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Involvement of Ossicular Chain and Its Management in Chronic Suppurative Otitis Media

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Abstract

Background: *Chronic suppurative otitis media is commonly found in children. Otohorrea is present if there is a perforation of the tympanic membrane. We in the current study tried to Reconstruction of ossicular chain using graft materials. To compare pre-operative and post-operative hearing thresholds (Air Bone Gap dB) in patients who underwent ossiculoplasty.* ***Methods:*** *This cross-sectional study was performed in the Department of ENT, Prathima Institute of Medical Sciences, Naganoor, Karimnagar. Based on the inclusion and exclusion criteria n=40 cases were studied in this study. intact canal wall and canal wall down procedures were included. The operations were performed under local or general anesthesia.* ***Results:*** *N=35 patients (87.5%) had a hearing threshold of more than 30 dB. The type of procedure performed was intact canal wall technique in n=32(80%) of cases and canal wall down technique was used in n=8(20%) of cases. n=15 patients (37.5%) had air conduction threshold within 30db and n=17 patients (42.5%) had > 30 dB in intact canal wall procedure and canal wall down procedure n=6 patients had air conduction threshold >30 dB.* ***Conclusion****: In our study, in patients with safe chronic suppurative otitis media, we have found good hearing results in patients implanted with autogenous cartilage and bone. These are easily available and cost-effective. Moreover, they are stable and are easily accepted by the body and are never extruded out.*

Keywords*: Ossicular chain, tympanoplasty, chronic suppurative otitis media, Otorrhoea*

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Introduction

Hearing is one of the vital senses of man. Deafness upsets the tranquility of life. When such a great vital sensation is lost, life naturally loses its charm. In India, especially in Andhra Pradesh, the incidence of Chronic Suppurative otitis media (CSOM) is very high. About 30% of patients who attend the ENT Outpatient Department suffer from CSOM. The management of COSM has evolved over a period of more than a hundred years from early attempts of surgical exposure of the middle year to present-day techniques of tympanoplasty. [1]

The contemporary ear surgeons have at their disposal, a wide range of surgical procedures for the treatment of CSOM, with and without Cholesteatoma. Middle ear reconstruction can be done after the successful removal of the disease. However, the main primary aim of any surgical procedure is the complete removal of bone-destroying disease. This could be either Canal wall up or Canal wall down Mastoidectomy. [2] For a successful ossicular reconstruction an air-filled middle ear and a functioning eustachian tube are very important prerequisites. The tympanic membrane must be intact, healthy, and mobile. The ossicular reconstruction must be secure and stable. Grafts

and biomaterials chosen for use in middle ear reconstruction ideally should not induce a sustained foreign body reaction, extrude or biodegrade. Most otologists prefer to use healthy, fresh, autologous tissues whenever possible and the success rate with these materials is high. [3] The second choice has been preserved allogeneic tissues. The deep external auditory meatus and middle ear are sites where immune rejection responses to a tissue allograft across the major histocompatibility barrier are somewhat muted. [4] Current preoperative otologic allograft preservation techniques also appear to make these tissues less susceptible to rejection after grafting, by altering, to a greater or lesser extent, the molecular configuration of antigenic determinants of transplantation antigens. This appears to diminish the ability of the graft to immunize the recipient but does not alter their specificity. The primary aim of the study includes defining the incidence of common ossicular pathology in CSOM in patients attending our Tertiary care Hospital. Reconstruction of ossicular chain using graft materials. To compare pre-operative and post-operative hearing thresholds (Air Bone Gap dB) in patients who underwent ossiculoplasty.

Materials and Methods

This cross-sectional study was performed in the Department of ENT, Prathima Institute of Medical Sciences, Naganoor, Karimnagar. Institutional Ethical committee permission was obtained for this study. Written consent was obtained from all the patients of the study after explaining the nature of the procedure and expected outcomes.

Inclusion Criteria

1. All cases diagnosed as Chronic suppurative otitis media clinically and radiologically
2. Patients of both sexes.
3. Aged between 15 years to 50 years.

Exclusion criteria

1. All cases diagnosed as Acute suppurative otitis media
2. Cases with otosclerosis and tympanosclerosis
3. Adhesive otitis media
4. Congenital Hearing disorder
5. CSOM with mixed / Sensory neural hearing loss
6. Those who do not fit as per inclusion criteria

Based on the inclusion and exclusion criteria n=40 cases were studied in this study. All patients underwent thorough history taking, examination with an otoscope, hematological and radiological investigations, audiometry assessment before surgery. Patients of both safe and unsafe types of chronic suppurative otitis media with a good cochlear reserve and good Eustachian tube function were selected. Both intact canal wall and canal wall down procedures were included. The operations were performed under local or general anesthesia. Post aural or endaural incision used. After clearing of disease from the middle ear and mastoid as necessary, the status of the ossicular chain was assessed and found that necrosed incus in 95% of cases, necrosis of malleus in 27.5%, necrosis of stapes superstructure in 27.5% of patients. The ossicular reconstructive procedure was planned according to the status of the ossicular chain. Temporalis fascia was used to reconstruct the tympanic membrane. Pure tone averages (500 Hz, 1000 Hz, and 2000 Hz) were compared between pre-operative and post-operative results. All the available data was uploaded on MS Excel and analyzed by SPSS version 22 in windows format.

Results

Out of n=40 cases in the study males were n=28(70%) and females were n=12(30%). In the present study of the n=40 cases, n=12 patients (30%) patients had the disease in the Right Ear, n=21 patients (52.5%) had the disease in the Left Ear and n=7 cases, (17.5%) had the disease in both ears. Of the n=7 patients with bilateral disease, n=5 patients had a safe type of disease and two patients had an unsafe disease. Of the n=5 patients with a safe type of disease, one patient had left ear operated on and ossicular reconstruction is done. Of the n=2 patients with the unsafe type of disease, the ear with the active and extensive disease was operated on first. The age-wise distribution of cases in the study is given in table 1.

Table 1: Age Distribution of the cases

Age group (years)	*Frequency*	*Percentage*
15-20	2	5%
21-30	30	75%
31-40	6	15%
41-50	2	5%
>50	0	0%

In the present study Commonest presenting complaint was otorrhoea in n=40 patients (100%) followed by hearing loss in n=37 patients (92.5%) and tinnitus in n=4 patients (10%), later earache in n=2 patients (5%) & vertigo in n=1 patient (2.5%) in descending order. One patient got relieved of tinnitus after medical management depicted in table 2.

Table 2: Symptom Distribution (n=40) in the cases of the study

Symptoms	*Frequency*	*Percentage*
Otorrhoea	40	100%
Hearing loss	37	92.5%
Ear-ache	2	5%
Vertigo	1	2.5%
Tinnitus	4	10%

Minimum duration of otorrhoea was 8 months Maximum duration of otorrhoea was 18 months Minimum duration of hearing loss was 2 months Maximum duration of hearing loss was 20 years given in table 3. On clinical examination under otoscope, the presence of central perforation was the commonest finding in n=28 patients (70%). Attic perforation seen in n=7 patients (17.5%) and Postero Superior Marginal perforation in n=5 patients (12.5%).

Table 3: Duration of symptoms (n=40) cases of the study

Duration (in years)	*Otorrohea*		*Hearing loss*	
	No. of Patients	*Frequency*	*No. of Patients*	*Frequency*
0 – 3	19	47.5%	27	67.5%
3 – 6	6	15%	6	15%
6 – 9	14	10%	0	0
9 – 12	6	15%	3	7.5%
> 12	5	12.5%	1	2.5%

In the present study, it is observed that n=35 patients (87.5%) had a hearing threshold of more than 30 dB. The type of procedure performed was intact canal wall technique in n=32(80%) of cases and canal wall down technique was used in n=8(20%) of cases.

Table 4: *Pre-operating hearing threshold (n=40)*

Air-bone gap dB	*No. of Patients*	*Percentage*
0 – 10	0	0%
11 – 20	1	2.5%
21 – 30	4	10%
> 30	35	87.5%

All the patients taken in the study had a pure conductive type of hearing loss. Pre-operative Air bone gap >30 dB in intact canal wall procedures was seen in n=29 cases (90.62%). while in canal wall down procedures it is seen in n=6 patients (75%). The commonest overall ossicular pathology is necrosis of incus in 38 patients (95%) next necrosed malleus in n=11 patients (27.5%,) least ossicular pathology seen is an absence of stapes superstructure in n=11 patients (27.5%). In intact canal wall technique, incus was absent in 96.8% of cases, stapes superstructure absents in 12.5% of cases, absent malleus in 9.3% of cases. In canal wall down procedures combined malleus and incus were absent in 87.5% of cases and stapes superstructure was absent in 75% of cases. In the present study n=15 patients (37.5%) had air conduction threshold within 30db and n=17 patients (42.5%) had > 30 dB in intact canal wall procedure and canal wall down procedure n=6 patients had air conduction threshold >30 dB.

Table 5: pre-operative air conduction thresholds with a type of procedure

Air conduction thresholds	*Frequency in intact canal wall procedure*	*Percentage*	*Frequency in canal wall down procedure*	*Percentage*
0-10	-	-	-	-
11-20	-	-	1	12.5%
21-30	15	37.5%	1	12.5%
>30	17	42.5%	6	75%

In the present study, the results varied according to the type of reconstruction, A closure of the air-bone gap within 20 dB was achieved in n=16(72.72%) patients where malleus stapes assembly is done. 22.2% of patients had air-bone gap closure within 20 dB with short columella reconstruction. All the patients had air-bone gap closure within 30 dB. In the canal wall down procedure, the patient's air-bone gap less than 20 dB is seen in n=1(12.5 %.) patient using long columella technique.

Table 6: Results according to the type of reconstruction in intact canal wall technique (n=32)

Reconstruction	*Closure within 20 dB*		*Closure within 30 dB*	
	Frequency	*percentage*	*Frequency*	*percentage*
Malleus stapes assembly	16	72.72	22	100
Malleus footplate assembly	-	-	2	100
Short columella	2	22.22	7	100
Long columella	-	-	1	100

The results based on the type of graft material revealed that the air-bone gap closure less than 20 dB is seen in n=17 (74.07%) cases using incus remnants (table 7). The air conduction thresholds within 20 dB are seen in n=28 patients (87.5%) in intact canal wall procedures and canal wall down procedures air conduction thresholds within 20db are seen in n=1 (12.5%) case.

Table 7: Results according to the type of graft material (ICW technique) (n=32)

Type of graft material	*Closure within 20 dB*		*Closure within 30 dB*	
	No. of Patients	*Frequency*	*No. of Patients*	*Frequency*
Incus remnant (A)	17	74.07%	25	92.59%
Conchal cartilage	1	100%	-	-
Septal cartilage (H)	-	-	4	100%

Discussion

The present study was conducted to determine the commonest ossicular pathology in patients with CSOM. It is conducted to try the different available graft materials in Ossicular reconstruction to review the post-operative results in comparison with pre-operative audiological assessment. The incidence of middle ear disease has revealed that there are 12.45 million (39.30%) out of 31.70 million suffering from chronic otitis media diseases in India. [5] Approximately 2.64 million (8.32%) out of 31.70 million suffering from various other types of middle ear diseases in India. [6, 7] In our hospital the incidence of chronic suppurative otitis media attending the out-patient department of Prathima institute of medical sciences, Karimnagar is 30%. It is observed in the present series that the majority of the patients belonged to the age group of 21 to 30 years 75% followed by the age groups of 31 to 40 15% and 11 to 20 years 5%. V.K. Poorey et al., [8] found the incidence more common in the age group of 0 to 10 years. This may be because this study includes those patients who underwent surgery of mastoid, unlike their study which is a bacteriological study. COSM was found to be more common in males. The ratio of M: F is 1.5:1 in the present study. It was 1.4:1 in the study by V.K. Poorey et al., [8] In COSM cases otorrhoea is the most common presentation followed by hearing loss, earache, giddiness which are similar to our study where 100% of patients presented with otorrhoea. [9] Homograft prosthesis was used exclusively in ossicular reconstruction as revised by Wehrs et al. [10] O'Reilly et al., [11] proposed Sculpted autologous incus interposition provides hearing success comparable with current allograft prosthesis studies, has a very low extrusion rate, and remains stable over time. In the present study, 74.07% of patients had air-bone gap closure within 20 dB using incus remnant in intact canal wall technique, and closure within 30 dB is seen in 100 % (out of 8) in canal wall down technique. According to Dornhoffer JL., [12] Canal wall-up mastoidectomy, with Ossicular reconstruction gave good hearing results when compared to canal wall down. In the present study, 70% of the patients achieved closure of air-bone gap within 20 dB with intact canal wall technique when compared to canal wall down. A.I. Naragund et al., [13] found that results of ossiculoplasty with autologous incus were better as compared to those with titanium prosthesis. The incidence of complications was also less with autologous incus ossiculoplasty. Pennington CL [14] in his study found a 10-to-15-year follow-up study of patients with modeled incus interposition procedure for restoration of hearing reveals that hearing gains as reported in 1972 were sustained by long-term postoperative care despite the resurgence of problems from negative middle ear air pressures. Black B., [15] in his study compared the results of malleus stapes assembly with malleus footplate assembly and achieved the closure of air-bone gap within 20 dB in 86 % of patients in the former and 80% in the latter. In the present study, the results of ossiculoplasty are compared with 4 standard criteria for a successful outcome of ossiculoplasty. In the present study air conduction thresholds within 20 dB is seen in 28 patients (87.5%) in intact canal wall procedure and canal wall down closure within 20 dB is seen in n=1 patient (12.5%). We analyzed our results according to the type of reconstruction and found that malleus stapes assembly gave results within 20 dB in 16 patients and within 30 dB in 22(100%) patients and short columella assembly in n=2 patients (22.22%) within 20 dB followed by long columella with n=1 patients within 30 dB in intact canal wall technique. Guildford F., [16] and others recommended transposing the residual autograft incus onto its side so that it lies on the stapes Capitulo and beneath the manubrium.

Conclusion

In the current practice where a large variety of innovative artificial prosthetic materials are being used to replace and reconstruct the

ossicular chain, autografts still play a significant role. In our study, in patients with safe chronic suppurative otitis media, we have found good hearing results in patients implanted with autogenous cartilage and bone. These are easily available and cost-effective. Moreover, they are stable and are easily accepted by the body, and are never extruded out.

***Conflict of Interest*: None**
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***Ethical Permission*: Obtained**

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