

# Autografts in Middle Ear Reconstruction: A Study of 30 Cases

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## ABSTRACT

**Introduction:** Chronic suppurative otitis media is an inflammation of the middle ear cleft with ossicular destruction. Restoration of a sound transfer mechanism is the goal of modern ossiculoplasty using a variety of allogenic and autograft materials.

**Material and Methods:** A retrospective analysis of 30 cases of ossiculoplasty using autografts was done. Patients with sensorineural hearing loss, tuberculosis and other complications were excluded from the study.

**Results:** Thirty cases were analysed for various factors. Majority of cases were from 21 – 30 years age group (36.7%). Males were predominantly affected in a ratio of 3:1. Nine cases (30%) presented with otorrhoea for a duration of 1 – 5 years. Equal number of patients presented with unilateral and bilateral deafness. Moderate degree of hearing loss was present in maximum cases (47%). In 7 patients (24%) there was otalgia, while 4 patients (14%) had tinnitus. 18 cases (60%) had tubotympanic type of disease. Intra-operatively, necrosis of lenticular process of incus was seen in a majority of 24 cases.

**Conclusion:** Ossicular reconstruction with significant improvement of conductive hearing loss remains a surgical challenge. Autologous ossicles have been preferred because of easy availability, low cost of preparation, good sound conduction and biocompatibility.

**Keywords:** Autografts, Ear Reconstruction

## INTRODUCTION

Chronic suppurative otitis media is an inflammation of the middle ear cleft. It is of insidious onset, intermittent or progressive in nature, with the potential severe destruction and irreversible sequelae. The middle ear ossicles often have to be removed because of pathological destruction. The replacement of these ossicles has always been a challenge in middle ear surgery.

With the advent of the operating microscope, Halland Rytznar performed the first ossicular chain reconstruction using autologous ossicular bone and a sculptured autologous malleus, interposed between the tympanic membrane and stapes footplate.<sup>1</sup> Portmann reported various interposition techniques using a sculptured autologous incus or malleus.<sup>2</sup> Guilford found better hearing gains with malleus to stapes head or footplate interposition.<sup>3</sup>

Austin described various types of ossicular defects and reconstructive interposition techniques labeled as the ‘malleus-stapes assembly’.<sup>4</sup> Incus interposition for reconstruction of the ossicular chain has also been described by several other authors (Pennington<sup>5</sup>; Smyth<sup>6</sup>; Glasscock<sup>7</sup>; Mawson<sup>8</sup>).

Zollner and Wullstein laid down the requirements for a functioning middle ear in the 1950s: an intact elastic tympanic membrane, a ventilated middle ear space, a mobile and unobstructed oval and round window and a mechanism to link the tympanic membrane to the oval window

Each technique has its own pros and cons, and there is currently

no universally effective way of correcting conductive hearing losses under these circumstances. Farnier reported that many transposition operations failed due to ossicular fixation.<sup>10</sup>

Incus is most commonly reshaped and placed between malleus and stapes. Allografts are used in cases when autograft materials are not available, or – as in patients with cholesteatoma - an ossicle may not be suitable because of osteitis, adherence to surrounding walls, resorption and loss of rigidity. The use of allogenic ossicles was first introduced by House et al in 1966.<sup>11</sup> Modern ossiculoplasty aims to restore stable sound transfer mechanism in middle ear.

In this study of 30 cases of ossiculoplasty with autografts, we aim to explore and correlate the importance of presenting symptoms and clinical signs of the disease with the investigations, intraoperative findings, various ossicular assemblies and post-operative follow up, finally to gauge hearing improvement in the patients.

## MATERIAL AND METHODS

We conducted a retrospective analysis of 30 cases of ossiculoplasty using incus/malleus/cartilage as autograft in patients who came for the treatment in our hospital over a period of two years. These cases, 16 to 60 years of age, presented with chronic suppurative otitis media (safe and unsafe) with or without previous surgery and with an air-bone gap (in pure tone audiogram). Patients with sensorineural hearing loss, bone diseases like tuberculosis, no follow-up for a period of 6 months after previous surgery, stapes fixation, congenital atresia, presence of any allergic or septic foci, other metabolic conditions like diabetes mellitus, hypertension, etc. and other complications of chronic suppurative otitis media like facial nerve dehiscence, labyrinthine fistula, etc. were excluded. We included 30 cases with the help of simple random sampling method after matching inclusion and exclusion criteria. Informed consent was taken. Institutional ethics committee approval was taken before the start of the study.

Following general physical and detailed ENT examination, the cases were prepared for surgery. Tuning fork tests, pure-tone audiometry and blood tests were carried out.

The following reconstruction options were used:

### 1. A malleus stapes assembly using incus

In patients who did not need a mastoidectomy, incus was used as the ossicle. Hearing results were better in such cases. As incus can be reshaped easily and its length can be adjusted, it can be used in different types of reconstruction.

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**How to cite this article:** Reema Rai, Sanjay Chhabria. Autografts in middle ear reconstruction: a study of 30 cases. International Journal of Contemporary Medical Research 2016;3(8):2364-2366.

## 2. Ossicle on the stapes head – using incus/malleus

Here, either incus or malleus were used. The results were better with malleus autografts probably due to shape of malleus. The malleus when shaped is barrel like and having a broad base is a stable assembly. Hence it sits comfortably on the head of stapes. This also augments the stapes head in a modified radical mastoidectomy.

## 3. Ossicles on stapes footplate (incus/malleus/cartilage)

Incus, malleus or cartilage was used in certain cases. The results were good with incus, malleus and tragal cartilage, probably because it helps in creating a middle ear space. Malleus is adaptable to both stapes suprastructure – present and stapes suprastructure – absent situations as well as in the presence of a fixed footplate and can be used with all type of middle ear autografts.

All cases were followed post-operatively for a minimum period of 6 months. All cases were subjected to post-operative pure tone audiogram for 6 months following surgery.

## STATISTICAL ANALYSIS

Statistical Analysis was done with the help of SPSS version 21. Descriptive statistics like mean and percentages were used to infer data.

## RESULTS

Majority of cases were from second decade of life forming 36.7%, followed by third decade forming 30%. Males were predominantly affected as compared to females in a ratio of 3:1. 9 cases (30%) presented with otorrhoea for a duration of 1 – 5 years. Seven cases (23.3%) had discharge for duration of 5 – 10 years. There were equal number of patients presenting with unilateral and bilateral deafness, 15 cases each.

Moderate degree of hearing loss (41 – 55 dB) was present in majority of cases (60%) patients followed by mild degree in 9 cases (30%) and severe hearing loss (56 – 70 dB) was present in 3 cases (10%).

In 7 patients (24%) there was presence of otalgia, while 4 patients (14%) had tinnitus. 18 cases (60%) had tubotympanic type of disease while 12 cases (40%) who were operated for ossiculoplasty had atticointral type of disease. All patients had sclerotic mastoid on X-ray.

Intra-operatively amongst a majority of 24 cases, necrosis of lenticular process of Incus was seen, and 22 cases had necrosis of long process of Incus. Handle of Malleus was necrosed in 16 cases. 7 cases who had necrosis of stapes suprastructure also had associated necrosis of malleus and incus.

Also it was observed intra-operatively that in 16 cases (54%) handle of Malleus was necrosed, while in 4 cases (13%) the same was foreshortened. 10 cases (33%) had normal handle of Malleus.

In most of our cases, body of Incus (64%) was used for reconstruction of ossicular chain after reshaping. In 7 cases (23%) tragal cartilage was used and in 4 cases (13%) head of malleus was used (Table-1).

Most of our patients underwent tympanoplasty followed by cortical mastoidectomy (Table-2)

9 patients had a hearing gain of 20 dB which formed 45% of study group. 30 dB hearing was achieved in 4 (20%) patients (Table-3). 10 patients showed a loss in hearing following

surgery, of which 60% showed loss of 10 dB. Only one patient had loss of 30 dB.

23 cases (77%) showed an intact tympanic membrane or a healed mastoid cavity post-operatively. 13 % showed a residual perforation and 10% showed retracted pars tensa.

## DISCUSSION

The aim of middle ear reconstructive surgery is to restore the ossicular chain as near to normal as possible. In the last three decades, various ossiculoplasty methods using different graft materials have evolved and good result have been obtained but ossiculoplasty is still evolving.

The challenge during ossiculoplasty has been how to achieve a stable, reliable connection between the tympanic membrane and mobile stapes footplate that will provide the best long term hearing results, without complications, in a chronically infected ear.

Out of several materials that are available for middle ear reconstruction we have studied tragal cartilage, autograft incus and malleus.

There are several variables in middle ear surgery that affects the results.

- Most significant variable is the function of Eustachian tube. It affects the long term survival of the various grafts in middle ear surgery.
- The second variable is the status of the middle ear mucosa. The presence of active infection, polypoidal changes, granulation tissue, or bare bone can affect the subsequent function of an implanted autograft.
- The condition of the tympanic membrane is the third variable. Ossicular reconstruction when the tympanic membrane is intact gives better results than when there is a perforation in tympanic membrane.
- The fourth variable is the status of the ossicular chain. The presence of stapes superstructure is very important to improve hearing in ossicular reconstruction.
- The underlying process itself (disease or trauma factor) that has caused a specific ossicular defect is a fifth variable. Congenital ossicular abnormalities, cholesteatoma cases and traumatic ossicular discontinuities are difficult to

Ossicles used for reconstruction	No of cases	Percentages (%)
Body of Incus	19	64
Head of Malleus	4	13
Tragal Cartilage	7	23

**Table-1:** Ossicles used for reconstruction (n=30)

Type of surgeries	No of cases	Percentages (%)
Tympanoplasty	13	44
Cortical Mastoidectomy	10	33
CWD Mastoidectomy	7	23

**Table-2:** Types of surgeries (n=30)

Range	Gain	Percentages (%)
0 to 10 dB	7	35
11 to 20 dB	9	45
21 to 30 dB	4	20

**Table-3:** Hearing improvement following surgery

manage.

Success of ossiculoplasty is measured by air-bone gap closure which is a good indicator of comparing different reconstructions. In the present study, we have included 30 patients who have undergone ossicular reconstruction with either a head of malleus, body of incus or tragal cartilage as autograft.

The pre-operative hearing disability (by air-bone gap), intraoperative findings, autografts used and post-operative improvement or loss in hearing have been studied. The findings of this study were then compared to earlier published series.

In our series the majority of cases were between 21 – 30 years of age (36.66%). Youngest being 10 years and oldest being 54 years. But age was not found as a predictor of underlying disease in ours as well as any other study referred. Males were predominantly affected, and the male to female ratio was 3:1. Out of 30 patients, 23 were males (77%) and 7 females (23%). 60% had tubotympanic type of disease while 40% had attic-antral type of disease.

Moderate degree of hearing loss was present in majority of cases. Intra-operatively in 22 cases which formed majority had necrosis of long process of incus with lenticular process. Handle of malleus was necrosed in 16 cases. 7 cases that had necrosis of stapes suprastructure also had associated necrosis of malleus and incus. In a series by Gordon Smyth where 900 cases were studied showed 90% with a defective incus and malleus handle.<sup>6</sup> In 44% tympanoplasty was done, in 33% cortical mastoidectomy was done and in 23% canal wall down mastoidectomy was done. In patients with tubotympanic type of disease (safe chronic suppurative otitis media), tympanoplasty (without mastoidectomy) was done. Whereas, cortical mastoidectomy was done in patients with granulation tissue in middle ear, aditus and with early retraction pocket of pars tensa (grade I and II). In patients with cholesteatoma or retraction pocket of pars tensa extending beyond lateral semicircular canal, canal wall down mastoidectomy was done.

Depending upon the remnant ossicular components, in most of our 19 cases (64%) body of incus was used for reconstruction of necrosed ossicle after reshaping. In 7 cases (23%) tragal cartilage was used and in 4 (13%) cases head of malleus was used. This correlated with the malleus-stapes assembly modification of Armstrong<sup>12</sup> and Austin<sup>4</sup> where incus is sculpted and fit into the interval between the stapes head and the malleus handle. Also seen in a study by Bauer et al (2000), the efficiency of the body of incus and that of the cortical bone are seen to be equally good.<sup>13</sup>

In our series improvement of hearing following surgery was 64%. Of which, 9 (45%) patients showed an improvement in air-bone gap of 20 dB, 4 (20%) patients with an improvement of 30 dB and 7 (35%) patients with an improvement of 10 dB. As compared to a study by Bauer et al where 68% of all ears undergone ossicular autograft reconstruction showed air-bone gaps improvement of 20 dB, and 10 dB improvement of 28%.<sup>13</sup> The causes for post-operative hearing loss in our study were residual perforation, retraction of pars tensa, mastoid cavities which retrospectively were presumed to be conducting loss.

Our series showed a failure of 36% as compared to a study by Yung who reported that among disease, extrusion and surgeon-related problems of ossiculoplasty, failures accounted for 56%.<sup>14,15</sup>

Good result in ossiculoplasty depends on case selection and technical ability. One of the most challenging aspects of training ear surgeons in a residency program is the instruction of when and when not to operate in a given situation based on the patient's hearing level, history, and presentation. Variable hearing results in literature after ossiculoplasty is because of lack of understanding and uniform reporting of those middle ear factor that influence the results.

## CONCLUSION

This study was conducted to provide an ossicular replacement prosthesis using an autograft between the tympanic membrane and oval window of a patient's ear, which will be inexpensive, have a low complication rate, and an acceptable hearing result. Ossicular reconstruction with significant improvement of conductive hearing loss remains a surgical challenge. The benefit of reconstructing the ossicular chain is well documented in both canal wall up and canal wall down tympanomastoidectomies. Autograft ossicles are ideal for this procedure, provided that they are disease free. We should thus strive to correct tympanic membrane deficiencies and reconstruct the ossicular chain, in order to improve the quality of life of our patients.

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**Source of Support:** Nil; **Conflict of Interest:** None

**Submitted:** 15-06-2016; **Published online:** 31-07-2016