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MODIFIED INCUS VS TRAGAL CARTILAGE TRANSPOSITION OSSICULOPLASTY - A PROSPECTIVE COMPARATIVE ANALYSIS.

Otorhinolaryngology

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ABSTRACT

Background: Ossiculoplasty can be done using autologous, homologous or artificial prosthesis materials. However, the search for widely available, cost-effective, easy to handle, as well as stable, reliable acoustic properties, biocompatible and less in extrusion failure is still inconclusive. The study's goals were to compare the effects of employing autologous tragal cartilage and modified incus for ossicular chain restoration and assess how well each procedure closed the AB gap and improved hearing. **Methods:** Data from a total of 60 patients were studied for this study. Patients were randomised to autologous tragal cartilage transposition and modified incus ossiculoplasty groups with 30 in each group. **Results:** The mean pre-operative air-bone gap (ABG) for modified incus ossiculoplasty was 41.2 dB and for the tragal cartilage transposition was 42.3 dB. The mean post-operative air-bone gap in the incus ossiculoplasty group and cartilage transposition group was 16.3 and 12.87, respectively; p-value = 0.0413. The mean air-bone gap closure in the incus ossiculoplasty group and cartilage transposition group was 24.27 and 28.8, respectively; p-value = 0.0269. **Conclusion:** Our study had showed that cartilage transposition ossiculoplasty to be clinically better and statistically significant hearing gain compared to modified incus ossiculoplasty.

KEYWORDS

Ossiculoplasty; Ossicular reconstruction; Otology; Air-Bone gap; Sculpted incus; Cartilage ossiculoplasty, Tragal cartilage, Chronic otitis media.

INTRODUCTION

Hearing and dry ears are equally important. People frequently go to ENT doctors for discharge from the ear as well as hearing issues, with chronic otitis media being the most common cause. Patients experience social distress as a result. 4.76 percent of chronic suppurative otitis media (CSOM) cases occur each year in children under the age of five. (1) WHO estimates that between 0.9 percent and 7.8 percent of people in Southeast Asia and more than 4 percent of people in India have CSOM. (1,2) There are 65 to 330 million CSOM cases worldwide. (1) A permanent abnormality of the pars tensa or flaccida, most likely caused by acute otitis media, negative middle ear pressure, or otitis media with effusion, is referred to as chronic otitis media. The prevalence of chronic otitis media, a middle ear ailment with a high incidence both globally and in our environment, is very significant. We, therefore, decided to undertake a study on the surgical treatment of this condition in light of the CSOM-tubotympanic type.

Ossiculoplasty is a microsurgical operation. This procedure is carried out to enhance hearing by reconstructing or repairing the ossicular chain (2). Infections including chronic suppurative otitis media (CSOM) and trauma typically result in ossicular chain destruction. In cases with CSOM with cholesteatoma, there is a higher likelihood of ossicular erosion. In all forms of CSOM, ossicular chain erosion is present, but it is typically more severe in cholesteatoma instances. Reconstruction of the ossicular chain should only be attempted if there is a reasonable likelihood that it will succeed (2).

The incus (long process) and superstructure of the stapes are the two ossicles most frequently involved in CSOM, Attico-antral disease frequently causes it. The complete ossicular chain, the stapes superstructure, the malleus handle, or only the long process of incus may be destroyed. As a result, Atticoantral disease always causes more hearing loss than tubotympanic type disease. (3) In tubo-tympanic or safe type of CSOM, ossicular chain involvement is uncommon. In compared to central perforations, subtotal perforations are more likely to have ossicular chain destruction.

The repair of the ossicular chain frequently involves the use of autologous bone (ossicles, cortical bone), cartilage (conchal, tragal), or both. Because there is no risk of graft extrusion or rejection, autologous graft materials are always the best choice for ossicular restoration.

Objectives

The study's goals were to compare the effects of employing tragal cartilage and autologous incus for ossicular chain restoration and assess how well each procedure closed the air-bone gap and improved hearing.

METHODS

Study Design

This is a prospective study with 24 months time period.
The present study was conducted in the Department of ENT & HNS, Approval from the Institutional ethical committee was obtained for the study.

Subjects

Data of totally 60 patients were studied for this study. For all the patients, a thorough examination was performed when visited the ENT outpatient department (OPD) and had a history of ear discharge and hearing loss. Each and every patient was subjected to a comprehensive clinical examination, and a complete medical history was taken. Each patient received an evaluation using an otoendoscope, a microscope, and pure tone audiometry (PTA). Patients with ossicular chain erosion were taken into consideration for the study.

As per Austine–Kartush classification, patient with group–A and group-C classes were considered for this study. Group-A means patients are with intact malleus and stapes suprastructure. Whereas, group-C means patients with malleus absent and intact stapes.

The patients were diagnosed with COM – mucosal, adhesive otitis media and COM with retraction pocket and limited cholesteatoma. Thus, we have considered autologous prosthesis using modified incus ossiculoplasty and tragal cartilage transposition osscіuloplasty with tympanoplasty with or without cortical mastoidectomy for ossicular reconstruction. Informed consent was obtained from all the patients.

Inclusion Criteria

- Patients diagnosed with chronic otitis media.
- Patients belonging to Austine–Kartush group-A and group-C.
- Both male and female gender were included.

Exclusion Criteria

- Patients with extensive cholesteatoma
- Patients with sensorineural hearing loss
- Patients with immunocompromised conditions
- Patients with active ear discharge and URTI

Surgical Technique

Under general anaesthesia, patients in the study population underwent single staged tympanoplasty with or without cortical mastoidectomy and ossiculoplasty. The surgical procedure used has been described and improved upon originally by Glasscock (4) The ossicular chain was examined for integrity after the temporalis fascia graft harvest, tympanomeatal flap elevation, and removal of the disease from the middle ear. The eroded incus was separated from the incudomalleolar joint and retrieved after the stapes footplate's mobility was established. The long and short processes of the incus were gently removed by drilling with a fine 1 mm cutting burr. A small fenestra was made at the opposite

end of the ossicle to facilitate articulation with the head of the stapes. The modified incus and were positioned between the temporalis fascia graft and the stapes suprastructure in situations where the distance and angle were favourable, whereas, in situations where the distance and angle were unfavourable, the modified incus or cartilage were positioned between the stapes head and the tympanic membrane or temporalis fascia graft (Transposition). Middle ear was packed with gel foam and the stability of the rebuilt ossicular chain was confirmed.

Post-operative Assessment

15 days after surgery, the patients were first evaluated to check for graft uptake and early extrusion. A thorough otoscopic examination was then conducted 3 months after surgery to determine whether full healing had occurred, and a post-op Pure Tone Audiometry was done.

Analysis

Students Paired T-test was to compare between post op ABG and post op A-B Gap closure of cartilage and modified incus ossiculoplasty.

Results

(Table 1) Patient Characteristics

Parameter	Sculpted Incus Ossiculoplasty	Cartilage Transposition Ossiculoplasty
No of patients	30	30
Males	14	13
Females	16	17
Age		
Mean	35.3	35.2
Median	37	37
Range	20-54	22-44
Diagnosis		
Austin-Kartush's classification Group-A	27	23
Austin-Kartush's classification Group-C	3	7
COM–mucosal	27	23
Adhesive otitis media	3	4
COM with limited cholesteotoma	0	3

(Table 2) Pure Tone Post-operative Gain/post-operative AB Gap Closure At Follow-up After 3 Months

ABG range	Sculpted Incus Ossiculoplasty		Cartilage Transposition Ossiculoplasty	
(dB)	Count	%	Count	%
0-20	7	23	3	10
21-30	15	50	13	43
>30	8	27	14	46
Total	30	100	30	100

(Table 3) Graft Uptake Rate 3 Months Post Operative Period

Group	No of patients	Graft accepted (%)	Graft rejected (%)
Sculpted Incus Ossiculoplasty	30	86	14
Cartilage Transposition Ossiculoplasty	30	100	0

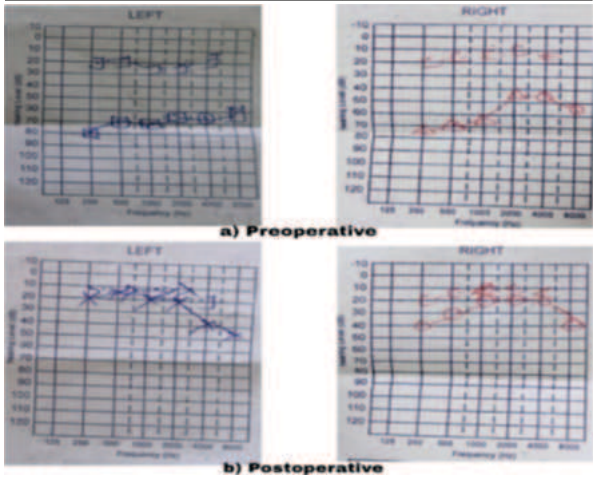

Figure I A) Preoperative PTA B) Postoperative PTA

Left Ear- Cartilage Ossiculoplasty, Right Ear - Incus Ossiculoplasty

(Table 4) Comparative Analysis

Parameter	Sculpted Incus Ossiculoplasty (Mean + SD)	Cartilage Transposition Ossiculoplasty (Mean + SD)	p-value & significant (P< 0.05)
Post-operative ABG	16.3 + 6.87	12.87 + 5.83	P = 0.0413 S
Post-operative AB gap closure	24.27 + 7.67	28.8 + 7.8	P = 0.0269 S

The mean post-operative AB gap in the incus ossiculoplasty group and cartilage transposition group was 16.3 and 12.87, respectively. Students paired T-test was used to compare between two groups and it suggests cartilage ossiculoplasty had shown a statistically significant lower post-operative AB gap (p-value= 0.0413) as shown in Table 4.

The mean AB gap closure in the incus ossiculoplasty group and cartilage transposition group was 24.27 and 28.8, respectively. This suggests cartilage ossiculoplasty had shown significantly better gap closure (p-value = 0.0269).

DISCUSSION

Poor hearing acuity is more likely to affect ones social as well as professional life. Although the early documented history of ear surgery was from the 17th century, it was only in the 20th century the attempts for ossicular chain reconstruction (OCR) has been noticed. It was after the 1950s that middle ear reconstruction attempts using incus or malleus autografts have been introduced. It's been observed that these attempts using autografts of incus, cartilage or cortical bone have shown excellent initial functional results as well as became preferred choices because of compatibility and acceptable tolerance (2).

The science of ossiculoplasty is still an evolving area in search of ideal materials for restoring hearing acuity that can provide long-term reliable results in an economical and acceptable manner. The closure of the air-bone gap is a good measure of ossiculoplasty success (3).

Ossicles such as malleus and incus as well as cartilage such as tragal or septal are used as autografts for prosthesis by virtue of their many characteristics of ideal prosthetics. Thus transposition of incus can be ideal but it requires both time and skill (4).

Naragund Amith et al in a study has shown that autologous incus had given significantly better hearing gain i.e., 58% of the patients had mean closure ABG <20 dB compared to 33% in titanium prosthesis group (4).

Literature has shown post-operative ABG results ranging from 10-60 dB. Singh et al., noted very sparse to no literature, especially regarding the ossiculoplasty with cartilage in the removal of cholesteatoma in the ear. They have reported a prospective study of type III tympanoplasty followed by mastoid surgery in 40 cases of cholesteatoma ear using conchal cartilage. They have observed only a short-term gain in hearing and inferred that it is important to have intact incus for achieving good hearing after tympanoplasty type II surgery in cases of cholesteatoma ears (6).

Cholesteatoma being an erosive condition involving damage to ossciles makes them unfit for sculpting. Cartilage autografts may be used in such conditions for ossiculoplasty. These materials are ideal considering lesser chances of extrusion, lesser risk of rejections, and also can come at low costs (6).

In our study, COM–mucosal, adhesive otitis media and COM with limited cholesteotoma was diagnosed in 83%, 12%, and 5%, respectively. 83% of these patients belong to group A and 17% of them belong to group C of Austin-Kartush's classification.

The mean post-operative AB gap in the incus ossiculoplasty group and cartilage transposition group was 16.3 and 12.87, respectively; p-value = 0.0413. The mean AB gap closure in the incus ossiculoplasty group and cartilage transposition group was 24.27 and 28.8, respectively; p-value = 0.0269. The mean closure of ABG for all the patients was found to be 21.9 dB (± 7.5) which is almost similar and can be considered as successful for hearing outcomes in line with Naragund Amith I et al who reported <20 dB (4).

Most of the patients presented erosion of the long process of the incus,

while the body of the incus remained intact. As published in previous papers, in more than 50% of the cases this is the common observation in CSOM that can be attributed to the blood supply (7).

For such cases we attempted for modified incus ossiculoplasty. Recently, Gugliani et al had published a comparison of cartilage versus incus ossiculoplasty (7).

Similar observations were reported in Indian patients by Rout et al., and Deshmukh et al.

Rout et al., had published a retrospective study using 200 patients and showed that cartillage ossiculoplasty to be superior to modified incus ossiculoplasty but the observation was not statistically significant (8).

Deshmukh et al., in his study with 66 patients had reported that although both the autologous incus and cartilage being good materials for ossicular chain reconstruction, tragal cartillage was recommended as better material for ossiculoplasty because it is easy to handle and is a stable material. Also, tragal cartilage has shown higher success rates (i.e, 87.5% had <20 dB & 12.5% had <30 dB) of ABG closure (9).

Gardner et al published a retrospective study comparing the success rate of PORP and TORP using titanium and non-titanium prostheses. It shows that, successful rehabilitation of conductive hearing loss was obtained in 70% of partial ossicular chain reconstructions and 44% of total ossicular chain reconstructions when titanium prostheses were used. A comparison of data revealed successful rehabilitation in 48% and 21% of nontitanium-based partial and total reconstructions, respectively (10).

Most of the previous studies using the cartilage ossiculoplasty have reported the success rates to be in the range of 72-82% (11,12).

The limitations of our study include smaller sample size, smaller duration. Further none of the in this current study were belonging group D class of Austin Kartush.

We warrant a further study in wider randomised and prospective mode using much bigger sample size to establish out findings. This can give a more economical, easily available, compatible, lesser extruding and much acceptable ossiculoplasty technique.

CONCLUSION

Our study had showed that cartilage ossiculoplasty to be clinically better and statistically significant hearing gain compared to modified incus ossiculoplasty.

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