

Comparison of Various Graft Materials in the Reconstruction of Ossicular Chain in Patients with Chronic Otitis Media: A Prospective Hospital Based Study

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ABSTRACT

Introduction

Ossicular chain reconstruction is the surgical procedure used to correct the hearing problems in patients with chronic otitis media (COM). In this era, 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.

Materials and Methods

The present study included 40 patients. Study population was selected based on inclusion and exclusion criteria. The ossicular reconstructive procedure was done under anesthesia and according to the status of the ossicular chain. Temporalis fascia was used to close the perforation. Mainly two procedures were performed: one is intact canal wall and the other is canal wall down.

Results

Most of the study population was middle aged and males were more compared to females. Thirty five patients had air bone gap above 30dB. In 38 patients, the incus had undergone necrosis. Most of the patients underwent short columella reconstruction. A closure of air bone gap within 20 dB was achieved in 72.2% in patients with malleus stapes assembly. In short columella 22.2% of patients had closure of air bone gap within 20 dB. Incus remnant grafts gave better hearing gain.

Discussion

The published literature on the result of use of sculptured ossicle and cartilage in tympanoplasty have been reviewed

Conclusion

In the present study, cases with COM showed good hearing results patients implanted with autogenous cartilage and bone.

Keywords:

Otitis Media, Suppurative; Tympanoplasty; Incus; Necrosis; Cartilage

The ear surgeons of today have at their disposal, a wide range of surgical procedures for the treatment of chronic otitis media (COM), with and without cholesteatoma.¹ The middle ear includes the tympanic cavity, the mastoid air cell system and the auditory tube. The parts to be considered are, in order; the tympanic membrane, the tympanic cavity and its contents, the mastoid antrum and mastoid air cells, and

the auditory tube.² Middle ear reconstruction can be done after successful removal of the disease. However, the primary aim of any surgical procedure is the complete removal of bone destroying disease. This could be either by canal wall up or canal wall down mastoidectomy.^{3,4}

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.^{2,5} Most ear surgeons prefer to use healthy, fresh, autologous tissues whenever possible and the success rate with these materials is high. The second

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choice has been preserved allogenic tissues. The deep external auditory meatus and middle ear are sites where immune rejection responses to a tissue allograft across major histocompatibility barrier are somewhat muted. 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 transplanted antigens. This appears to diminish the ability of the graft to immunize the recipient, but does not alter their specificity.⁶ The present study was conducted to compare various graft materials in the reconstruction of ossicular chain in patients with COM.

Materials and Methods

This prospective study was conducted in a medical college in the state of Tamil Nadu. The study period was two years. This study was cleared from Institutional Research Committee and Institutional Human Ethics Committee. 40 patients were selected for this study. Informed consent was taken from all patients before initiation of study protocol. Demographic data (age, gender) and clinical data (perforated ear, type of symptom, type of perforation, air bone gap) of all patients and ear involved were noted in the case sheet. The procedures were explained to the study population.

Patients of both mucosal and squamous type of chronic otitis media with good cochlear reserve and good Eustachian tube function were selected. The Inclusion criteria were COM and willingness to be included in our study. Exclusion criteria were previous ear surgery, congenital ear abnormalities, sensorineural hearing loss, pregnancy and lactation and ototoxic medication (Aminoglycosides, diuretics).

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 were used. After clearing of disease from the middle ear and mastoid as necessary, the status of ossicular chain was assessed. Ossicular reconstructive procedure was planned according to the status of the ossicular chain. Temporalis fascia was used to close the perforation. In this study, we have included

only the cases where autogenous cartilage (conchal) or autogenous bone (incus remnant), homograft septal cartilage was used between: (i) Malleus and head of stapes (malleus-stapes assembly), (ii) Malleus and foot plate (malleus footplate assembly), (iii) Stapes head and newly constructed tympanic membrane (short columella) and (iv) Footplate and newly constructed tympanic membrane (long columella).

All patients underwent audiometric assessment before surgery and three months and six months after surgery. Pure tone averages (500Hz, 1000Hz & 2000Hz) were compared between pre-operative and post-operative audiograms. Statistical analysis of the data was expressed in number and percentage. Statistical Package for Social Sciences (SPSS ver 16.0) was used for analysis. Chi square test was applied to find the statistical significance. p value less than 0.05 ($p < 0.05$) was considered statically significant at 95% confidence interval.

Results

A total of 40 patients were included in the study. 30 patients were in the age group of 21-30 years. Males (28) were more compared to females (12) (Table I). 21 patients had disease in left ear, 12 in right ear and 7 in both ears. Hearing loss and otorrhoea were the most common complaint in the study population. Maximum number of patients were suffering from ear problem from last 3 years in the study population.

Central perforation is more common in the patients

Table I: Comparison of type of procedure among study population

PROCEDURE	NUMBER	PERCENTAGE (%)
Intact canal wall technique	32	80.00
Canal wall down	8	20.00
Total	40	100.00

Table II: Pre-operative hearing loss in patients with type of surgery

AIR BONE GAP (DB)	INTACT CANAL WALL		CANAL WALL DOWN	
	NUMBER	PERCENTAGE (%)	NUMBER	PERCENTAGE (%)
1-10	0	0	0	0
11-20	0	0	1	12.5
21-30	3	9.37	1	12.5
Above 30	29	90.63	6	75
Total	32	100	8	100

compared to posterior and attic. 35 patients had an air bone gap more than 30 dB (Table II).

32 patients underwent intact canal wall technique

Table III: Comparison of intra operative ossicular status

OSSICULAR STATUS	NUMBER	PERCENTAGE (%)
Necrosed malleus	11	27.5
Necrosed incus	38	95.0
Absent stapes suprastructure	9	22.5

and others underwent canal wall down procedure. 29 patients in intact canal wall group and 6 in canal wall down group had air bone gap above 30 dB. 38 patients had necrosed incus, 11 had necrosed malleus and 9 had absent stapes suprastructure (Table III).

The results varied according to the type of reconstruction. A closure of air bone gap within 20 dB was achieved in 72.2% in patients where malleus stapes assembly was done. In short columella 22.2% of patients had closure of air bone gap within 20 dB. All the patients with the above described techniques had closure of air bone gap within 30 dB (Fig. 1). In patients with long columella, air bone gap less than 20 dB was seen in 25%. As the results were assessed according to the type of

graft material used, it was found that the air bone gap closure less than 20dB in patients using incus remnants was 6.2%. In canal wall down technique, closure within 20 dB using septal cartilage was 12.5% (Tables IV, V and VI).

Discussion

This study was conducted to know the commonest ossicular pathology in COM and the various materials used for ossicular reconstruction and to compare the results with pre-operative and post-operative air-bone gap hearing thresholds. This study included 40 patients clinically diagnosed as COM either mucosal or squamous type.

There were 28 males and 12 females. Left ear (52.5%) was more commonly involved than right ear (30%). 17.5% patients had bilateral ear disease. Homograft prosthesis was used exclusively in ossicular reconstruction from 1972 to 1986.^{7,8} Guildford et.al and others recommended transposing the residual autograft incus onto its side so that it lies on the stapes capitulum and beneath the manubrium.⁹ Zollner et.al described the benefits of sculpturing the autologous incus in order to obtain a better assembly and reduce subsequent ankylosis.¹⁰ Wehrs et.al and others refined this technique and advocated the use of homograft ossicles.¹¹

The use of self-stabilizing pre-sculptured cartilage homografts for middle ear reconstruction has an established track record with long term results equivalent to those of reconstruction methods using alloplastic

Table IV: Distribution of patients based on type of reconstruction in intact canal wall technique

RECONSTRUCTION	CLOSURE WITHIN 20DB		CLOSURE WITHIN 30 DB	
	NUMBER	PERCENTAGE (%)	NUMBER	PERCENTAGE (%)
Malleus stapes assembly	2	6.2	4	12.5
Malleus footplate assembly	-	-	2	6.2
Short columella	16	50	7	21.8
Long columella	-	-	1	3.1

Table V: Distribution of patients according to the type of graft material (ICW technique; A: Auto graft, H: Homo graft)

TYPE OF GRAFT MATERIAL	CLOSURE WITHIN 20DB		CLOSURE WITHIN 30 DB	
	NUMBER	PERCENTAGE (%)	NUMBER	PERCENTAGE (%)
Incus remnant	2	6.2	25	84.4
Conchal cartilage (A)	1	3.1	-	-
Septal cartilage (H)	-	-	4	12.4

Table VI: Distribution of patients according to the type of graft material (CWD technique; A: Auto graft, H: Homo graft)

TYPE OF GRAFT MATERIAL	CLOSURE WITHIN 20DB		CLOSURE WITHIN 30 DB	
	NUMBER	PERCENTAGE (%)	NUMBER	PERCENTAGE (%)
Incus remnant (A)	3	37.5	1	12.5
Septal cartilage (H)	1	12.5	3	37.5

materials.^{12,13} Austin et.al in their study reported good stability of hearing results with autografts.¹⁴ Black et al compared the results of malleus stapes assembly with malleus footplate assembly and achieved the closure of air bone gap to within 20dB in 86% of patients in the former and 80% in the latter.¹⁵ McGee and Hough reported excellent results of hearing i.e. air bone gap closure within 10dB with sculptured ossicles.

They observed that the type of ossicular defect influenced the success of the operation. The results of malleus stapes assembly (85% patients with AB gap

closure within 20dB) were better than malleus footplate assembly (73% patients with AB gap closure within 20 dB).¹⁶ Bauer et.al., analyzed his 34 years of experience of autogenous incus and cortical bone to form a collumella between stapes head and tympanic membrane. In their study 85% showed an air bone gap closure < 20 dB and 43% showed closure < 10 dB when the tympanic membrane was normal.¹⁷

We analyzed our results according to the type of reconstruction and found that malleus stapes assembly gave best results i.e., 72.72% within 20 dB and 100%

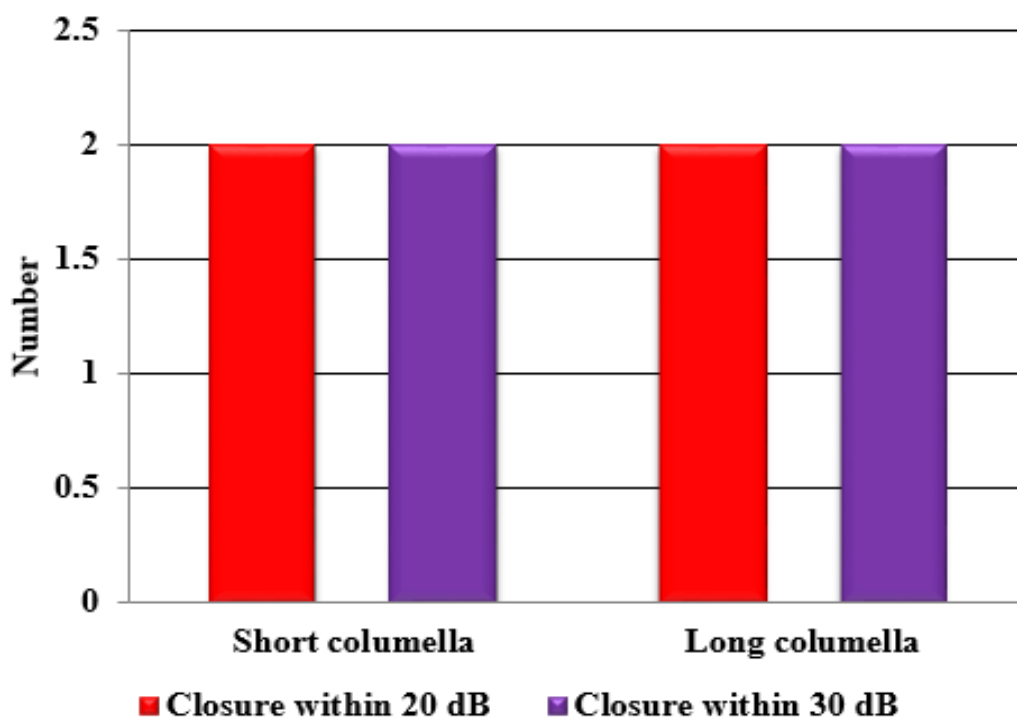


Fig. 1. Distribution of patients based on reconstruction in canal wall down procedure

within 30 dB and followed by short collumella with 22.22% within 20 dB and 100% within 30 dB in intact canal wall technique. Kartush et al found that the results of incus remnants and cortical bone were similar.¹⁸ They also found that the autogenous, bone provides better sound transmission than cartilage. In the present study too, we achieved better results with autogenous bone as compared to homograft cartilage. In this era, 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.

Conclusion

In the present study, in patients with chronic otitis media, we have found fairly 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 rarely extruded.

Limitations of study: The major limitation of this study is small sample size.

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