

Audiological Evaluation of Various Factors Influencing Type 1 Tympanoplasty: A Preoperative and Postoperative Study

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Abstract

Background: Studying several aspects of type 1 tympanoplasty that may affect the procedure's outcome, such as the size of the perforation, the existence of active ear discharge, and the presence of a tympanosclerotic patch, and comparing the audiological outcomes of the two periods.

Material and Methods: Between August 2021 and November 2022, a total of 106 patients with CSOM tubotympanic illness who underwent type 1 tympanoplasty at the Department of ENT & HNS, Madhubani Medical College and Hospital, Madhubani, Bihar, were examined. Each patient's history, clinical examination, investigations, surgical procedures, postoperative period, and follow-up appointments were all recorded in a thorough proforma. Pure tone audiometry was used to evaluate the patient's hearing before, during, and after operation. The results were collated.

Results: The size of the perforation was found to correlate with the audiological benefit. Hearing gain was reported to increase surgically as perforation size increased. In our 106 case research, 101 (95.2%) cases showed improvement in speech frequency, and 83 instances (78.3%) showed improvement in high frequency; in 3 cases (2.83%), speech frequency and 19 cases (17.9%), high frequency, hearing deteriorated. The audiology of the rest didn't alter. Active discharge from type 1 tympanoplasty does not statistically significantly alter the audiological outcome as long as it is mucoid, sparse, and culturally unfavourable. The postoperative speech frequency benefit is less (8.393 dB) in 27 of the 106 instances with tympanosclerosis than in the 106 cases without tympanosclerosis (13.949 dB), which is statistically significant. There is a statistically negligible difference in the audiological benefit at high frequency between cases with and without tympanosclerosis (7.872 dB vs. 7.143 dB).

Conclusion: The size of the perforation, the existence of tympanosclerosis, and the condition of the middle ear at the time of surgery were discovered to have a significant impact on the surgical outcome.

Keywords: CSOM, Type 1 Tympanoplasty, Hearing Gain.

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Introduction

Ear infections with complications were a serious health issue in earlier centuries. The

development of antibiotics and the use of operating microscopes in surgery were

dramatic improvements in the management of disease. In our nation, chronic suppurative otitis media continues to be a serious issue. It is a common condition that otolaryngology clinic patients encounter. The otologist must decide whether to operate on the discharging ear. This is because it's widely believed that tympanoplasty on discharged ears has a much lower success rate.

Recurrent ear infections in hearing loss are caused by TM perforations. Bilateral holes make hearing impairment more obvious (Adkins WY, White B 1984) [1]. Preoperative perforation size and air conduction audiometric gains following successful myringoplasty (Wasson JD *et al*, 2009)[2]. Traumatic perforations that become infected can lead to persistent perforations if they are not properly treated to prevent recurring middle ear infections. Since many years ago, repairs to TM perforations have been made.

Tympanosclerosis, a hyaline degeneration of the TM submucosal layer, may contribute to the failure of myringoplasty. The outcomes were worse in ears with tympanosclerosis than in ears with normal TM. In this manner, we can see how tympanosclerosis may impair the cicatrization of the TM. Better hearing gain is seen in patients with limited localization of sclerotic plaques and minimal impact on the ossicular chain. Surgery is the most effective treatment for tympanosclerosis even if it is still debatable; this is the case until new effective medications are discovered (Mutlu F *et al*, 2015) [3].

In a myringoplasty, the patient's cochlear reserve is adequate, the middle ear ossicles are working regularly, and the Eustachian tube is patent. The reconstructive treatment is confined to the repair of tympanic membrane perforation. On the other hand, tympanoplasty is a procedure in which the reconstruction of the tympanic membrane is

combined with inspection and repair of the middle ear's sound conductive apparatus (Michael E. Glasscock, 1990) [4]. Therefore, we intended to research the various factors, such as the condition of the middle ear, the extent of the perforation, and the presence of a tympanosclerotic patch, that affect the outcome of type 1 tympanoplasty and compare the corresponding preoperative and postoperative audiological results. The purpose of our study was to compare the preoperative and postoperative audiological outcomes for type 1 tympanoplasty and examine numerous aspects, such as the condition of the middle ear, the size of the perforation, and the existence of a tympanosclerotic patch.

Material and Methods

From August 2021 to November 2022, Department of ENT & HNS at Madhubani Medical College and Hospital in Madhubani, Bihar, performed type 1 tympanoplasty on 106 patients with CSOM tubotympanic illness. Patients with conductive hearing loss and the CSOM tubotympanic type must also have dry ears or discharge-producing ears and have had type 1 tympanoplasty. Finally, the graft must be fully absorbed and hold up for three months after surgery. In this study, sensory neural hearing loss, discontinuity of the ossicular chain, and atticofacial type of CSOM were excluded along with patients whose patients failed to appear for postoperative audiological screening.

Each patient's history, clinical examination, investigations, surgical procedures, postoperative period, and follow-up appointments were all recorded in a thorough pro forma. Preoperatively, three months after surgery, and six months after surgery, pure-tone audiometry was performed, and the data were collated. ANOVA, Chi-square, and Student's t-tests were used to make statistical comparisons. If the "p" value is less than 0.05, the statistical difference is significant.

Results

The Student's t-test, Chi-square test, and ANOVA test were used to compare the tabulated findings statistically; a statistical difference is significant if the "p" value is less than 0.05.

The size of the perforation was found to correlate with the audiological benefit. The postoperative hearing gain was shown to improve as the perforation's size grew.

Hearing declined in 3 instances (2.83%) under speech frequency and in 19 cases (17.9%) under high frequency in our study of 106 cases. However, 101 (95.2%) cases showed improvement in speech frequency, and 83 cases (78.3%) cases showed

improvement in high frequency. The audiology of the rest did not alter.

As long as the active discharge was mucoid, sparse, and culturally unfavourable, it had no statistically significant impact on the audiological result of type 1 tympanoplasty.

The postoperative speech frequency benefit is reduced (8.393 dB) in the 27 cases of tympanosclerosis out of 106, which is statistically significant compared to cases without tympanosclerosis (13.949 dB). There is a statistically negligible difference in the audiological benefit at high frequency between cases with and without tympanosclerosis (7.872 dB vs. 7.143 dB).

Table 1: Duration of Ear Discharge and Audiological Benefit

Duration of Ear Discharge (in yrs.)	Number of Cases	Audiological Benefit	
		Speech Frequency	High Frequency
<10	65	11.308 dB	7.462 dB
11-20	29	13.724 dB	6.655 dB
>20	12	15.833 dB	11.333 dB
Total	106		

Table 2: Size of Perforation and Audiological Benefit

Size of Perforation	Number of Cases	Audiological Benefit	
		Speech Frequency	High Frequency
Small	13	4.692 dB	0.385 dB
Medium	40	10.825 dB	7.050 dB
Large	53	15.642 dB	9.943 dB
Total Cases	106		

Table 3: Audiological Assessment in Type 1 Tympanoplasty

Hearing Results	Audiological Benefit	
	Speech Frequency	High Frequency
Improvement	101 (95.2%)	83 (78.3%)
No change	2 (1.89%)	4 (3.77%)
Worsened	3 (2.83%)	19 (17.9%)
Total Cases	106	106

Table 4: Effect of Active Ear Discharge on Audiological Improvement in Type 1 Tympanoplasty

Ear Discharge	Number of Cases	Speech Frequency	High Frequency
Active	43	11.512 dB	5.953 dB
Inactive	63	13.143 dB	8.857 dB
Total Cases	106		

Table 5: Tympanosclerotic Patch and its Effect on Audiological Improvement

Tympanosclerotic Patch	Number of Cases	Speech Frequency	High Frequency
Present	27	8.393 dB	7.143 dB
Absent	79	13.949 dB	7.872 dB
Total Cases	106		

Discussion

Tympanoplasty of type 1 is defined by Wullstein as an operation in which the only reconstruction process is the repair or retraction of tympanic membrane perforation. Inferred from the criteria is that there is no middle ear disease, such as diseased mucosa or skin growth, and that the ossicular chain is intact and movable. The current study offers numerous metrics for evaluating the improvement in hearing following successful type 1 tympanoplasty. Postoperative audiological tests were conducted three and six months after the operation.

The duration of ear discharge and audiological benefit at speech frequencies and high frequencies were not related in this series, and vice versa (Table 1). Contrary to popular belief, a lengthier disease process does not increase the audiological benefit since there are more pathological alterations. Instead, statistically, a longer period of ear discharge indicated higher audiological benefit.

When compared to patients with longer ear discharge durations, patients with shorter ear discharge durations must either have continuous discharge or more intense exacerbation events. However, the extent of the disease's damage to the middle ear and the

rate of audiological improvement are independent of the length of the illness.

The size of the perforation was shown to be correlated with the audiological benefit in our study. Hearing gain was observed to rise postoperatively as the perforation's size increased (Table 2). There aren't many studies on the connection between perforation size and audiological advantage. This study validates Packer's findings, which showed that people with greater preoperative hearing deficits clearly benefited more than people with smaller preoperative hearing deficits [5].

In our study, hearing declined in 2.83% of patients under speech frequency and in 17.9% of cases under high frequency, whereas 95.2% of cases showed improvement in speech frequency and 78.3% in high frequency. The remainder's audiological state was unaltered (Table 3). The most likely reason for incomplete success in terms of hearing is that, even though the ossicular chain may appear normal in most cases of CSOM, there is usually some aspect of scar tissue that inhibits complete restoration of hearing (Sheehy *et al* 1980) [6]. In 1994, Saeed Ghamdi *et al* [7] reported that 3% of the patients had a permanent hearing loss.

There were 11 audiological failures in the series by Vartiainen and Nauutinene [8] (1993). It was discovered that the surgeon had disregarded the fixation or erosion of the ossicles as the source of the patient's ongoing hearing loss. Tympanosclerosis, ossicular stiffness, and Eustachian tube dysfunction disorders that might affect the middle ear's ventilating or conducting function that have not been addressed during the surgery can be used to explain the unchanging audiological state after tympanoplasty (Rance W. Rance in 1995) [9].

In our study, active discharge had no statistically significant impact on the audiological outcome of type 1 tympanoplasty (Table 4). Similar research was conducted by S.K. Nagle *et al.* [10], who performed type 1 tympanoplasty on seven cases of active chronic otitis media, dry tympanoplasty on 43 cases, and wet tympanoplasty method on the remaining 29 cases. The improvement in hearing was the second requirement for a successful myringoplasty and tympanoplasty 1 procedure after a positive graft was taken.

Myringoplasty and tympanoplasty-1 had a dry technique success rate of 93.02% and a wet method success rate of 89.65%. The results of the statistical analysis revealed that there is no appreciable distinction between the dry and wet methods' success rates. Mucoid, sparse, and culture-negative discharge are required.

Tympanosclerosis, a hyaline degeneration of the submucous layer of the TM, may contribute to the failure of a myringoplasty. Statistically significantly worse results were seen in ears with tympanosclerosis than in ears with normal TM. In this manner, we can see how tympanosclerosis may impair the cicatrization of the TM.

In our investigation, cases without tympanosclerosis showed a significant postoperative speech frequency benefit

compared to cases with tympanosclerosis (Table 5). In his study, Kageyama-Escobar AM [11] found that 82% of tympanic perforations were closed, and he also noted that tympanosclerosis was one of the causes of surgical failure, particularly when it diffusely impacted the TM. However, Wielinga EW *et al.* [12] examined 555 myringoplasties to assess the impact of tympanosclerosis and found no correlation between its presence or absence in the final outcome, even though it is distributed. To help the epithelium migrate and close the TM perforation, we advise removing the focus whenever practical.

Conclusion

The patient receives hearing improvement and chronic suppurative otitis media of the tubotympanic type with tympanoplasty. A careful choice of instances is crucial to achieving these two goals. Numerous issues, including middle ear diseases that might impair ossicular function and middle ear airflow, can hinder the predicted audiological advantage. It should be highlighted, nevertheless, that thorough middle ear examination in all cases during surgery may result in better hearing outcomes since any ossicular disease, fibrous adhesions, or tympanosclerotic patches can be treated during surgery.

In the majority of the instances in this series, we have significantly improved hearing. It was discovered that the patient's age, the condition of the middle ear, the extent of the perforation, and the existence of tympanosclerosis at the time of surgery all significantly influenced the procedure's prognosis.

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