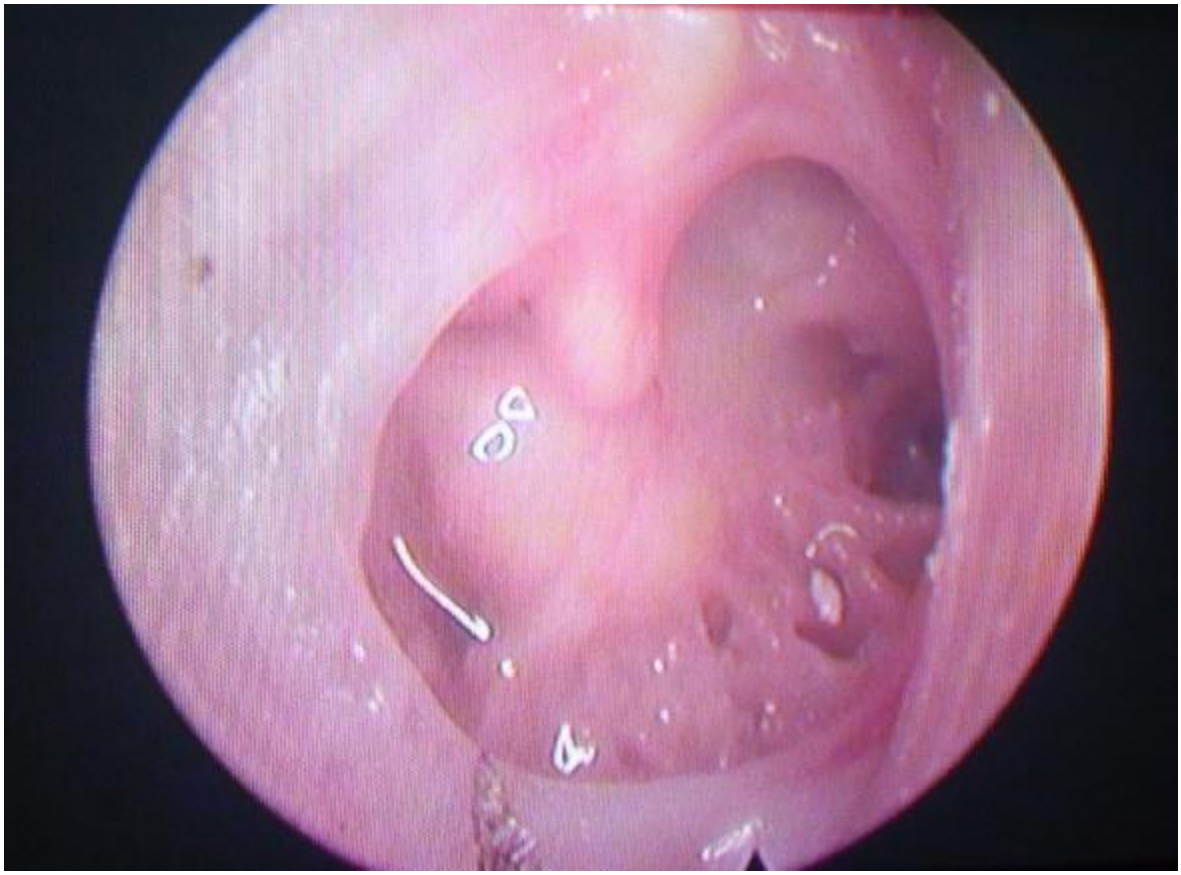
LARGE CENTRAL PERFORATION WITH MEDIALISED HANDLE

(1)

(2)

(3)



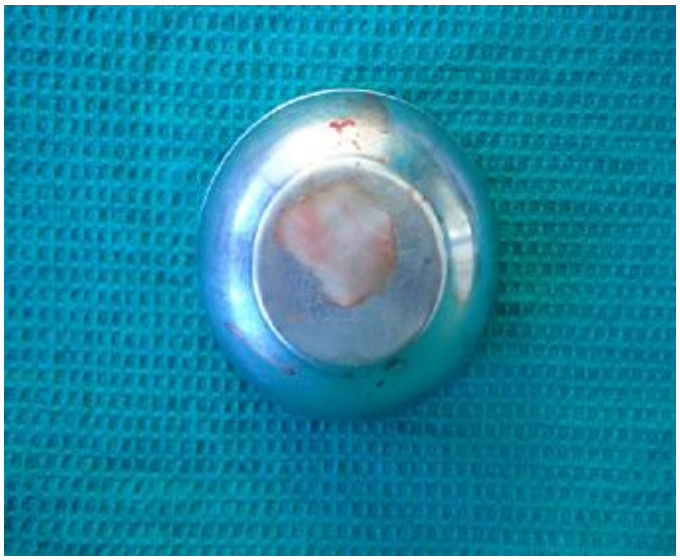
STEPS OF THE PROCEDURE

AREA PREPARATION

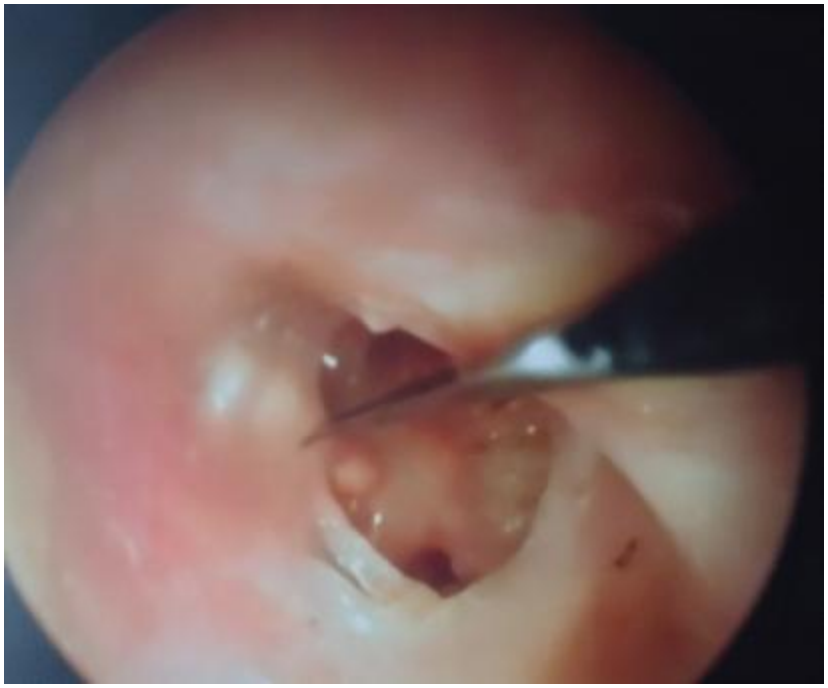
POST AURICULAR INCISION

TEMPORALIS FASCIA EXPOSED

GRAFT BEING PREPARED



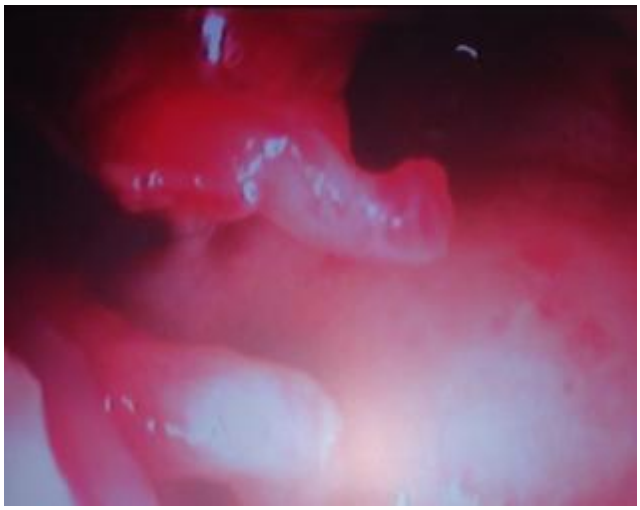
FRESHENING OF PERFORATION MARGINS



FLAP ELEVATION

MALLEUS HANDLE SKELETONISATION

TENSOR TYMPANI TENDON EXPOSED

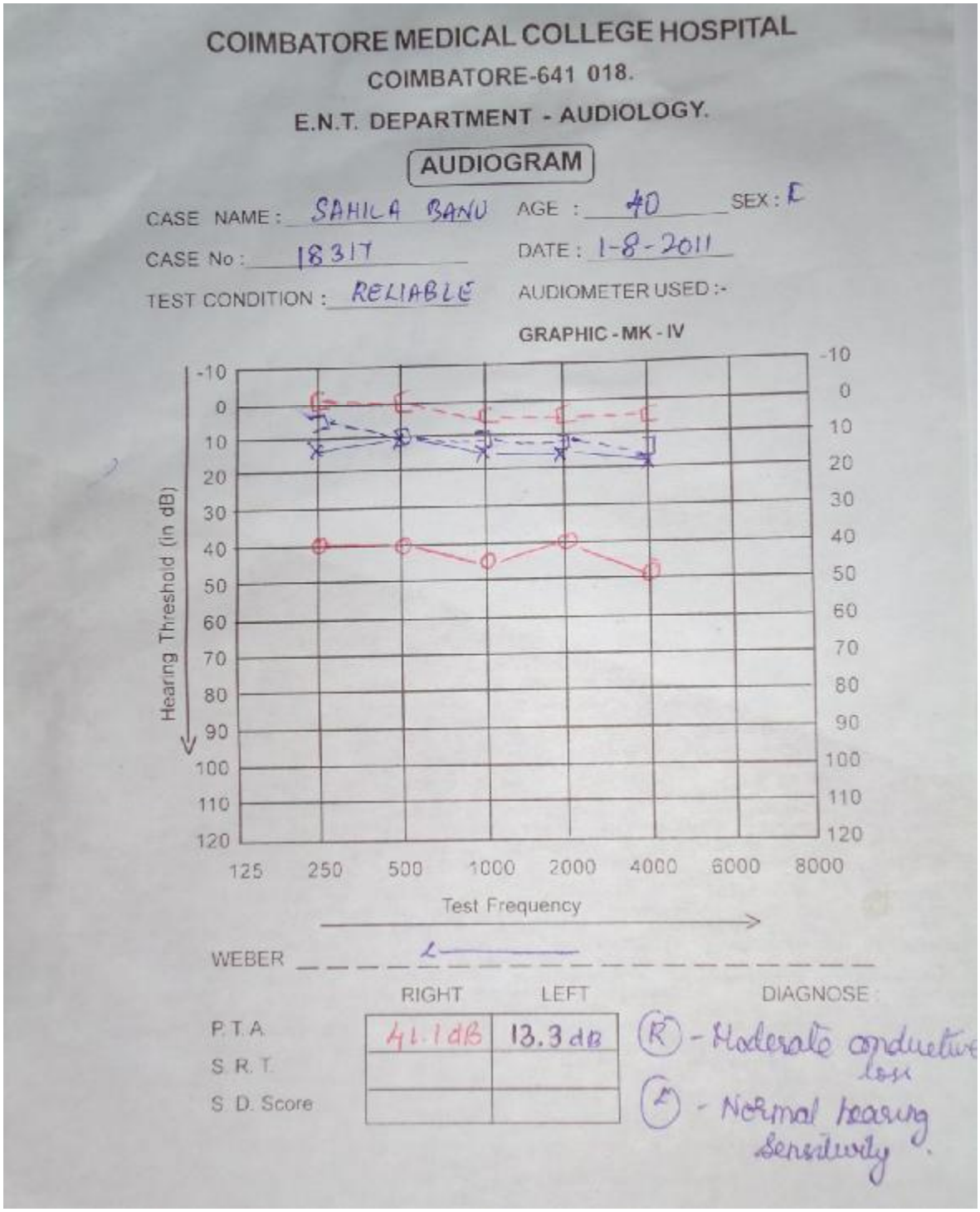


MALLEUS HANDLE AFTER TENSOR TYMPANI RELEASE

CLOSURE

GRAFT TAKEN UP

PRE OPERATIVE AUDIOGRAM – CONTROL GROUP



COIMBATORE MEDICAL COLLEGE HOSPITAL

COIMBATORE-641 018.

E.N.T. DEPARTMENT - AUDIOLOGY.

AUDIOGRAM

CASE NAME : SAHILA BANU AGE : 40 SEX : F

CASE No : 18317 DATE : 1-8-2011

TEST CONDITION : RELIABLE AUDIOMETER USED :-

GRAPHIC - MK - IV

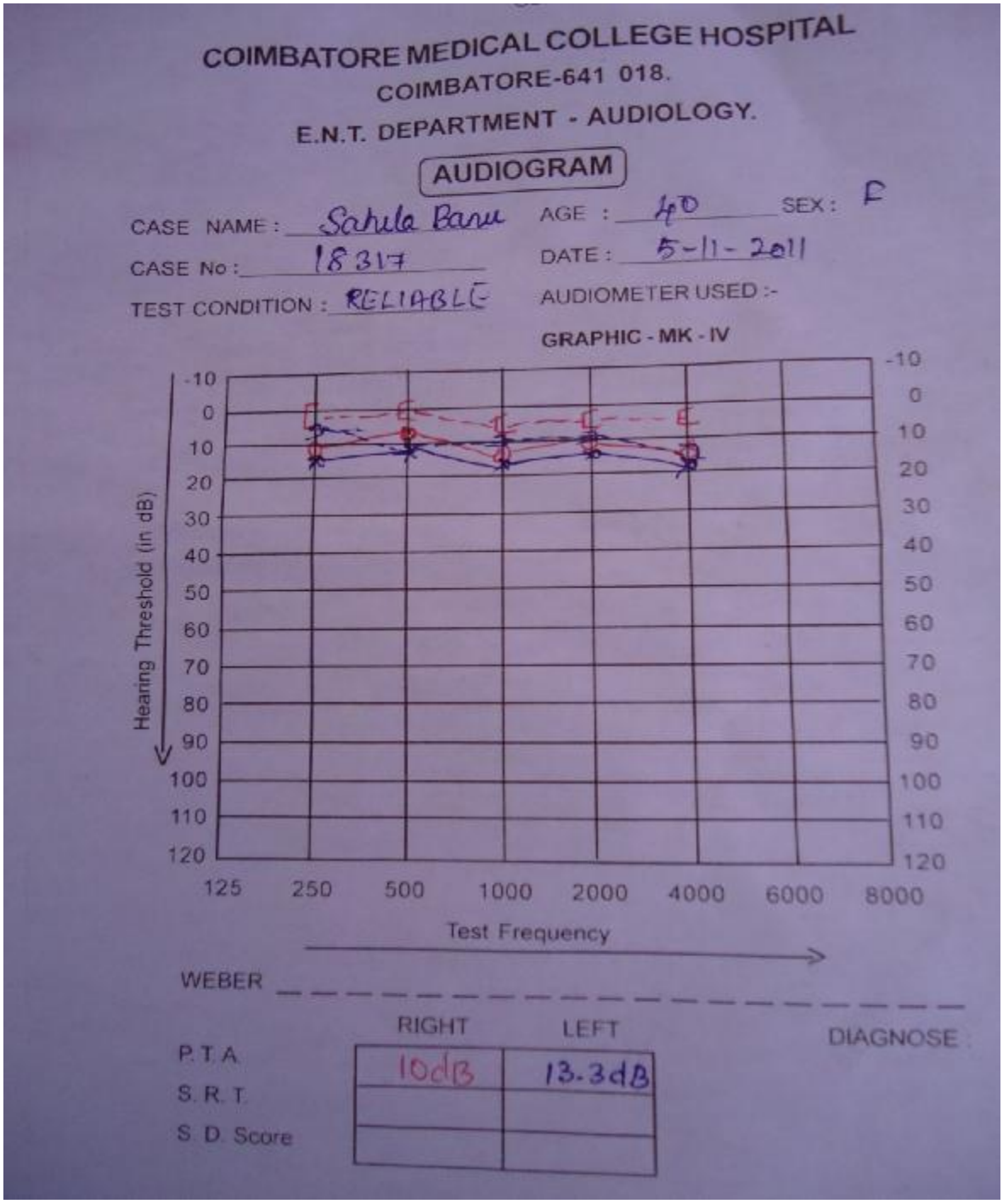
	RIGHT	LEFT
P.T.A.	41.1 dB	13.3 dB
S.R.T.		
S.D. Score		

DIAGNOSE :

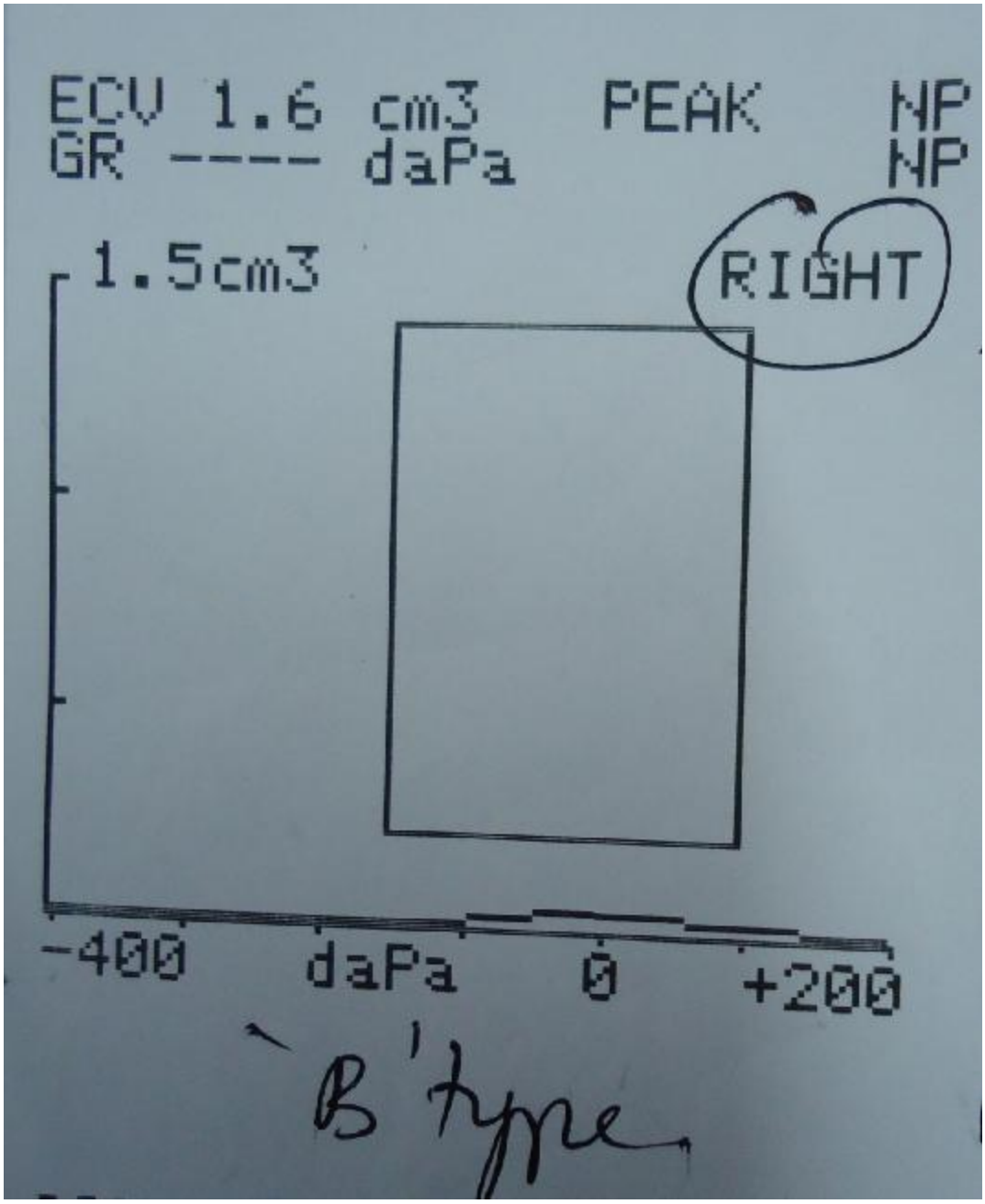
(R) - Moderate conductive loss

(L) - Normal hearing sensitivity.

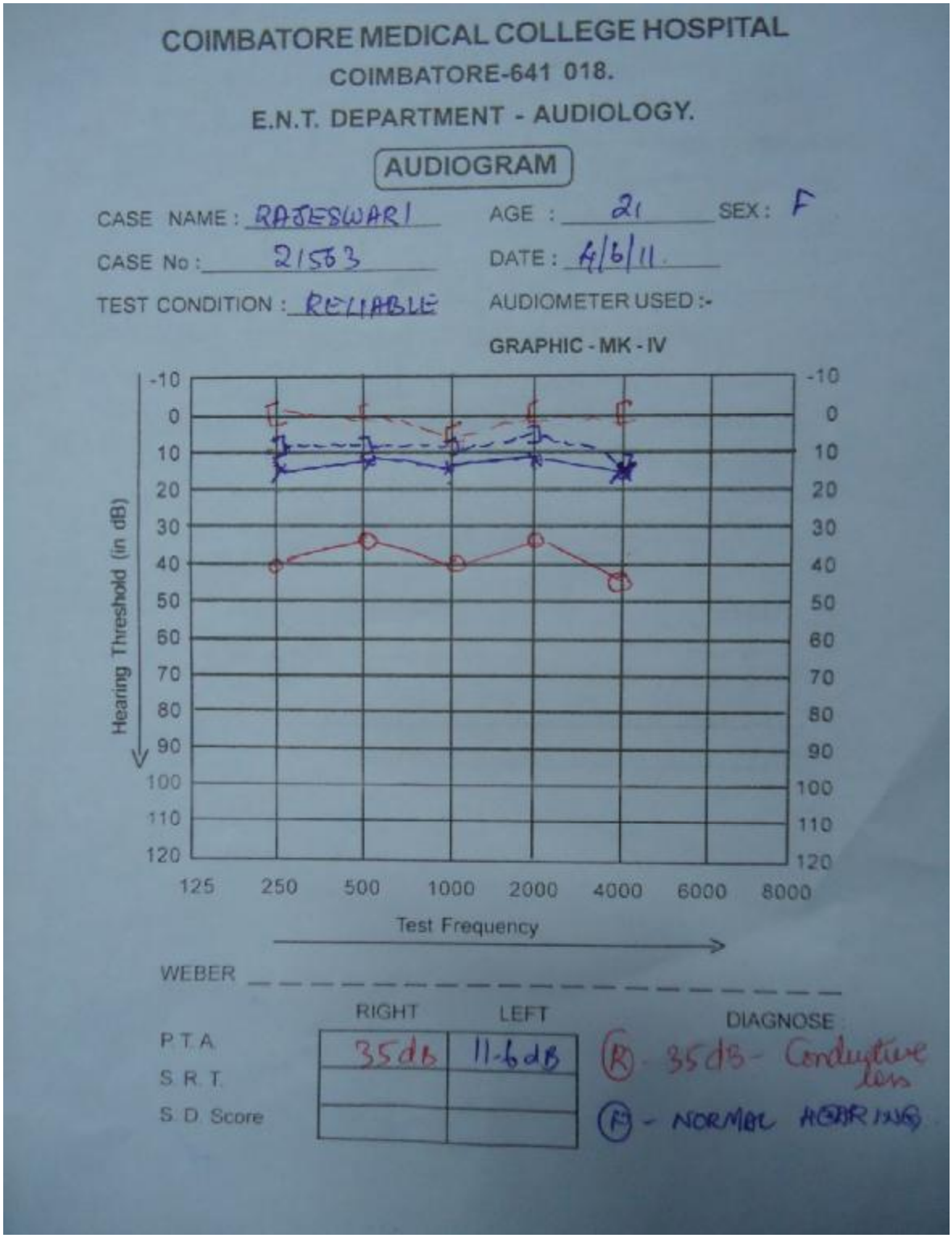
POST OPERATIVE AUDIOGRAM – CONTROL GROUP



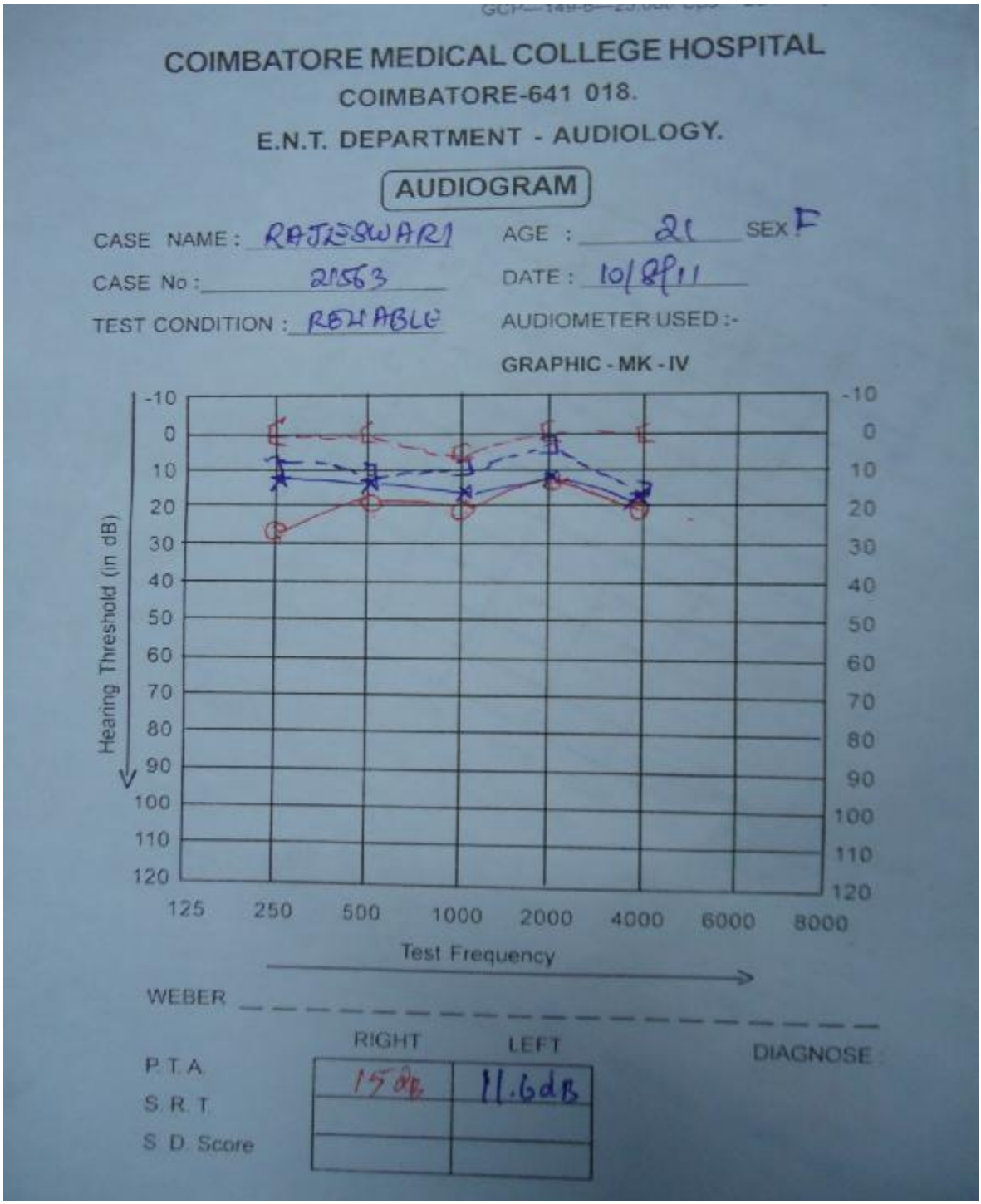
POST OPERATIVE TYMPANOGRAM – CONTROL GROUP



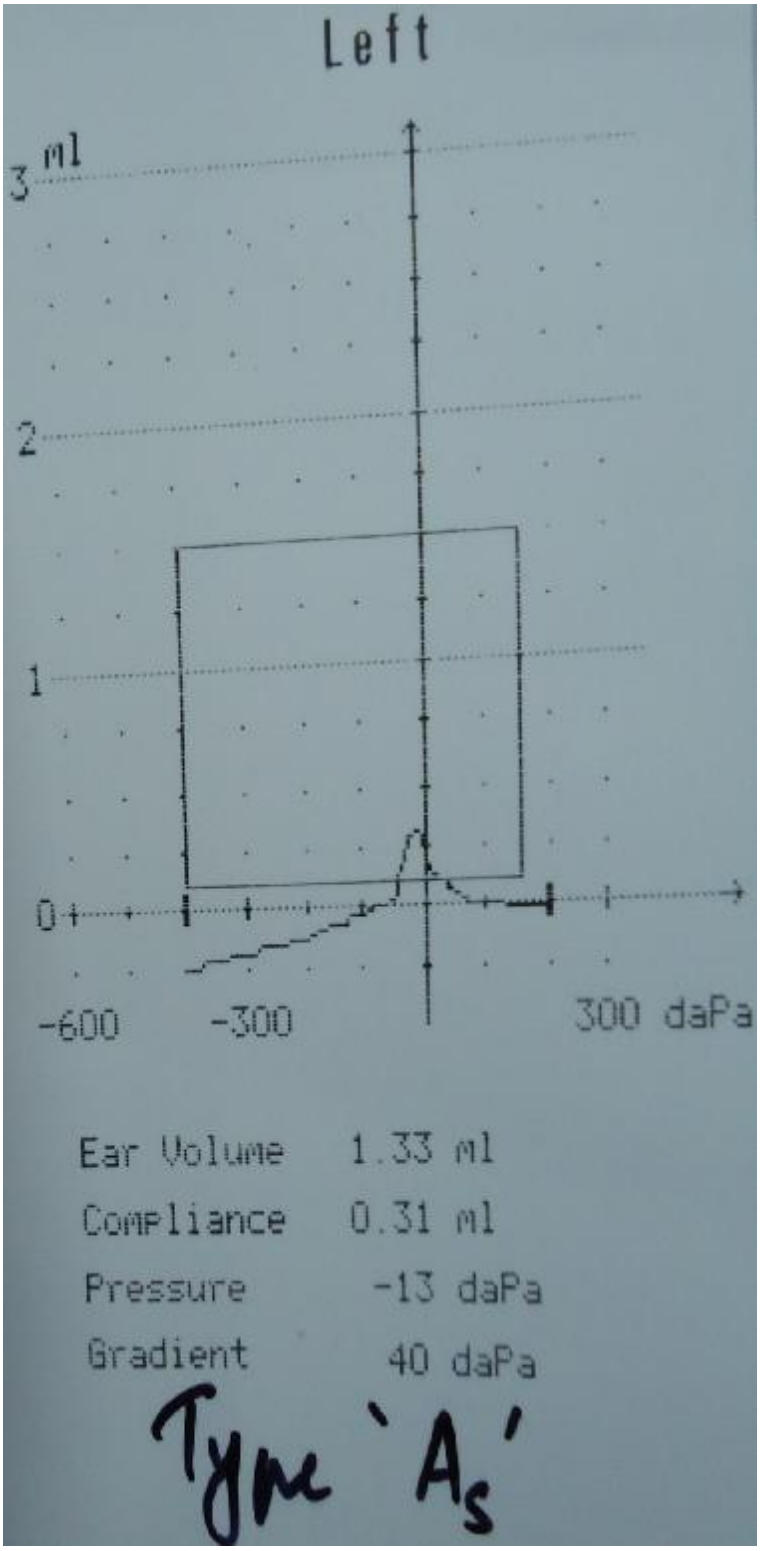
PRE OPERATIVE AUDIOGRAM – STUDY GROUP



POST OPERATIVE AUDIOGRAM – STUDY GROUP



POST OPERATIVE TYMPANOGRAM –STUDY GROUP



PROFORMA

NAME :

AGE :

SEX :

IP NUMBER :

COMPLAINTS

- Ear discharge
- Hard of hearing
- Ear pain
- Tinnitus / vertigo
- Nasal symptoms

HISTORY OF PRESENT ILLNESS :

- Ear discharge
- duration
- quantity
- colour
- whether foul smelling/ blood stained
- duration for which ear is dry
- Hard of hearing
- degree of hard of hearing
- onset

- progression
- tinnitus : present / absent
- vertigo : present / absent
- otalgia
- nasal symptoms :
- obstruction
- discharge

PAST HISTORY :

- Systemic diseases – diabetes ,hypertension, tuberculosis
- History of trauma
- Noise exposure
- Previous ear surgery / nasal surgery
- Ototoxic drugs

PERSONAL HISTORY :

- Occupation
- Socioeconomic status
- Smoking

EXAMINATION

- GENERAL EXAMINATION :
- VITAL SIGNS : pulse , temperature ,blood pressure
- SYSTEMS :

  CVS

  RS

  CNS

  ABDOMEN

OTOLOGICAL EXAMINATION:

	RIGHT	LEFT
PRE AURICULAR REGION		
PINNA		
POST AURICULAR REGION		
EXTERNAL AUDITORY CANAL		
TYMPANIC MEMBRANE		
PARS TENSA :		
Perforation		

Site

Size

- Condition of middle ear mucosa
- Any obvious ossicular erosion
- Malleus handle medialised or not

If membrane intact :

- Lustre
- Cone of light: absent/ present/distorted
- Mobility

PARS FLACCIDA

Mastoid tenderness

Facial nerve

Fistula test

TUNING FORK TESTS

Rinne

Weber

Absolute bone conduction

Nasal cavity :

- Anterior rhinoscopy
- Post nasal examination
- Sinus tenderness

Oral cavity and oropharynx :

INVESTIGATIONS

- Pure tone audiogram :
    - type of loss
    - pre operative air bone gap
- Tympanometry of the other ear
- Xray mastoids
- Diagnostic nasal endoscopy

Others :

Blood counts , blood sugar , urea , chest Xray , ECG , urine examination

PER OPERATIVELY :

- Side of operaterd ear
- Anesthesia
- Tensor tympani – released or not

- Ossicular status
- Canalplasty done or not

POST OPERATIVELY :

- Facial nerve function
- Giddiness / vomiting

1 st P.O.D :

- Post auricular wound

6th P.O.D :

- Post auricular wound
- Any abnormal ear discharge

1st week review

1st month review

- Graft status – taken up or not

3 rd month review

- Graft status
- Subjective hearing impairment
- Tuning fork tests
- Otoscopy

- Graft mobility by Valsalva manouvre / Seigelisation
- Graft medialisation
- Post operative audiogram :
- Post operative air bone gap
- Post operative tympanogram :
    - Un operated ear :
    - Operated ear :
    - Shape of curve
    - Compliance (ml)
    - Middle ear pressure at maximal compliance

KEY TO MASTER CHART

D	-	Canalplasty done
ND	-	Canalplasty not done
T	-	Graft taken up
NT	-	Graft not taken up
M	-	Neomembrane mobile
NM	-	Neomembrane not mobile
ME	-	Graft medialised
NME	-	Graft not medialised
NP	-	No peak middle ear pressure
G	-	Patient's subjective hearing improvement – good
F	-	Patients subjective hearing improvement – fair
NC	-	No change in hearing
W	-	Worsening of hearing
TT REL	-	Tensor tympani released or not
GR STAT	-	Graft status
R/L	-	Right /left
GRF MED	-	Graft medialisation
A-B GAP	-	Air bone gap
PRE OP	-	Pre operative
POST OP	-	Post operative
SUBJ HEARING	-	Subjective hearing assessment

MASTER CHART

Sl No.	Age / Sex	R/L	Pre op air bone gap	TT REL. OR NOT	CANAL PLASTY DONE OR NOT	1ST MTH GRAFT STATUS	3rd Mth GRST	GFT MOB	GFT MED	POST OP A-B GAP	TYPE OF CURVE	COMPLIANCE (ML)	MIDDLE EAR PRESSURE (daPa)	SUBJ HEARING
1	28/F	L	30	NR	D	T	T	M	NME	8	A	1.0	-15	G
2	21/F	L	38	R	ND	T	T	M	NME	10	As	0.7	+ 5	F
3	52/F	L	40	R	D	T	T	M	NME	10	As	0.3	+30	G
4	30/F	L	36	NR	D	T	T	NM	ME	16	B	-	NP	W
5	47/F	L	42	R	ND	T	T	M	NME	18	A	1.4	-10	G
6	40/F	R	42	NR	ND	T	T	M	NME	10	As	0.3	-40	F
7	31/F	L	36	R	ND	NT	NT	-	-	-	-	-	-	-
8	33/F	L	34	NR	ND	T	T	NM	NME	14	B	0.3	NP	NC
9	60/F	R	36	R	ND	T	T	M	NME	12	As	0.6	-40	F
10	21/M	L	38	NR	ND	T	T	NM	NME	20	As	0.3	-5	F
11	14/F	R	35	NR	D	T	T	NM	ME	18	B	-	NP	G
12	35/F	R	33	NR	ND	T	T	M	NME	12	As	1.2	+10	F
13	45/F	L	35	NR	ND	NT	NT	-	-	-	-	-	-	-
14	44/F	L	38	R	ND	T	T	M	NME	14	A	0.4	- 80	G
15	58/F	L	38	R	ND	T	T	M	NME	10	As	.5	-30	G

16	32/F	L	40	R	D	T	T	NM	MED	8	A	0.6	0	G
17	34/F	R	33	NR	ND	NT	-	-	-	-	-	-	-	-
18	36/F	L	38	NR	ND	T	T	NM	ME	18	B	-	NP	W
19	40/F	R	40	NR	ND	LOST FOLLOW UP								
20	55/F	R	41	NR	ND	T	T	NM	NME	20	B	-	NP	NC
21	18/F	R	40	R	ND	NT	-	-	-	-	-	-	-	-
22	42/F	L	34	R	D	T	T	M	NME	14	A	1.0	-5	G
23	45/F	R	33	R	D	LOST FOLLOW UP								
24	50/F	L	30	R	ND	T	T	M	NME	15	A	0.8	+20	G
25	24/F	L	38	NR	ND	T	T	NM	ME	17	B	-	NP	NC
26	22/M	L	38	R	D	T	T	NM	ME	16	B	-	NP	NC
27	28/M	L	44	NR	ND	T	T	NM	ME	24	B	-	NP	NC
28	21/F	L	40	R	D	T	T	NM	ME	26	B	-	NP	W
29	14/M	R	36	R	D	T	T	NM	NME	10	As	0.3	-10	G
30	22/M	R	40	NR	ND	T	T	NM	ME	20	B	-	NP	NC
31	32/F	R	42	NR	ND	T	T	M	NME	18	A	0.7	0	NC
32	21/F	R	35	R	ND	T	T	M	NME	16	A	1.0	-40	G
33	22/F	L	36	R	D	T	T	M	NME	10	A	0.8	+30	G
34	24/M	R	34	NR	ND	T	T	NM	NME	8	As	0.4	-10	F
35	23/M	L	40	R	ND	T	T	NM	NME	18	B	-	NP	NC
36	16/F	L	44	NR	D	T	T	NM	ME	20	B	B	NP	NC

37	30/F	L	30	R	ND	T	T	M	NME	11	A	0.4	-15	G
38	35/F	L	40	NR	D	T	T	NM	ME	27	B	-	NP	G
39	34/F	R	36	NR	ND	T	T	M	NME	19	A	1.0	+50	F
40	40/M	R	33	R	ND	T	T	M	NME	8	As	0.4	- 20	G
41	33/F	L	34	NR	D	T	T	NM	ME	16	As	0.3	+5	G
42	16/F	R	38	NR	ND	T	T	M	NME	9	A	1.3	-10	G
43	27/F	R	33	R	ND	-	LOST FOLLOW UP							
44	44/M	L	40	NR	ND	T	T	NM	ME	10	As	0.3	-30	F
45	58/F	L	32	R	ND	T	T	NM	NME	8	A	1.2	0	G
46	29/F	R	30	R	ND	NT	NT	-	-	-	-	-	-	-
47	27/F	L	35	R	D	T	T	NM	ME	26	B	-	-5	W
48	19/F	L	40	NR	ND	T	T	NM	ME	24	B	-	NP	F
49	25/F	R	42	R	D	T	T	NM	NME	12	A	0.7	-15	F
50	11/M	R	30	NR	D	T	T	M	NME	14	A	1.4	+20	F

LIST OF ABBREVIATIONS

CSOM : Chronic suppurative otitis media

CT : Computed tomography

dB : decibel

daPa : deca Pascal

ECG : Electrocardiogram

Hz : Hertz

ml : milliliter

mm : millimeter

P.O.D :Post operative day

W.H.O :World Health Organisation

LIST OF FIGURES

LIST OF TABLES