Original Research

MANAGEMENT AND HEARING REHABILITATION OUTCOMES IN PATIENTS WITH TRAUMATIC OSSICULAR DISRUPTION: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Traumatic ossicular chain disruption is an important cause of persistent conductive hearing loss following head trauma. Early diagnosis and appropriate surgical intervention are essential for restoring hearing. Ossiculoplasty is commonly performed to reconstruct the ossicular chain and improve auditory outcomes. However, hearing rehabilitation outcomes may vary depending on the type of ossicular injury and reconstruction technique used.

Objective: To evaluate the management strategies and hearing rehabilitation outcomes in patients with traumatic ossicular chain disruption.

Materials and Methods: This prospective observational study was conducted in the Department of Otorhinolaryngology at IMS & SUM Hospital, Bhubaneswar, from September 2023 to December 2025. A total of 30 patients aged 18–60 years with conductive hearing loss due to traumatic ossicular disruption were included. All patients underwent detailed clinical examination, otoscopic evaluation, pure tone audiometry, and high-resolution computed tomography (HRCT) of the temporal bone. Patients with confirmed ossicular chain disruption underwent exploratory tympanotomy followed by ossiculoplasty. Hearing outcomes were assessed by comparing preoperative and postoperative air-bone gap (ABG) values over a 12-month follow-up period.

Results: The majority of patients were male (66.7%). Road traffic accidents were the most common cause of trauma (46.7%). Incudostapedial joint dislocation was the most frequent ossicular injury observed. The mean preoperative air-bone gap was 34.6 ± 6.8 dB, which improved significantly to 13.2 ± 4.5 dB at 12-month follow-up. Successful hearing improvement (ABG ≤ 20 dB) was achieved in 83.3% of patients. Titanium partial ossicular replacement prosthesis and autologous incus interposition were the most common reconstruction techniques used.

Conclusion: Traumatic ossicular chain disruption is a significant cause of conductive hearing loss following head injury. Early diagnosis and appropriate surgical reconstruction provide favorable hearing rehabilitation outcomes.

Keywords: Traumatic Ossicular Disruption, Ossiculoplasty, Conductive Hearing Loss, Temporal Bone Trauma, Hearing Rehabilitation.

INTRODUCTION

Traumatic injuries to the temporal bone are an important cause of hearing impairment and may significantly affect the function of the middle ear. One of the most common consequences of such trauma is disruption of the ossicular chain, which results in conductive hearing loss[1]. The ossicular chain consists of three small bones—the malleus, incus, and stapes—which form a mechanical linkage that transmits sound vibrations from the tympanic membrane to the oval window of the inner ear. This transmission system plays a vital role in amplifying sound energy and ensuring efficient sound conduction. Any interruption or discontinuity within this chain can impair sound transmission and lead to varying degrees of hearing loss[2,3].

Traumatic ossicular chain disruption typically occurs as a result of blunt head trauma, road traffic accidents, falls, sports injuries, or interpersonal violence.

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The delicate articulation between the ossicles makes them susceptible to displacement or fracture following sudden mechanical forces applied to the temporal bone[4]. Among the different types of ossicular injuries, dislocation of the incudostapedial joint is reported as the most common, followed by incus dislocation, malleoincudal joint separation, and fractures of individual ossicles[5]. In many cases, these injuries may occur without perforation of the tympanic membrane, which can make clinical diagnosis difficult during the initial evaluation[6].

Patients with traumatic ossicular chain disruption commonly present with persistent conductive hearing loss following head injury. While some degree of hearing impairment may occur immediately after trauma due to hemotympanum or middle ear edema, these conditions often resolve spontaneously.

However, if hearing loss persists after the resolution of middle ear inflammation, ossicular disruption should be suspected. A comprehensive diagnostic evaluation including otoscopic examination, tuning fork tests, and audiological assessment with pure tone audiometry is essential for identifying conductive hearing loss[7]. High-resolution computed tomography (HRCT) of the temporal bone is particularly useful in visualizing ossicular abnormalities and confirming the diagnosis[15]. Surgical exploration of the middle ear through exploratory tympanotomy is considered the gold standard for both diagnosis and management of ossicular chain disruption. During this procedure, direct visualization of the ossicles allows the surgeon to assess the extent of injury and perform appropriate reconstruction[8]. Ossicular chain reconstruction, commonly referred to as ossiculoplasty, may involve techniques such as autologous ossicle interposition, cartilage grafting, or the use of prosthetic implants including partial ossicular replacement prosthesis (PORP) and total ossicular replacement prosthesis (TORP)[11].

Advances in microsurgical techniques, improved imaging modalities, and the development of biocompatible prosthetic materials—particularly titanium prostheses—have significantly improved the outcomes of ossicular reconstruction procedures[9]. Numerous studies have demonstrated favorable hearing improvement following ossiculoplasty, with significant closure of the air–bone gap in patients with traumatic ossicular injuries[12]. Despite these advances, postoperative hearing outcomes can vary depending on several factors, including the type and severity of ossicular injury, the surgical technique used, the condition of the middle ear mucosa, and the timing of surgical intervention[10],[13],[14].

Therefore, evaluating the effectiveness of different management approaches is essential for optimizing hearing rehabilitation in affected patients. The present study was undertaken to evaluate the management strategies and hearing rehabilitation outcomes in patients with traumatic ossicular chain disruption treated at a tertiary care center.

AIM AND OBJECTIVES

Aim: To evaluate the management strategies and hearing rehabilitation outcomes in patients with traumatic ossicular chain disruption undergoing surgical treatment at a tertiary care center.

Objectives

Primary Objective

1. To assess the hearing outcomes following ossicular reconstruction (ossiculoplasty) in patients with traumatic ossicular chain disruption using pure tone audiometry and air-bone gap closure.

Secondary Objectives

1. To determine the pattern and types of ossicular injuries in patients presenting with traumatic conductive hearing loss.
2. To evaluate the different surgical techniques used for ossicular chain reconstruction, including autologous ossicle interposition and prosthetic ossiculoplasty.
3. To compare the preoperative and postoperative air-bone gap (ABG) to assess the effectiveness of surgical management.
4. To analyze the association between type of ossicular injury and postoperative hearing outcome.
5. To determine the overall success rate of hearing rehabilitation, defined as postoperative air-bone gap ≤20 dB at 12-month follow-up.

MATERIALS AND METHODS

Study Design

The current study was planned as a prospective observational study to evaluate care and hearing rehabilitation outcomes in patients with traumatic ossicular chain disruption. A prospective strategy was used to carefully monitor patients over time and assess postoperative hearing improvement following surgical intervention.

Study Setting

This study was conducted in the Department of Otorhinolaryngology, IMS & SUM Hospital, Bhubaneswar, a tertiary care teaching hospital that provides specialized care for patients with ear disorders, including traumatic middle ear injuries.

Study Duration

The study was conducted between September 2023 and December 2025, a span of two years and four months. Eligible individuals with traumatic conductive hearing loss were assessed throughout this time, had surgical treatment where necessary, and had their hearing results monitored.

Sample Size

The study comprised 30 patients in all who met the inclusion criteria. The number of patients who presented with traumatic ossicular chain disruption during the study period and those who agreed to have surgery and follow-up were used to calculate the sample size.

Study Population

The study population consisted of adult patients aged between 18 and 60 years who presented to the outpatient department or emergency department with a history of head trauma and persistent conductive hearing loss suggestive of ossicular chain disruption.

Patients were thoroughly evaluated through clinical examination, audiological assessment, and radiological imaging to confirm the diagnosis.

Inclusion Criteria

Patients were included in the study if they met the following criteria:

- Age between 18 and 60 years.
- History of head trauma followed by persistent conductive hearing loss.
- Audiological evidence of conductive hearing loss on pure tone audiometry.
- High-resolution computed tomography (HRCT) of the temporal bone demonstrating ossicular chain disruption.
- Patients willing to undergo surgical management and comply with regular postoperative follow-up.

Exclusion Criteria

Patients were excluded from the study if they had:

- Sensorineural hearing loss detected on audiological evaluation.
- Chronic otitis media or active middle ear infection.
- Congenital ossicular chain anomalies.
- History of previous ear surgery.
- Patients who were unwilling for surgery or follow-up.

Data Collection

Each patient's comprehensive clinical data was gathered utilizing a standardized case record form following informed consent.

Clinical History

A comprehensive clinical history was obtained including:

- Mode of trauma (road traffic accident, fall, assault, or other causes)
- Duration of hearing loss
- Associated symptoms such as tinnitus, vertigo, ear pain, or ear discharge
- Any previous medical or otological conditions.

Clinical Examination

A comprehensive examination of the ears, nose, and throat was performed on each patient, which included:

- Otoscopic examination to evaluate external auditory canal and tympanic membrane health.
- Microscopic examination when required for better visualization of the tympanic membrane.

Audiological Assessment

Pure tone audiometry (PTA) was used for the audiological assessment in a soundproof audiometric booth. At frequencies of 0.5, 1, 2, and 4 kHz, both air conduction and bone conduction hearing thresholds were tested.

The difference between the thresholds for air conduction and bone conduction was used to compute the air-bone gap (ABG). Conductive hearing loss was indicated by a significant air-bone gap.

Radiological Assessment

Every patient had a temporal bone high-resolution computed tomography (HRCT). HRCT imaging helped identify ossicular abnormalities such as:

- Incudostapedial joint dislocation
- Incus dislocation
- Malleoincudal joint disruption
- Ossicular fractures.

Before proceeding with surgical surgery, radiological data were compared to clinical and audiological findings.

Surgical Procedure

Patients diagnosed with ossicular chain disruption were scheduled for exploratory tympanotomy under general anesthesia.

Depending on the surgical needs and anatomical considerations, either a postauricular or transcanal approach was employed.

During surgery, the middle ear cavity was carefully explored to assess:

- Integrity and position of the ossicles
- Presence of ossicular dislocation or fracture
- Mobility of the stapes
- Condition of the middle ear mucosa.

Based on intraoperative findings, appropriate procedures were used to conduct ossicular reconstruction.

Reconstruction Techniques

The following ossiculoplasty techniques were used:

1. **Autologous Incus Interposition**

The patient’s own incus was reshaped and repositioned between the malleus and stapes to restore ossicular continuity.

2. **Partial Ossicular Replacement Prosthesis (PORP)**

The stapes head and the malleus handle or tympanic membrane were separated by a titanium prosthetic.

3. **Total Ossicular Replacement Prosthesis (TORP)**

A TORP prosthesis was utilized to restore the ossicular chain in situations where the incus and stapes superstructure were either missing or damaged.

The tympanic membrane was moved, and gel foam soaked with antibiotics was put into the ear canal.

Outcome Assessment

Hearing outcomes were evaluated using pure tone audiometry during follow-up visits.

Audiometric testing was performed at:

- Preoperative baseline
- 3 months postoperatively
- 6 months postoperatively
- 12 months postoperatively

The air-bone gap (ABG) was used as the primary measure of hearing improvement.

A successful hearing outcome was defined as postoperative air-bone gap closure to ≤ 20 dB.

Statistical Analysis

The Statistical Package for Social Sciences (SPSS) program, version 26.0 (IBM Corp., Armonk, NY, USA), was used to enter and analyze all of the study's data. The study population's clinical and demographic features were compiled using descriptive statistics.

Frequencies and percentages were used to display categorical characteristics such gender, the type of ossicular injury, and the etiology of the trauma. Mean ± standard deviation (SD) was used to express continuous variables, such as preoperative and postoperative air-bone gap (ABG).

To assess improvement following surgery, preoperative and postoperative hearing thresholds were compared using the paired t-test.

Statistical significance was defined as a p-value of less than 0.05. For easier interpretation, tables and charts were used to show the results.

RESULTS

A total of 30 patients with traumatic ossicular chain disruption who fulfilled the inclusion criteria were included in the study. All patients underwent detailed clinical evaluation, audiological assessment, radiological investigation, and surgical management followed by regular follow-up for 12 months to evaluate hearing outcomes.

Age and Gender Distribution of Study Population

A total of 30 patients with traumatic ossicular chain disruption were included in the study. The patients were categorized into four age groups ranging from 18 to 60 years. The majority of patients belonged to the 18–30 years age group, accounting for 33.3% of the study population.

When gender distribution was analyzed across age groups, male patients predominated in all age groups, contributing to 66.7% of the total cases, while females accounted for 33.3%. The higher prevalence among males may be attributed to increased exposure to trauma-related activities such as road traffic accidents and occupational injuries.

Table 1: Age and Gender Distribution of Patients with Traumatic Ossicular Chain Disruption

Age Group (Years)	Male	Female	Total	Percentage
18–30	7	3	10	33.3%
31–40	6	3	9	30%
41–50	5	2	7	23.3%
51–60	2	2	4	13.3%
Total	20	10	30	100%

This distribution indicates that traumatic ossicular chain disruption is more commonly seen in young adult males, which is consistent with the higher incidence of trauma in this population.

Cause of Trauma

The most common cause of trauma leading to ossicular chain disruption in this study was road traffic accidents, accounting for 46.7% of cases. This was followed by falls (30%), assault (16.7%), and sports-related injuries (6.6%).

Road traffic accidents remain a major contributor to head injuries and temporal bone trauma, which can subsequently lead to ossicular chain disruption and conductive hearing loss.

Table 2: Distribution of Patients According To Cause of Trauma

Cause of Trauma	Number of Patients	Percentage
Road Traffic Accident	14	46.7%
Fall	9	30%
Assault	5	16.7%
Sports injury	2	6.6%

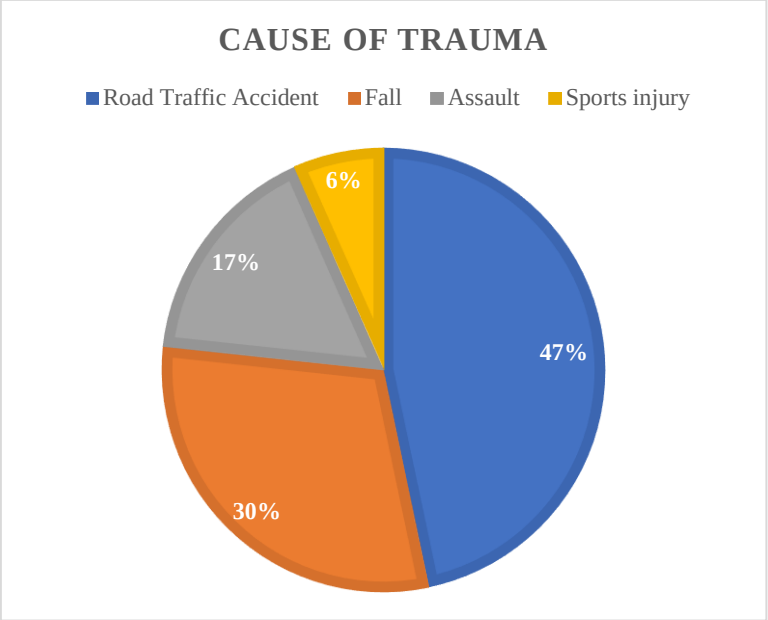

Figure 1. Pie Chart Showing the Distribution of Causes of Trauma, with Road Traffic Accidents Being the Most Common Cause.

Type of Ossicular Injury

Intraoperative findings during exploratory tympanotomy revealed different types of ossicular injuries among the patients.

The most common injury observed was incudostapedial joint dislocation, which was present in 40% of cases. This was followed by incus dislocation (26.7%), malleoincudal joint dislocation (20%), and ossicular fractures (13.3%).

The predominance of incudostapedial joint dislocation may be explained by the relatively weak ligamentous attachment between the incus and stapes, making it more susceptible to disruption following trauma.

Table 3: Types of Ossicular Injuries Observed During Exploratory Tympanotomy

Type of Ossicular Injury	Percentage
Incudostapedial dislocation	40%
Incus dislocation	26.7%
Malleoincudal dislocation	20%
Ossicular fracture	13.3%

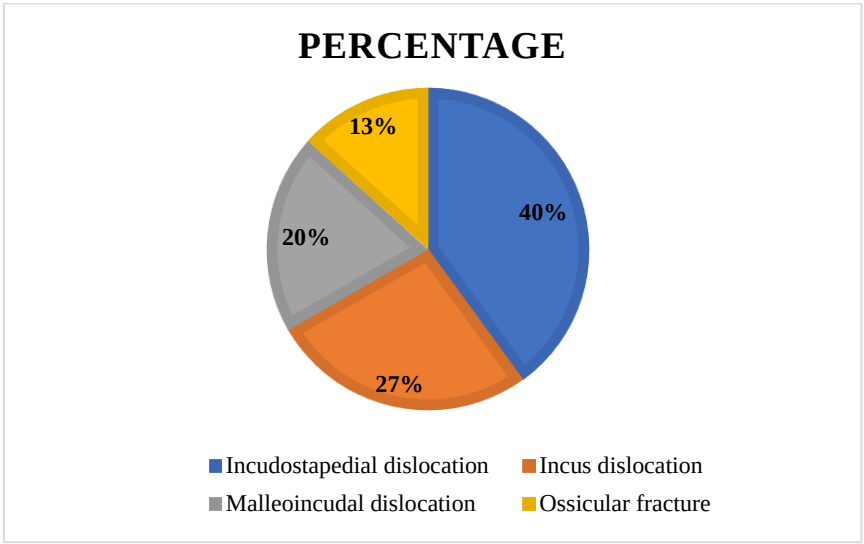

Figure 2: Pie Chart Illustrating The Distribution Of Different Types Of Ossicular Injuries Observed During Surgery.

Hearing Outcomes

Hearing outcomes were evaluated using pure tone audiometry, and the air-bone gap (ABG) was used as the primary parameter to assess hearing improvement following ossiculoplasty.

The mean preoperative air-bone gap among the patients was 34.6 ± 6.8 dB, indicating moderate conductive hearing loss. After surgical reconstruction of the ossicular chain, a significant improvement in hearing was observed.

At the 12-month postoperative follow-up, the mean air-bone gap decreased to 13.2 ± 4.5 dB, demonstrating substantial hearing improvement following ossiculoplasty.

Statistical analysis using the paired t-test showed that the improvement in hearing thresholds was highly significant ($p < 0.001$).

Table 4: Comparison of Preoperative and Postoperative Air–Bone Gap (ABG)

Parameter	Mean Air-Bone Gap (dB)
Preoperative ABG	34.6 ± 6.8
Postoperative ABG (12 months)	13.2 ± 4.5

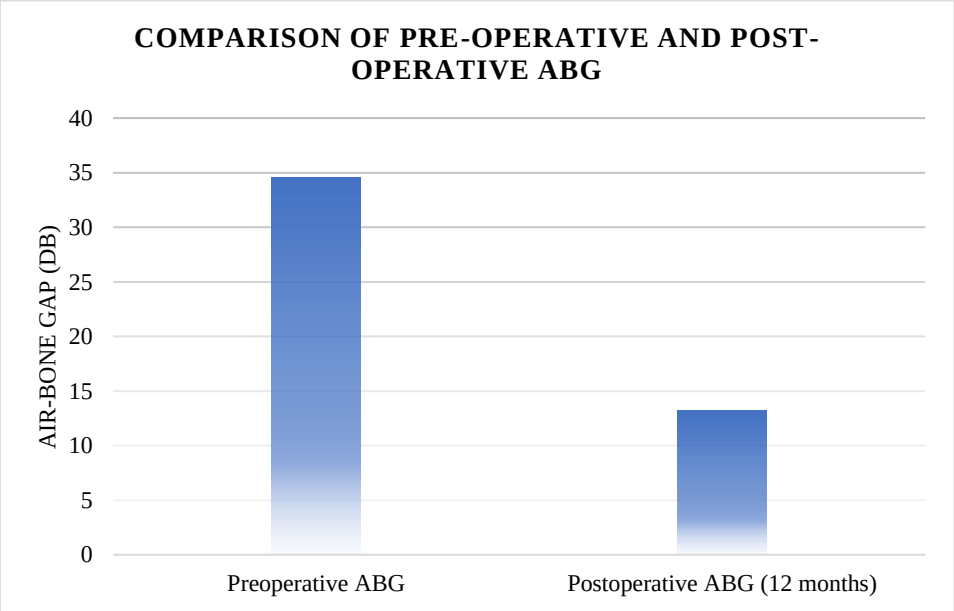

Figure 3: Bar Graph Comparing Mean Preoperative And Postoperative Air–Bone Gap Values Demonstrating Significant Improvement After Ossiculoplasty.

Success Rate of Hearing Rehabilitation

The success of hearing rehabilitation was defined as postoperative air-bone gap closure to ≤ 20 dB.

In the present study:

- 25 patients (83.3%) achieved successful hearing improvement with postoperative ABG ≤ 20 dB.
- 5 patients (16.7%) showed partial improvement, with postoperative ABG remaining greater than 20 dB but demonstrating measurable improvement compared to preoperative values.

These findings indicate that ossiculoplasty is an effective surgical procedure for restoring hearing in patients with traumatic ossicular chain disruption.

DISCUSSION

Traumatic ossicular chain disruption is a well-recognized cause of persistent conductive hearing loss following temporal bone trauma. However, it may remain undiagnosed in the early stages because the tympanic membrane may appear intact and initial hearing loss may be attributed to hemotympanum or middle ear edema. Therefore, careful clinical evaluation combined with audiological and radiological investigations is essential for identifying ossicular injuries.

In the present study, the majority of patients were young adults between 18 and 40 years of age, and a clear male predominance was observed. This pattern can be explained by the increased exposure of young adult males to trauma-related activities such as road traffic accidents, occupational hazards, and outdoor physical activities. Similar demographic trends have been reported in previous studies on traumatic middle ear injuries.

With regard to the mechanism of injury, road traffic accidents were identified as the most common cause of trauma in our study. This observation reflects the increasing incidence of head injuries related to vehicular accidents and highlights the importance of considering middle ear trauma in such patients presenting with persistent hearing loss.

Intraoperative findings during exploratory tympanotomy revealed that incudostapedial joint dislocation was the most frequent ossicular abnormality encountered. The incudostapedial joint is known to be particularly vulnerable to traumatic forces because of its relatively delicate ligamentous attachments and the anatomical position of the incus within the middle ear. Disruption at this joint can easily interrupt the continuity of the ossicular chain and lead to conductive hearing loss.

The effectiveness of surgical intervention was assessed by comparing the preoperative and postoperative air–bone gap (ABG) values. In the present study, the mean preoperative ABG was 34.6 dB, indicating moderate conductive hearing loss among the patients. Following ossicular chain reconstruction, the mean postoperative ABG decreased significantly to 13.2 dB at the 12-month follow-up, demonstrating substantial improvement in hearing thresholds. The improvement was statistically significant, confirming the effectiveness of ossiculoplasty in restoring sound conduction.

Successful hearing rehabilitation, defined as postoperative ABG closure to ≤20 dB, was achieved in 83.3% of patients. This success rate is comparable with outcomes reported in several previous studies evaluating ossicular reconstruction after trauma. These findings support the role of surgical management in achieving favorable hearing outcomes in patients with ossicular chain disruption.

Various reconstruction techniques were used in this study depending on the intraoperative findings. Titanium partial ossicular replacement prosthesis (PORP) was commonly used due to its advantages such as excellent biocompatibility, lightweight structure, and mechanical stability within the middle ear. Titanium prostheses have been widely accepted in ossiculoplasty because they provide reliable sound transmission and maintain long-term structural integrity.

In selected cases, autologous incus interposition was performed when the incus could be reshaped and repositioned to reconstruct the ossicular chain. The use of autologous ossicles remains a valuable option because it reduces the risk of foreign body reaction and provides good acoustic transmission.

The timing of surgical intervention also plays an important role in determining the success of ossiculoplasty. Early surgical exploration after stabilization of the patient can prevent complications such as fibrosis, ossicular fixation, or scarring within the middle ear, which may adversely affect surgical outcomes.

Overall, the findings of the present study demonstrate that exploratory tympanotomy with ossicular reconstruction is an effective and reliable treatment for hearing rehabilitation in patients with traumatic ossicular chain disruption. Proper patient selection, accurate diagnosis, and appropriate surgical technique are essential for achieving optimal hearing outcomes.

CONCLUSION

Traumatic ossicular chain disruption is an important cause of persistent conductive hearing loss following head injury. Early recognition and appropriate diagnostic evaluation are essential for timely management. The findings of the present study demonstrate that exploratory tympanotomy with ossiculoplasty is an effective treatment for restoring hearing in patients with ossicular chain disruption. Significant improvement in hearing outcomes was observed following surgical reconstruction of the ossicular chain. Both titanium prostheses and autologous ossicular grafts provided satisfactory results in suitable cases. Careful patient selection, precise surgical technique, and adequate postoperative follow-up are crucial for achieving optimal hearing rehabilitation and ensuring long-term stability of hearing improvement.

REFERENCES

1. Salem MA, El-Kholy NA, Hemdan A, ElSobki AA, Ghonim MR, Ghoniem MR. Endoscopic ossiculoplasty in traumatic conductive hearing loss with intact tympanic membrane: a five-year experience. J Laryngol Otol. 2024;138(4):398-404. doi:10.1017/S002221512300186X.
2. Plichta L, Dąbkowska A, Wawszczyk-Froehlich S, Skarżyński H, Skarżyński PH. Titanium prostheses for treating post-traumatic ossicular chain disruption. J Int Adv Otol. 2022;18(5):411-414. doi:10.5152/iao.2022.21810.
3. Kim MS, Chung J, Kang JY, Choi JW. Transcanal endoscopic ear surgery for traumatic ossicular injury. Acta Otolaryngol. 2020;140(1):22-26. doi:10.1080/00016489.2019.1674237.
4. Yetiser S, Hidir Y, Birkent H, Satar B, Durmaz A. Traumatic ossicular dislocations: etiology and management. Am J Otolaryngol. 2008;29(1):31-36.
5. Maillot O, Attyé A, Boutet C, Boubagra K, Perolat R, Zanolla M, et al. The relationship between post-traumatic ossicular injuries and conductive hearing loss: a 3D-CT study. J Neuroradiol. 2017;44(5):333-338.
6. Sharma RK, Kumar S. Ossiculoplasty outcomes in conductive hearing loss: a clinical study. Indian J Otolaryngol Head Neck Surg. 2015;67(3):287-292.
7. Vincent R, Sperling NM, Oates J, Jindal M. Ossiculoplasty hearing outcomes: a multicenter study. Otol Neurotol. 2013;34(6):1050-1057.

8. Austin DF. Ossicular chain reconstruction: surgical techniques and outcomes. Am J Otol. 2012;33(5):529-536.
9. Vincent R. Titanium prostheses in ossiculoplasty: long-term outcomes. Otol Neurotol. 2014;35(7):1150-1156.
10. Hasso AN, Ledington JA. Traumatic injuries of the temporal bone. Otolaryngol Clin North Am. 1988;21(2):295-316.
11. Dornhoffer JL. Ossicular reconstruction techniques in middle ear surgery. Otolaryngol Clin North Am. 2012;45(4):687-701.
12. Fong JC, Michael P, Raut V. Titanium versus autograft ossiculoplasty. Acta Otolaryngol. 2010;130(5):554-558.
13. Merchant SN. Middle ear mechanics and conductive hearing loss. Otol Neurotol. 2014;35(3):453-460.
14. Brenski AC, Isaacson B. Reconstruction of the ossicular chain in middle ear surgery. Oper Tech Otolaryngol Head Neck Surg. 2009;20(3):187-196.
15. Vrabec JT. Temporal bone trauma and middle ear injuries. Otolaryngol Head Neck Surg. 2011;145(2):193-198.

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