

Original article

Study of type II Tympanoplasty using Autologous incus

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Abstract:

Introduction: Chronic otitis media (COM) is a major health problem in India, a developing country. In our country, the burden is too high (prevalence >4%) considering the huge population(1). Tympanoplasty is a surgical procedure done to repair the defect in the tympanic membrane after eradicating all the disease in the middle ear cleft with or without reconstruction of the ossicular chain. Both intact tympanic membrane and ossicular chain are essential for restoration of hearing in these cases. The most vulnerable ossicle to trauma and infectious processes is incus (5-6)

Method: A prospective, cohort, clinical study was carried out. Patients in the age group of 14-60 years attending the otorhinolaryngology outpatient department were selected. They were screened by detailed history, clinical examination, otomicroscopy and pure tone audiometry. 30 cases with moderate to large central perforation and with a conductive or mixed hearing loss underwent Tympanoplasty in which ossicular chain was reconstructed using autologous incus. Otoscopic examination and audiological assessment were done preoperatively and at 3month, 6 months and 1 year postoperatively.

Result & Conclusion: Postoperative air-bone gap closure of around 15 decibel was seen when autologous incus was used in ossicular reconstruction, there were fewer postoperative complications. Good hearing outcomes and better graft take up when reconstruction of ossicular chain is done using autologous incus.

Keywords: autoincus, autologous incus, Type II Tympanoplasty

Introduction

Chronic otitis media (COM) is a major health problem in India, a developing country. In our country, the burden is too high (prevalence >4%) considering the huge population(1). It is more common in low socio-economic status groups, communities with overcrowding, inadequate housing, poor hygiene, nutrition, impaired immunological status, passive smoking, frequent upper respiratory tract infections, and inadequate health care. It poses a major hurdle in the day-to-day life of a person in the form of hearing disability. The discharge from the ear makes the patient uncomfortable. Otologists, since time immemorial, have tried ways and means to treat the middle ear disease.(2)Tympanoplasty is a surgical procedure done to repair the defect in the tympanic membrane after eradicating all the disease in the middle ear cleft with or without reconstruction of the ossicular chain. It is classified mainly as follows – Wullstein’s Classification (3)

Type-1 - the simple closure of the tympanic membrane perforation. Type-2 - Ossicular chain partially destroyed but preserved and continuity restored. Skin graft is laid against the ossicles after removal of the bridge.

Type-3 - Myringostapediopexy producing a shallow middle ear and a columella effect. Type-4 - Round window protection with a small middle ear; mobile footplate is left exposed.

Type-5 - Closed middle ear with round window protection; fenestra in the horizontal semicircular canal covered by a skin graft.

The main purpose of surgery in cases of chronic otitis media (COM) is to eradicate the infection and restore the middle ear hearing function (4). Both intact tympanic membrane and ossicular chain are essential for restoration of hearing in these cases. The most vulnerable ossicle to trauma and infectious processes is incus (5-6). Iurato reported that this situation is accompanied by an intact malleus and stapes suprastructure in 60% of ossicular defects (Austin-Kartush group A)(7).

Austin – Kartush classification (for middle ear ossicular status)

Group A - Malleus and stapes present (commonly seen status) because of precarious vascularity of incus

Group B - Malleus and foot plate of stapes present

Group C - Malleus absent and stapes present

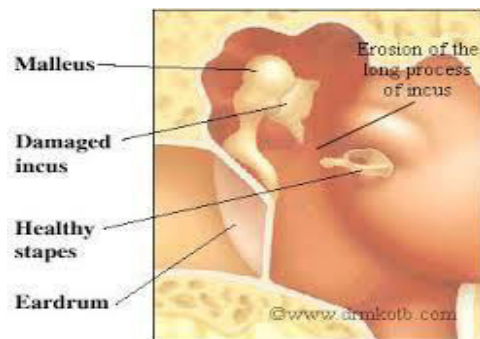
Group D - Malleus and stapes suprastructure absent

Study on human cadaveric middle ear model has demonstrated that the mechanical performance of sound transmission when prosthesis used between tympanic membrane (TM) and stapes in contrast to TM directly contacts with stapes (8). Clinical studies showed that type III tympanoplasty, in which graft is placed over the stapes directly, resulted in 5-10 dB conductive hearing loss in comparison with type II tympanoplasty, in which a bridge is placed between drum and incus (9,10).

In 1957 Hall and Rytzner used the first sculpted auto graft incus for reconstruction when the incus was the only eroded ossicle. As several clear advantages of this method such as very low extrusion rate, high benefit/cost ratio and ready availability; it is now the most common ossicular reconstruction method in defects of incus (7).

The patients with Austin type A

The aim of this study was to survey the hearing results, success rate and risk factors of ossiculoplasty with sculpted autologous incus.



Aim And Objectives-

- To evaluate the result of Type-II Tympanoplasty using refashioned autologous incus.
- To assess the uptake rate of graft.
- To assess the hearing improvement.
- To study complications, if any, associated with autologous incus.

MATERIAL AND METHODS

- Age group of 15-50 years attending the E.N.T. OPD of tertiary care hospital.
- Complains of ear discharge and decreased hearing.
- Screened by detailed History, Clinical examination, Otomicroscopy and Audiometry.
- 30 such subjects having Central Perforation in pars tensa of Tympanic Membrane were included in the study after fulfilling the mentioned inclusion and exclusion criteria-
- **Inclusion Criteria:**
 - a) age group of 15-50 years
 - b) Having central perforation in the Pars Tensa of the tympanic membrane.
 - c) Having conductive/ mixed hearing loss
 - d) Having ossicular pathology (incus)
 - e) ear surgery for the first time.
 - f) Subjects with a dry ear (3 months)
 - g) Subjects with Inactive Mucosal type of Chronic Otitis Media
 - h) Subjects who were willing for follow-up after 3 months, 6 months, 1 year and 2 years and 5 years after surgery.
- **Exclusion Criteria:**
 - a) below 15 yrs and above 50 yrs
 - b) Having sensorineural hearing loss
 - c) Those without ossicular pathology
 - d) Subjects not fit for surgery due to comorbidity
 - e) Subjects already operated on the diseased ear previously. (Revision cases).
 - f) Subjects with wet discharging ear.
 - g) Subjects with active or inactive Squamosal type of Chronic Otitis Media.
 - h) Subjects with Immunocompromised status.
 - i) Subjects with active Tuberculosis

Pre-operative Preparation

- Admitted previous day of surgery
- Otomicroscopic evaluation
- Inj TT and XST
- IV antibiotics and oral antihistaminics prior
- Written informed consent in vernacular language
- NBM the night before Surgery
- 3cm postaural area shaved and prepared

Operative Steps

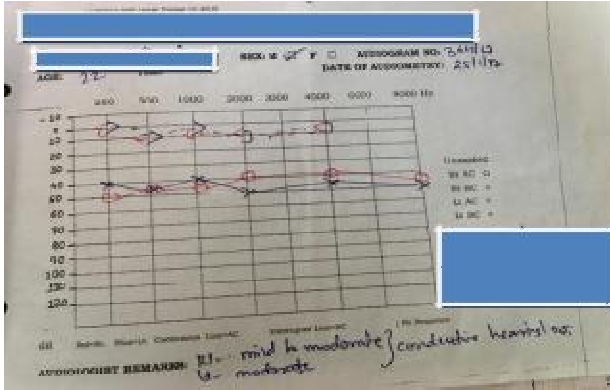
- Operation done under GA /LA with sedation.

- AAP, positioned in supine position, head turned opposite side.
- Betadine used to clean auricle, postauricular and preauricular area.
- Otological Draping done.
- Infiltration of local anesthetic done.(2% ligno + adrenaline, 1 in 1lac)
- Postaural Wildes incision taken. Temporalis fascia graft harvested.
- Periosteal flap elevated till spine of henle.
- Posterior meatotomy just medial the spine of henle
- Margins of TM perforation freshened
- Circumferential tympanomeatal flap was elevated till the level of the annulus.
- Ossicles were inspected, cases in which lenticular/ long process of incus was eroded, with mobile stapes were included in the study
- incus with necrosed lenticular/long process was detached from the incudomaleal joint and taken out.
- It was then held with Derlacki's ossicle holding forceps such that the body of incus was available for drilling and reshaping. Drilling of incus was performed using 0.6 mm diamond burr.
- Part of short process was removed and a notch was drilled on the superior surface of body to accommodate the handle of malleus.
- The remnant long process was drilled to make it cylindrical in shape with a flat base.
- A socket was drilled in the undersurface of remodelled long process for engaging the head of stapes.
- The refashioned incus was then interposed between the handle of malleus and stapes superstructure.
- Reconstructed ossicular chain was checked for mobility, confirmed by looking for round window reflex.
- Temporalis Fascia graft was placed in such a fashion that it rested beneath the mucosal layer and bony canal all around and below the handle of malleus and was pulled over the anterior canal wall.
- The graft was then adjusted all around the canal wall and was taken to the annulus.
- The TympanoMeatal flap was repositioned carefully with the annulus.
- Gelfoam soaked in Povidone Iodine was kept on the annulus and in external auditory canal.
- The Postaural incision was sutured in two layers.
- Sterile mastoid dressing was given.

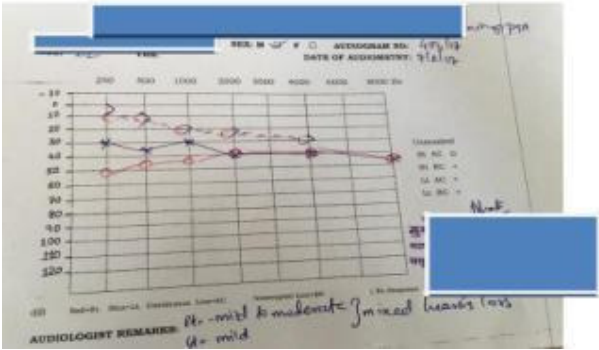
The outcome of the procedure was taken as

- Positive (Successful) – If the graft acted as a scaffold for the epithelial lining and at the end of 3 months, there was complete epithelialization, closure of the perforation, dry ear was achieved and hearing was improved.
- Postoperative hearing improvement (as determined by ABG closure) is the one with postoperative Air-Bone Gap equal to or less than 20 Db
- Negative (Failure) – If there was graft rejection and no hearing improvement occurred by the end of 3 months

PRE OPERATIVE PURE TONE AUDIOMETRY



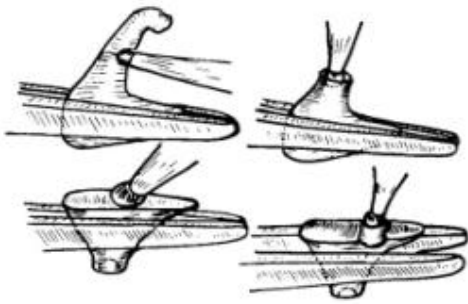
POST OPERATIVE PURE TONE AUDIOMETRY



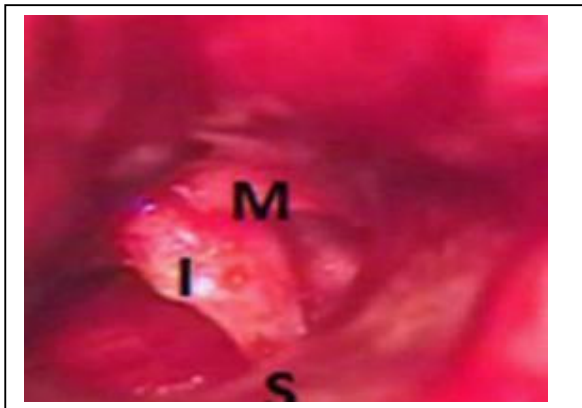
HOLDING INCUS WITH OSSICLE HOLDING FORCEP FOR DRILLING



DRILLING OF ACETABULUM ON LONG PROCESS AND SUPERIOR SURFACE OF BODY OF INCUS



TRANSPOSITION OF REFASHIONED INCUS BETWEEN MALLEUS AND STAPES



HEALED TYMPANIC MEMBRANE 3 MONTHS POSTOPERATIVE



Observation & Results

Age-wise distribution

Patients were in the age group of 15 years to 60 years. The maximum numbers of patients were in the age group of 25-35 years. The mean age was 31.6 years with a standard deviation of 10.6.

Sex Distribution

It was a study with slight female preponderance accounting for 53% of test subjects.

Symptomatology

Majority of patients (90%) in the study had both hearing loss and discharge, while other 10% had hearing loss only.

Presence of Tympanosclerosis (TS)

17% had tympanosclerotic patch. All patients with TS patch had successful graft uptake

- 93.33% in our study had MERI 1-3 (Mild Disease)
- 6.66% had MERI 4-6 (Moderate Disease)
- 96% subjects having MERI 1-3 had successful graft uptake
- Only 50% subjects with MERI 4-6 (moderate disease) had successful graft uptake.

Complications

6.66% had residual perforation of the tympanic membrane.

3.33% each had partial flap necrosis and postaural wound infection.

Complication	Percentage
Residual perforation	6.66%
Postaural wound infection	3.33%
Partial flap necrosis	3.33%
Granular myringitis	0
Graft extrusion	0
Sensorineural Hearing Loss	0
Retracted grafts	0

Stapes fixation	0
Total	13.33%

Discussion

- The minimum age in the study was 15 years and the maximum was 50 years with a mean of 31.76 and a standard deviation of 10.5. Maximum numbers of patients were found in the age group of 25-30 years. Study done by Sharma et al (11) had a mean age of 28.05 +/- 10.5 with the maximum number of patients in the age group of 15-30 years. Zakzouk et al.(12) and Bihani et al (13) in their study had a mean age of 24 years(+/-11) and 27.83 years (+/- 11.6), respectively
- In our study, males comprised 46.66% (14 cases) and females comprised 53.33% (16 cases) showing a slight female preponderance. In a study by Bihani et al(13), 36% were males and 64% were females. In a study done by Mokhtarinejad et al al.(68), 25 patients were operated in which, 13 cases were males (52%) were males and 12 cases (48%) were females. In a study by Sharma et al (11), 60 cases were operated in which 25 cases were male (41.6%) and 35 cases (58.4%)were females. In a study by Naragund et al (14), 30 cases were operated in which 22 cases were male (55%) and 18 cases (45%) were females.
- Maximum number of patients had complaints of both discharge and hearing loss (90%) while there was history of only hearing loss in 10 % patients. Bihani et al.(13) and Naragund et al (14) in their study found that all patients complained of both discharge as well as hearing loss.
- 6 cases (20%) had tympanosclerotic patches on the tympanic membrane and all the 6 cases had successful graft uptake (100%).Lima et al.(15) in their study had 13 cases of tympanosclerosis of which 12 cases had successful graft uptake (92.3%) and only 1 case showed failure in graft uptake (7.7%). Our study had 100% success rate in the presence of tympanosclerotic patch on the tympanic membrane. Before placing the refashioned incus, the tympanosclerotic plaques present in the tympanic membrane can be easily excised without damaging the remnant epithelium, if the plane between the fibrous and epithelial layer of the tympanic membrane is achieved. This holds particularly true in cases of plaques in the antero-superior quadrant.
- Out of 30 cases, 16 patients (53%) had pre-operative air- bone (A-B) gap - within 21-30 dB, 8 cases (27%) had A-B gap between 31-40 dB. 4 cases (13.33%) had A-B gap in the range of 11-20 dB whereas 2 cases (13.33%) had A-B gap in the range of 41-50 dB. None of the patients had AB gap less than 10 dB. The mean pre-operative ABG in our study was 28.49 dB with a standard deviation of +/- 6.87.
- Out of the total 30 cases, only 2 cases had graft failure, thus giving a success rate of 93.33% .2 cases had unsuccessful graft uptake and discharge during follow-up visits. The cases were treated

conservatively with antibiotics, antihistaminics and local ear drops. The discharge subsided after a week's time but the residual perforation persisted at the end of the third month. It was further observed that out of 2 patients having unsuccessful graft uptake, one had a moderate Middle Ear Risk Index (4-6) while other had mild Middle Ear Risk Index(1-3) However, it was also observed that few of the patients that participated in the study with mild MERI(1-3) had upper respiratory tract infection of varying severity in the postoperative period, 1 of which had an unsuccessful graft uptake. Thus, it was believed that most probable cause of 1 unsuccessful graft uptake was high MERI index while the probable cause of other unsuccessful graft uptake was postoperative upper respiratory tract infection causing Eustachian tube dysfunction.

- The air-bone gap closure at the end of 3rd month was as follows- 11 cases (36.66%) had post-operative ABG less than or equal to 10 dB, 17 cases (56.66%) had ABG in the range between 11-20 dB and 2 cases (6.66%) had ABG in the range 21-30 dB. The mean post-operative air-bone gap at the end of 3rd month was 12.6 +/-4.9 dB and mean ABG closure (hearing gain) was 15.86 decibels.
- It was observed that 1 out of 2 patients who had higher Middle ear risk index had postoperative Air-Bone gap of >20 decibels (50%) whereas out of 28 patients with lower Middle ear risk index, only 1 had Air-Bone gap of >20 decibels. (3.5%). It was also observed that out of 28 patients with MERI 1-3 (mild disease) 27 had successful graft uptake but in 1 patient the graft uptake was not successful, (3.5%), while out of 2 patients with MERI 4-6 (moderate disease) 1 had successful graft uptake (50%) but in 1 patient the graft uptake was not successful.(50%)
- Of the 30 cases, the complications took place in 4 patients, 1 case (3.33%) of which developed partial flap necrosis, 1 case (3.33%) had postaural wound infection and 2 cases (6.66%) had unsuccessful graft uptake. 2 (6.66%) cases in our study had unsuccessful graft uptake following episode of upper respiratory tract infection and/or high MERI. The cases were treated conservatively with antibiotics, antihistaminics and local ear drops. The discharge subsided after a week's time but the residual perforation persisted at the end of the third month.
- 1 case had partial flap necrosis in the posterior part of the tympanomeatal flap. The affected area was debrided and treated with local ear drops and oral antibiotics. The case was followed regularly and after 1 week, healthy granulation tissue was seen at the site of previous necrosis and the site re-epithelialized at the end of 2 months. Partial flap necrosis probably resulted due to large size temporalis fascia graft covering major part of the posterior meatal wall, thus hampering the vascular supply of the tympanomeatal flap and its uptake, subsequently. The superiorly based flap gives the advantage of wide exposure and good anchoring to the temporalis fascia graft all around the bony annulus, thereby avoiding any residual perforation. If required, canalplasty can be easily performed due to circumferential elevation of the tympanomeatal flap without causing its tear, visualisation of ossicles, thus providing a wider exposure and facilitating easy dislocation and transposition of refashioned incus as well as placement of the graft. In our study, canalplasty was required and done in 9

cases with bony canal overhang obscuring the visualization of the incudo-stapedial joint and the annulus. There are no chances of anterior canal wall blunting by this technique, as the fibrous annulus, which is carefully elevated during the procedure, is carefully placed back onto the bony annulus all around and secured with small pieces of gelfoam.

1 case in our study had postaural wound infection, gaping of postaural sutures and pus discharge 7 days after surgery. Debridement of the wound edges was done, postaural dressing with topical antibiotics ointments given and patient instructed to take oral antibiotics for 7 days. The discharge subsided completely within 2 days and the wound healed completely by 14th postoperative day.

There was no fear of graft extrusion as the acetabulum made over superior surface of incus for articulation with malleus and long process of incus for articulation with stapes in such a way that it fits snugly. This was achieved by drilling a deep hole with narrow neck. The mobility was checked by gently moving the malleus and looking for round window reflex.

CONCLUSION

- Type II tympanoplasty using autologous incus for ossicular reconstruction results in excellent graft uptake and postoperative hearing improvement.
- The complications seen with PORPs like higher extrusion rate, stapes fixation, lateralization and poor hearing improvement, were not seen with autologous incus.
- There is no risk of transmission of disease and no extra cost involved.
- Ossiculoplasty using autologous incus transposition provides excellent hearing restoration if patients are selected properly and surgeon is skilled for the procedure.
- Thus, Type II tympanoplasty using autologous incus for ossicular reconstruction is a preferred technique for restoration of hearing in patients undergoing ear surgery for the first time.

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