

# Ossiculoplasty – Our Experience

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## ABSTRACT

**Introduction:** Tympanic membrane perforations are a common presentation at ENT outpatient department. Ossicular discontinuity is co-existent in long standing cases of chronic otitis media and also in surgical removal of pathology. Ossiculoplasty is very useful in post operative hearing outcome of these cases. The objective of this study is to analyse the post operative hearing outcome with different graft materials used for ossiculoplasty.

**Material and methods:** This is a prospective comparative study on patients of selected age groups with ossicular chain defect in addition to tympanic membrane perforation presenting to the Outpatient Department in a tertiary care centre for a period of 2 years. The clinical presentation, type of ossicular defect and management with different grafts were analyzed. The post-operative hearing was categorised as Satisfactory (A-B gap on PTA <20db), Unsatisfactory (A-B gap >20db) and Failure (No improvement or deterioration in hearing).

**Results:** 50 patients aged 12-66 years were evaluated. Age group of under 30-40 years was most affected (60%). Females outnumbered males with Male to female ratio being 1:0.32. M+S+ was the most common ossicular chain defect found in 30 cases followed by M-S+ observed in 12 cases. According to the defect, majority of cases were managed with conchal cartilage (31 cases) followed by sculptured incus (10 cases). Post operative hearing was Satisfactory in 84% and unsatisfactory in 12%. Failure occurred in only 2 cases.

**Conclusions:** A single stage ossiculoplasty procedure done during the disease removal itself will result in significant air bone gap closure post-operatively and improve the quality of hearing tremendously.

**KEYWORDS:** Chronic Otitis Media, Ossiculoplasty, Sculptured Incus Graft, PORP, TORP

## INTRODUCTION

Tympanoplasty refers to any operation involving reconstruction of the tympanic membrane and/or the ossicular chain.<sup>1</sup>The post operative hearing of the patient is predominantly affected by the ossicular chain reconstruction in addition to the closure of perforation of tympanic membrane.

The discontinuity of the ossicular chain is caused by chronic otitis media, trauma and by purposeful removal of ossicles during surgery. Pars tensa retraction pockets and cholesteatoma are often associated with ossicular erosion.<sup>2</sup> Several classification systems have been proposed to assess the ossicular chain status of which the Austin classification is widely accepted. The Austin classification is based upon the presence or absence of the malleus handle (M+, M-) and stapes superstructure (S+, S-). According to this classification

there are four types of ossicular defects: type A (M+,S+), type B (M+,S-), type C (M-, S+), and type D (M-,S-).<sup>3</sup> The commonest defect is erosion of the long process of the incus<sup>4</sup> with intact malleus handle and stapes superstructure (type A), followed by types B, C, and D.

Different materials have been used for the reconstruction of middle ear ossicular assembly. Autologous conchal and tragal cartilage, autologous incus and malleus, preserved allografts, septal spur cartilage, biomaterials like PORP (partial ossicular reconstruction prosthesis) and TORP (total ossicular reconstruction prosthesis) are some of them.

In the present study, different graft materials used in ossicular reconstruction and the post operative outcomes were analysed.

## MATERIAL AND METHODS

This comparative prospective study was conducted on 50 cases of chronic otitis media with ossicular discontinuity during a period of two years, from March 2021 to March 2023. All patients presenting to Outpatient Department meeting the inclusion criteria were included in the study.

### Inclusion criteria

Patients of age group 10 - 70 years with a clinical presentation of tympanic membrane perforation, documented pure tone audiogram indicative of ossicular discontinuity and suspicious ossicular discontinuity on examination under microscope were included in the study.

### Exclusion criteria

Patients of age below 10 years and above 70 years, pregnant and lactating women were excluded from the study.

Cases with fixation pathology of ossicles were also excluded from the study.

Every case in the study was examined under microscope and pure tone audiogram was done which was indicative of more than 40db conductive hearing loss in the respective ear. Cases with large perforation were also examined with rigid 0 degree and angled endoscopes.

Most of the cases were operated under local anaesthesia while few apprehensive patients were operated under

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general anesthesia. Depending on the nature and extent of disease, tympanoplasty and canal wall up or canal wall down mastoidectomy procedures were performed. The extent of ossicular damage was assessed intra operatively and different graft materials were used accordingly.

All the ossiculoplasty procedures were single stage only. Different materials used for ossiculoplasty were -

- Autograft – (i) Ossicles – incus (ii) Conchal cartilage
- Preserved Allograft – (i) Ossicles – incus (ii) Septal spur cartilage
- Biomaterials – (i) Partial ossicular replacement prosthesis (PORP). (ii) Total ossicular replacement prosthesis (TORP)

The post operative outcomes were evaluated according to hearing status as observed in pure tone audiogram and categorised as :

- Satisfactory : Post-operative air-bone gap (a-b gap) of 20 decibels (dB) or less.
- Unsatisfactory : Post-operative air-bone gap of 20 to 30 dB.
- Failure : No Post-operative improvement in hearing or deterioration in hearing

All the patients were followed up at regular intervals during the course of the study and the data was analysed and results tabulated.

## RESULTS

In this present study a total of 50 cases with some sort of ossicular mechanism defect except fixation pathology were studied and the post operative hearing outcomes analysed.

### Age and sex distribution

Age group of 30-40 years was mostly affected (60%) in our study followed by 40-50 year age group which comprised 20 percent. The youngest patient was 12 years old and the oldest 66 years.

Number of males were 16 while females were 34 out of the total 50 cases. Male to female ratio was 1:0.32. The data is presented in Table 1.

### Type of ossicular chain defect

In this study, the most common ossicular defect was absence of long process of incus or incus as a whole followed by absent incus and malleus with intact stapes superstructure. The list is presented in Table 2. (M= Malleus, S= Stapes super structure)

### Different graft materials for ossiculoplasty

The whole list of graft materials used for ossiculoplasty in different scenarios is presented in Table 3.

### Hearing outcomes of the procedure performed

In this study, the post operative outcomes were measured in hearing status observed in pure tone audiogram and categorised as :

- Satisfactory : Post-operative air-bone gap (a-b gap) of 20 decibels (dB) or less.
- Unsatisfactory : Post-operative air-bone gap of 20 to 30 dB.
- Failure : No Post-operative improvement in hearing or

deterioration in hearing

The post operative result was Satisfactory in majority of the cases (42) with Unsatisfactory result in few cases (6) only. 2 cases were labelled as failure. All the patients were followed up at regular intervals and the results documented. The satisfaction levels remained largely similar at all the intervals. The details are in Table 4.

### Detailed Analysis of the outcome with the graft used

\* **M+S+ (30 cases):** In the 30 cases having the defect of absent incus with M+S+, majority (23) were dealt with fresh autologous conchal cartilage interposed between malleus and stapes superstructure while in only 7 cases sculptured incus was used to complete the ossicular assembly. Out of all the 30, satisfactory result with closure of air bone gap to <20db was obtained in 27 cases and unsatisfactory result was obtained in the remaining 3 cases ( One case in which conchal cartilage was used and other 2 in which incus graft was used). There was no failure.

\* **M+S- (5 cases):** Among the 5 cases of this category, in 3 cases autologous conchal cartilage was used and in 2 cases, preserved septal spur cartilage was used in ossiculoplasty. Satisfactory result was obtained in 4 while only 1 case was labelled unsatisfactory in which septal spur cartilage was used.

\* **M-S+ (12 cases):** Out of the 12 cases, 5 were dealt with autologous conchal cartilage. In 3 cases, autologous sculptured incus was used in 2 and preserved incus was used in 1 case. In the remaining 4 cases, Partial ossicular reconstruction prosthesis (PORP) was used atop the stapes superstructure. Satisfactory result was obtained in 10 cases and unsatisfactory result in 1 case (of incus graft). A singular case of Failure was encountered in this category in which the PORP used got extruded out at 3 months post operative period.

\***M-S- (3 cases):** Among the 3 cases in this group, in 2 cases stored septal spur cartilage was used as a long collumella stapes graft. In the remaining one case, Total ossicular reconstruction prosthesis (TORP) was used. The post operative outcomes were satisfactory in the 1 case of long collumella stapes graft and unsatisfactory in the other. The sole case of TORP usage resulted in a failure due to displacement of the prosthesis.

### Satisfaction levels with Graft used

- **Autologous Conchal cartilage:** Total 31 cases: 30 Satisfactory (96.78%); 1 Unsatisfactory (3.22%)
- **Sculptured Incus :** Total 10 cases: 7 Satisfactory result (70%) ; 3 Unsatisfactory (30%)
- **Preserved Septal spur cartilage:** Total 4 cases: 2 Satisfactory (50%); 2 Unsatisfactory (50%)
- **PORP:** Total 4 cases: 3 Satisfactory (75%); 1 Failure (25%)
- **TORP:** Total 1 case: Failure

## DISCUSSION

Attempts to rebuild the middle ear transformer mechanism

began after the introduction of tympanoplasty and great advances have been made in the physiological functioning and biocompatibility of autografts and implants.<sup>5</sup> Ossicular repositioning was described in 1957<sup>6</sup> and continues to be used today. Several classifications of ossicular chain discontinuity and their management have been proposed. The most common ossicular defect is absent long process and precisely the lenticular process of incus. If the lenticular process of the incus is eroded, and if the malleus is in close proximity to the stapes superstructure, a sculptured incus prosthesis is a good option with satisfactory post operative hearing outcome. This management method has been described by Pennington<sup>7</sup> and Austin. Over the years, several graft materials comprising autografts ( conchal cartilage, tragal cartilage, ossicles-malleus & incus ), allografts ( preserved cartilage and ossicles), preserved septal spur cartilage, biomaterials (PORP,TORP) have been employed for ossiculoplasty with variable success rates.

In this study different graft materials were used in all the 50 cases of ossicular chain defects and the hearing outcomes

assessed according to the post operative pure tone audiogram air bone gap correction. Satisfactory results (A-B gap <20db) were obtained in majority of cases (84%). The study comprised of age group 10-70 years with majority (60%- 30 cases) in the age group of 31-40 years. The youngest was 12 years and the oldest 66 years. In a study by Thotambailu et al<sup>8</sup>, age of the patients ranged from 18 to 65 years, with a mean of 34.17 years. The median age group in their study was 31.5 years. This is similar to the result obtained in the present study.

In the present study, females outnumbered males with male to female ratio being 1:0.32. Particularly females in the mid 30s age were observed to be more in number. In the study by Khanam et al<sup>9</sup> on 60 patients, there were 32 (53.3%) female and 28 (46.7%) male patients with a male to female ratio of 1:1.4. This observation shows almost equal number of male and female patients which is in contradiction to the present study.

In this study, the most common ossicular defect was absent incus with intact malleus and stapes (M+S+), found in 30 out of the 50 cases (60%). Absent Malleus and incus with intact stapes (M-S+) was the next common presentation found in 12 cases, followed by M+S- (5 cases) and M-S- (3 cases). This finding is similar to the study by Thamizh arasan<sup>10</sup> who observed that incus was absent in 104 (62.27%) cases with the presentation being M+S+. This is also similar to the study by Austin<sup>3</sup> who reported the most common ossicular defect to be the erosion of incus, with intact malleus and stapes, in 29.50% cases. However in the study by Somesh Mozumder et al<sup>11</sup>, in 10(16.67%) cases ossicular status was M+ I+ S+, in 9(15%) cases it was M+ I- S+, in 14(23.33%) cases it was M+ I- S- ,in 12(20%) cases ossicular status was M- I- S+ and in 15(25%) cases ossicular status was M- I- S-. Therefore, the commonest ossicular chain status was M- I- S followed by M+ I- S- & M- I- S+. This finding is in contradiction to the present study.

In the present study, different graft materials used for ossiculoplasty were tailored according to the situation and operational challenges. Autologous conchal cartilage was used in majority of cases (31), followed by autologous and

Age group (in years)	Male	Female	Total number of cases	%
10-20	01	01	02	4
21-30	02	03	05	10
31-40	08	22	30	60
41-50	04	06	10	20
51-60	01	01	02	4
61-70	00	01	01	2
Total	16	34	50	100

**Table-1:** Age and sex distribution of cases.

Defect	Total number of cases	Percentage (%)
M+S+	30	60
M+S-	05	10
M-S+	12	24
M-S-	03	6
Total	50	100

**Table-2:** Type of Ossicular chain defect.

Defect (total cases)	Sculptured Incus (Preserved allograft and fresh autograft)	Conchal cartilage	Septal Spur Cartilage (Preserved allograft)	PORP	TORP
M+S+ (30)	7	23	0	0	0
M+S- (5)	0	3	2	0	0
M-S+ (12)	3	5	0	4	0
M-S- (3)	0	0	2	0	1
Total (50)	10	31	4	4	1

**Table-3:** Type of Graft material used in ossiculoplasty.

Result	Total number of cases	Percentage (%)
Satisfactory	42	84
Unsatisfactory	06	12
Failure	02	4

**Table-4:** Hearing outcome of the procedure.

preserved sculptured incus (10 cases) and preserved septal spur cartilage (4 cases). Biomaterials like PORP was used in 4 cases and TORP in 1 case. The post operative hearing outcome was declared Satisfactory when <20db of AB gap closure was achieved.

With Conchal cartilage graft, the satisfaction level was 96.78%. In the study by Acharya SK et al.<sup>12</sup>, 60% satisfactory result was obtained with cartilage graft ossiculoplasty which was similar to ossicular graft (70% satisfactory result). With Sculptured incus graft, we have obtained a satisfaction level of 70% combining all the different scenarios which is similar to the study of Acharya SK et al. This finding is also similar to the study by Ikramullah Khan et al.<sup>13</sup> on 150 cases of tympanoplasty and ossicular chain reconstruction, who achieved an overall success rate of 80% with autologous sculptured incus graft.

Preserved septal spur cartilage was used in only 4 cases of the study with 50% satisfactory and 50% unsatisfactory hearing outcome in post-operative period. This is in contradiction to the study by Rukmini M Prabhu, et al.<sup>14</sup>, who used preserved septal cartilage in the presence of the stapes superstructure and achieved 90% hearing improvement after surgery.

PORP was used in 4 cases with a Satisfaction level of 75% which is similar to the study by Schember S et al.<sup>15</sup> who achieved post operative A-B gap closure <20db in 77% of PORP usage cases. This finding is also similar to the study by Berenholz et al.<sup>16</sup> who obtained an A-B gap within 20 dB 81.2% of PORP patients. TORP was used in only one case in the present study and it was a failure due to extrusion of prosthesis. A proper comparative analysis could not be made as one case was a very small number.

## CONCLUSION

Ossiculoplasty is a very important step in reviving the hearing of the patient to an acceptable level post operatively. If done in a tailor-made fashion according to the case presentation, the post operative air-bone gap will be significantly reduced and the conductive hearing loss corrected. In this study, different graft materials were used in ossiculoplasty with the post operative A-B gap closure < 20db being achieved in 84% cases. The type of graft material used was according to the demand of the situation coupled with operational challenges. Also, the result was largely similar with all graft materials predominantly used. Mere closure of perforation and eradication of disease in cases of chronic otitis media, although acceptable to patient, is not enough and ossiculoplasty should be done wherever possible as it makes a tremendous difference. So, we conclude that a good ossiculoplasty done as a single stage procedure during the disease removal itself, creates a world of difference in the patient's hearing and improves the quality of life.

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