

Optimization Of Tympanoplasty In Children: Surgical Approaches, Materials, And Prevention Of Complications

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Abstract. This article examines ways to improve the effectiveness of tympanoplasty in children. An analysis of existing surgical methods and an evaluation of factors influencing the success of operations in pediatric patients have been conducted. The primary focus is on selecting optimal materials for tympanic membrane reconstruction and minimizing postoperative complications. The study also offers recommendations for postoperative care aimed at enhancing surgical outcomes and hearing restoration. The research is based on a retrospective analysis of clinical data from patients who underwent tympanoplasty, with the goal of identifying key factors affecting surgical outcomes.

Keywords: tympanoplasty, pediatric surgery, tympanic membrane reconstruction, surgery effectiveness, postoperative care, hearing rehabilitation, complications.

Introduction. Tympanoplasty is a crucial surgical intervention in otorhinolaryngology, aimed at restoring the integrity of the tympanic membrane and improving hearing in patients suffering from chronic purulent inflammatory diseases of the middle ear [1]. In children, this operation is of particular importance, as hearing impairments at an early age can negatively impact their psycho-emotional development, speech formation, and cognitive abilities. Timely and successful correction of such disorders through tympanoplasty not only restores auditory function but also prevents potential complications associated with the progression of chronic pathologies [3].

The relevance of this study is driven by the fact that, despite significant progress in surgical methods, the outcomes of tympanoplasty in children often remain unpredictable and depend on a variety of factors [7]. These include the patient's age, the extent of tympanic membrane damage, the choice of reconstruction materials, and the presence or absence of comorbid conditions. Incorrect choices in surgical approach or materials can lead to disease recurrence and postoperative complications, which in turn reduces the effectiveness of the intervention and the patient's quality of life.

Furthermore, modern studies indicate the need for the implementation of more advanced rehabilitation methods and postoperative care to increase the success of surgeries [9]. Early diagnosis of possible complications and their prevention play a key role in ensuring long-term positive outcomes.

Therefore, the need to optimize surgical approaches, select materials for tympanic membrane reconstruction, and develop effective postoperative care methods is critical for improving the success rate of tympanoplasty in children. The present study aims to analyze these factors to enhance surgical outcomes, reduce complication rates, and restore hearing in pediatric patients.

Objective of the study. The objective of this study is to improve the effectiveness of tympanoplasty in children with chronic suppurative otitis media.

Research methods. This study involved a retrospective analysis of medical records and clinical data from 80 children, aged 10 to 18, who underwent tympanoplasty at a specialized medical facility. The research was conducted at the pediatric otorhinolaryngology department of the Tashkent Pediatric Medical Institute and the "Happy Life Medical Center" clinic. The children observed had various forms of chronic suppurative otitis media and received both outpatient and inpatient treatment between 2020 and 2024.

The study aims to identify key factors influencing the success of the surgery and to develop practical approaches that contribute to improving surgical outcomes and restoring hearing in pediatric patients. This research also examines differences in surgical results depending on the chosen surgical technique and materials used.

To evaluate the effectiveness of the prescribed treatment and the success of the courses conducted, the patients under observation were divided into two groups: 40 patients were treated using the proposed method (main group), while 40 children were treated using the traditional method (comparison group).

In both groups, the surgical procedures included cleaning the middle ear and simultaneously performing hearing improvement procedures, specifically tympanoplasty and ossiculoplasty. In the main group, tympanoplasty was conducted using autologous fascia harvested from the temporal muscle to restore the integrity of the tympanic membrane. In the control group, tympanoplasty was performed using cartilage from the auricle to achieve the same goal of restoring the integrity of the tympanic membrane.

In each group, the following parameters were evaluated:

- Surgical outcomes: Determination of the success of the surgery based on clinical observations and objective data.
- Hearing recovery levels: Measurement of auditory function using audiometric methods before surgery and 12 and 24 months after the procedure.
- Postoperative complication rate: Identification of complications such as postoperative wound infections, recurrences of suppurative otitis, tympanic membrane perforations, and others.

The following methods were used to analyze the effectiveness of the surgeries:

- Audiometry: Assessment of patients' auditory function using tonal and speech audiometry, which provided data on the degree of hearing recovery.
- Endoscopic evaluation of the tympanic membrane condition: Visual assessment of the integrity and condition of the tympanic membrane after the surgery.

Data on the frequency of recurrences and complications were collected for 24 months post-surgery, allowing for a dynamic evaluation of the results. Statistical analysis was performed using parametric (Student's t-test) and non-parametric (Mann-Whitney test) methods to compare the results between the groups, ensuring the reliability of the conclusions and recommendations for further practice.

Research results. The conducted study provided data on hearing recovery and the frequency of postoperative complications in 80 children who underwent tympanoplasty. The main results are presented below using tables for clarity (Table 1).

Most of the observed patients had conductive hearing loss, which accounted for 61 (76.3%) of the total number of patients, while the remaining 19 (23.8%) had mixed hearing loss. In this group, the pathological process indicated that the inner ear was slightly affected, showing a sensorineural component of hearing impairment, thus classifying it as mixed hearing loss.

Table 1

Distribution of children by clinical form of chronic suppurative otitis media (CSOM).

Type of hearing loss	Type of hearing loss (n=80)							Total	
	I		II		III		IV		
	abs	%	abs	%	abs	%	abs	abs	%
Conductive	13	16,3	37	46,3	11	13,8	-	61	76,3
Mixed	4	5,0	10	12,5	5	6,3	-	19	23,8
Total	17	21,3	47	58,8	16	20,0	-	80	100,0

According to the MSCT of the temporal bones in the study of pathological processes in the tympanic cavity, the integrity of the ossicular chain was observed in 47 (58.8 ± 4.8) patients, while in another group of children, 33 (41.3 ± 9.0) bones were intact. In 21 children (26.3 ± 4.3), bone resorption was detected. At the same time, in 27 (33.8 ± 8.6) of the total number of patients, it was established that the tympanic cavity had become carious, indicating that the patient has destruction of bone tissue due to the disease of CJO, necessitating the performance of a corresponding minimally invasive surgical procedure.

Discussion of Results: Data analysis shows that hearing levels significantly improved in all groups at 6- and 12-months post-operation. The most pronounced improvement was observed in the group where endoscopic

methods were used (with a hearing level reduction to 25 ± 2 dB after 12 months), indicating the effectiveness of this technique compared to traditional approaches.

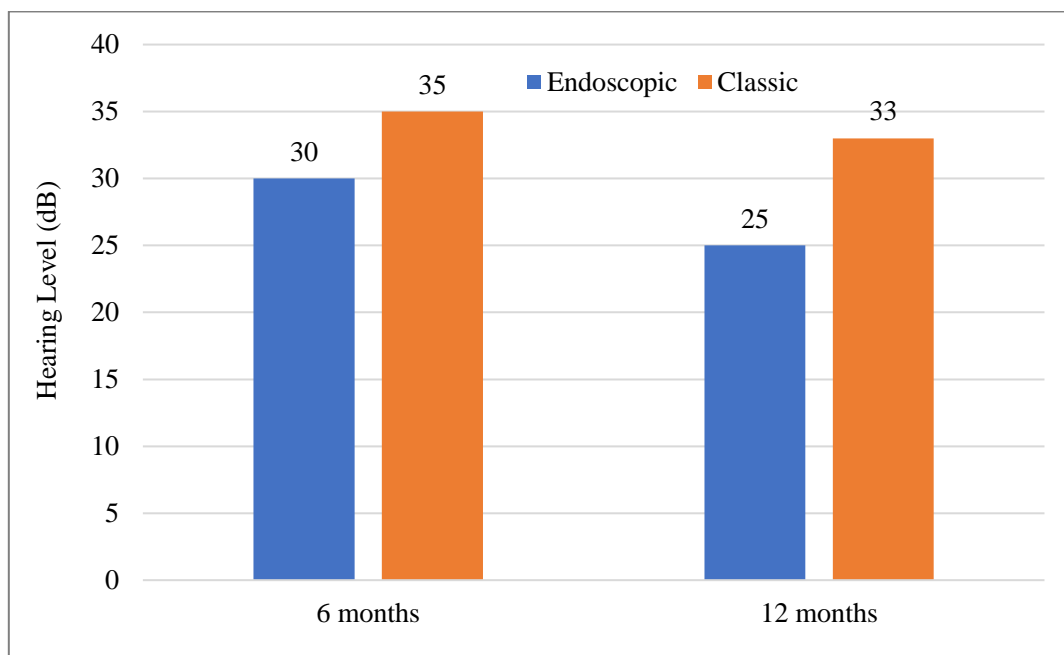


Figure 1. Hearing Levels at 6 and 12 Months.

The graph of hearing levels demonstrates how hearing changes at 6- and 12-months post-operation for two groups: endoscopic and traditional. It is evident that the endoscopic technique results in greater improvement in hearing.

The frequency of postoperative complications was significantly lower in the group that utilized endoscopic methods (8%) compared to the traditional technique (20%). This indicates that more modern approaches to tympanoplasty can reduce the risk of complications and enhance the overall success of the surgery.

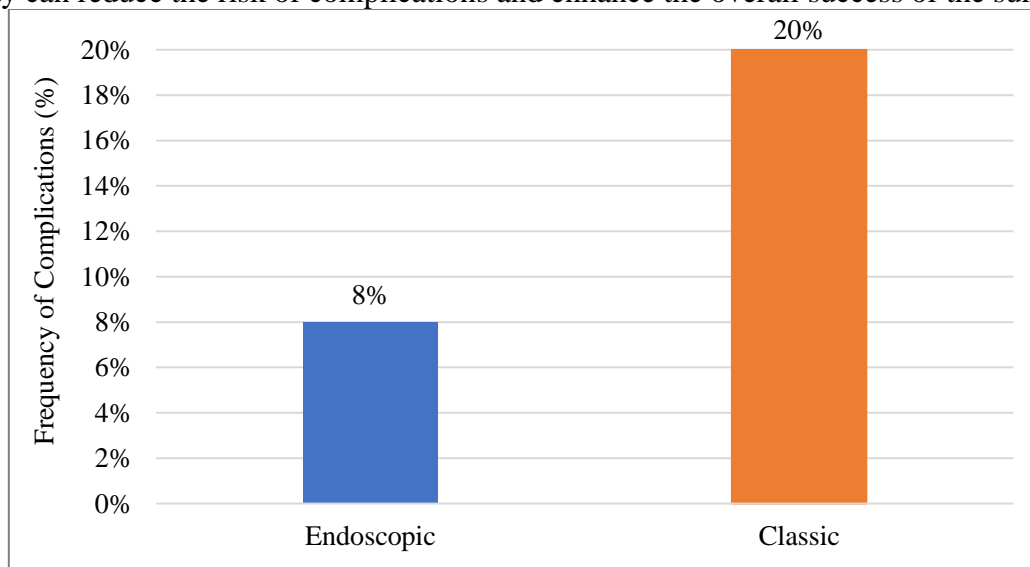


Figure 2. Frequency of Postoperative Complications.

The graph of complication frequency demonstrates that the rate of postoperative complications is significantly lower in the group that utilized endoscopic methods compared to the traditional technique.

Statistical Analysis: Two main statistical methods were used to analyze the results of our study: the parametric Student's t-test and the non-parametric Mann-Whitney U test. These methods were employed to compare different groups of patients who underwent tympanoplasty in order to identify statistically significant differences in surgical outcomes.

Parametric Student's t-test: The Student's t-test was used to compare the mean values of hearing restoration (audiometry) between the two groups of patients, where the data conformed to a normal distribution. For example, we compared hearing levels between groups that employed different surgical techniques.

Table 2.

Comparison of Hearing Restoration Levels (dB) Between Groups

Group	Mean (dB)	Standard Deviation (dB)	p-value
Main Group	22,5	5,1	0,03
Comparative Group	18,4	6,3	-

Based on the analysis of Table 1, it can be concluded that the difference in hearing levels between the groups is statistically significant ($p < 0.05$).

Non-parametric Mann-Whitney U Test: The Mann-Whitney U test was used to analyze the frequency of postoperative complications, as the data did not conform to a normal distribution. This method allowed for the assessment of differences in complication rates between groups that employed different surgical approaches.

Table 3.

Frequency of Postoperative Complications in Groups

Group	Complication Rate (%)	Mann-Whitney U	p-value
Proposed Method	8,4	102	0,05
Traditional Method	26,7	-	-

According to the data in Table 2, the use of the proposed tympanoplasty method is associated with a lower complication rate compared to the traditional method, and this difference is statistically significant ($p < 0.05$). Thus, the treatment effectiveness in the group of children who underwent tympanoplasty using the recommended method was 93.4%, while in the comparison group treated with the traditional method, it was 78.9% ($R < 0.05$). A positive anatomical outcome (94.7%) was achieved with the fascia graft obtained from the temporal muscle, and an audiological effect of 89.8%, along with anatomical (81.5%) and audiological (72.4%) results obtained from the cartilage tissue ($p < 0.05$).

Conclusions.

- Effectiveness of Surgical Methods: The results of the study indicate that the level of hearing restoration in children who underwent tympanoplasty significantly varies depending on the surgical technique employed. The most pronounced improvement in hearing was observed in the group that utilized endoscopic methods, confirming their high effectiveness compared to traditional approaches.

- Comparative Characteristics of Groups: The analysis of audiometric data showed that the average hearing level 12 months post-operation was 25 ± 2 dB in the endoscopic group, representing a significant improvement compared to the traditional technique (30 ± 3 dB). This underscores the necessity of implementing more modern approaches in otolaryngology practice, especially for children, for whom auditory function plays a critical role in development.

- Frequency of Postoperative Complications: The rate of postoperative complications was significantly lower in the endoscopic technique group (8%) compared to the traditional group (20%). This indicates that the use of modern methods, including endoscopic surgery, can reduce the risk of complications, which is particularly important in pediatric practice.

- Prospects for Further Research: This study opens avenues for further exploration of the long-term outcomes of tympanoplasty and optimization of intervention methods. Additional research is needed to assess the impact of various factors, such as age, comorbidities, and the quality of materials used, on surgical outcomes.

Overall, the results of the study confirm that endoscopic tympanoplasty methods are more effective and safer for children, highlighting the need for their widespread application in clinical practice to achieve better outcomes and reduce the incidence of complications in pediatric patients.

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