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Evaluation of endoscopic and microscopic approaches in pediatric patients who undergo type 1 tympanoplasty

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Abstract

Aim: In the present study, we aimed to investigate endoscopic and microscopic type 1 tympanoplasty outcomes in pediatric patients.

Materials and Methods: In this retrospective analysis, we assessed a total of 134 patients. The study focused on the outcomes of 138 ears from these 134 pediatric patients who received type 1 tympanoplasty. Four patients had the procedure performed on both ears. The ages of the patients varied from 7 to 16 years. They were categorized into two groups based on the surgical technique employed. Group 1 consisted of patients who had type 1 tympanoplasty via an endoscopic method (n=58), while Group 2 included those who underwent the microscopic approach to type 1 tympanoplasty (n=80). The tympanic membrane was repaired using cartilage graft obtained from tragus cartilage in all patients. The outcomes (regaining hearing, graft success, duration of operation, etc.) of the patients in both groups were analyzed.

Results: The postoperative air-bone gap (ABG) in both groups was statistically lower than preoperative ABG. The pre-operative ABG of group 1 and group 2 were comparable with and no significant difference among the groups. Likewise, postoperative ABG of groups 1 and 2 showed no significant difference among the groups. The duration of operation of group 1 was statistically shorter than the durartion of operation ofgroup 2. The graft success rates of group 1 and group 2 were 94.55% and 94.74%, respectively; (p=0.309).

Conclusion: As in adults, type 1 tympanoplasty can be safely performed in children with an endoscopic approach. The most important advantage of this procedure is better visualization of the entire tympanic membrane in patients who have narrow external auditory canals. Although the regain rate of hearing of the groupswere , endoscoğic approach has shorter duration of operation and the duration of postoperative care were shorter than the microscopic approach.

Introduction

Chronic otitis media (COM) is a common disease that can cause serious complications as a result of inadequate treatment. The preferred modality for treatment of COM is tympanoplasty surgery, which aims to eradicate ear infections, restore hearing, and repair the perforated tympanic membrane [1].

Tympanoplasty has been widely performed in pediatric patients for many years. Eradication of ear infections at an early age prevents long-term complications of COM. However, there may be some handicaps in performing this type of surgery on pediatric patients. First of all, the external auditory canal is narrow and curved, and postoperative care is more difficult in pediatric patients [2,3]. Although the microscope is classically used in otologic surgery, the use of endoscopes has become increasingly popular due to advantages in the exposure of the operative site. Our aim was to evluate the efficacy of the mode of access during tynpanosplasty in pediatric patients.

In this study, we aimed to analyze the outcomes of endoscopic and microscopic tympanoplasty. Also, we investigated the advantages, disadvantages, and technical difficulties of endoscopic tympanoplasty in pediatric tympanoplasty.

Materials and Methods

The medical records of patients who were diagnosed with pediatric COM at our training and research hospital and underwent type 1 tympanoplasty from January 2010 to

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February 2019 were retrospectively reviewed. Ethical approval of the study was obtained from the istitutional review board (decision no: 2020-08/6). The patients younger than 7 and older than 16 years of age, patients with previous ear surgery, and patients who have ossicular damage, cholesteatoma, and congenital ear malformation were excluded from evaluation in the preset study.

In total 138 ears of 134 pediatric patients were included for evaluation in our study. Four patients underwent tympanoplasty in bilateral ears. Five patients were excluded from the study due to insufficient records of the postoperative follow-up. The patients included in the study were divided into 2 groups: group 1 (n:58) consisted of patients who underwent type 1 tympanoplasty with the endoscopic approach, and group 2 (n:80) consisted of patients who underwent type 1 tympanoplasty with a microscopic approach. Postoperative outcomes were compared in both groups.

The demographic data, hearing gains, graft success, and operation duration were collected and examined for all the pateints. Detailed findings of the ear, nose, and throat examination were evaluated and recorded. Tympanic membrane (TM) perforations were classified according to the size of the perforation. TM perforations affecting <25% of the surface of the TM were classified as small, perforations between 25% -50% of the TM surface was classified as moderate, perforations affecting 50% -75% of the TM membrane were classified as large, and> 75% TM perforations were classified as as near total.

The postoperative follow-up was performed on 1st, 6th, and 12th-month following the operation. The postoperative evaluation of the hearing, the physical examination findings, and the graft status were evaluated. The air-bone gaps (ABGs) in all patients were assessed before surgery and at 1, 6, and 12 months after the procedure. Hearing thresholds were recorded at frequencies of 0.5, 1.0, 2.0, and 4.0 kHz, and the average hearing levels were determined.

All patients underwent type 1 tympanoplasty under general anesthesia by an experienced otorhinolaryngologist. A microscope (Opmi Vario S88; Carl Zeiss) was used to operate the patients in Group 2, and the endaural approach was preferred. The graft obtained in the tragus cartilage of all patients was used as the graft material of the surgery. After the endaural incision, the tympanomeatal flap was elevated and accessed to the middle ear. The graft that was tailored according to the perforation size, and was placed.The cartilage graft was supported with Gelfoam above and below. Endoscopic system (Karl Storz, Tuttlingen, Germany) and rigid endoscope (2.7 mm [6.0 cm]) were used in patients in group 1 . The incision was performed about 6mm from the tympanic membrane lateral to the external ear canal, and the tympanomeatal flap was elevated. A cartilage graft obtained from the tragus was used for TM reconstruction, and the graft was supported by Gelfoam.

All patients received otomicroscopic and endoscopic evaluations at the 1st, 6th, and 12th months following surgery. The patients were assessed using audiometric measurements, examination of the TM , and ABGs. The postoperative audiologic results were assessed based on the audiograms obtained on the 12th month.

During the postoperative follow-ups, numeric rating scale of pain intensity (NRS-11, range 0 to10) were obtained from the patients on the postoperative 1st day.

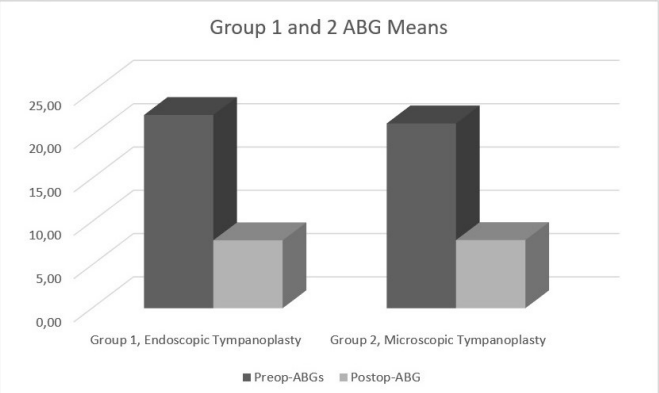
Statistical analysis

Statistical analyses were conducted utilizing the Statistical Package for Social Sciences, version 20 (SPSS v20) from IBM (USA). Continuous variables were described using the mean ± standard deviation (SD), along with the minimum and maximum values. Furthermore, 95% confidence intervals (CIs) were calculated for comparisons between groups. Categorical variables were represented as both the count of affected individuals and the corresponding percentage of the overall study population. To evaluate the normality of continuous variables, the Shapiro-Wilk test was applied. When comparing continuous variables between two groups (such as age and duration of surgery), the independent samples t-test was utilized for data that were normally distributed, while the Mann-Whitney U test was implemented for data that did not follow a normal distribution. For paired comparisons within the same groups (e.g., preoperative and postoperative air-bone gap), the paired samples t-test was used as needed. For categorical variables, such as gender distribution and condition of grafts, the Chi-square test was employed for comparison. If the expected frequencies were less than 5, Fisher's exact test was utilized for those comparisons. A p-value of less than 0.05 was determined to be statistically significant for all analyses.

Results

From total of 134 patients included in our study and 56 (41.79%) were female and 78 (58.21%) were male. The mean age in group 1 was 11.40 ± 2.34 years (range: 7–16 years), while the mean age in group 2 was 12.43 ± 2.03 years (range: 7–16 years). There was no statistically significant difference in age between the two groups (p = 0.216).

There were 56 patients in Group 1; 24 (42.9%) of these patients were female, and 32 (57.1%) were male. The bilateral ears of 2 male patients were operated and the data of a total of 58 ears were analyzed. In Group 2, 31 (39.74%) of



Alpha significance level was accepted as p<0.05. Air-bone gap (ABG).

Figure 1. Preoperative and Postoperative ABGs following endoscopic and Microscopic Tympanoplasty.

Table 1. Distribution of General Features by Groups.

	Endoscopic Tympanoplasty (n:58) Group 1			Microscopic Tympanoplasty (n:80) Group 2			p*
	Mean±SD (CI:95%)	Min	Max	Mean±SD (CI:95%)	Min	Max	
Age (years)	11.40±2.34	7	16	12.43±2.03	7	16	0.216
Air-bone gap (dB)							
Preoperative	22.32±5.12	12	30	21.34±4.12	10	30	0.445
Postoperative	7.84±3.41	5	13	7.87±3.26	5	15	0.380
P*	0.000			0.000			
Operative duration (minute) p*	59.37±3.12	48	64	79.42±4.36	72	89	0.000**
Condition of the graft	n		%	n		%	p
Perforated	3		5.45	4		5.26	0.309
Nonperforated	55		94.55	76		94.74	

Abbreviations: n: number; SD: standard deviation; dB: decibel; CI: confidence interval; *: p-value by independent samples t-test; **: p-value by paired sample test.

Table 2. Distribution of Perforation Sizes and Locations in the study groups.

Perforation size	Locations	Endoscopic Tympanoplasty (n:58) Group 1	Microscopic Tympanoplasty (n:80) Group 2	Total
Small	Anterosuperior	3	2	5
	Anteroinferior	2	3	5
	Posterosuperior	5	7	12
	Posteroinferior	3	3	6
Moderate	Anterior	10	9	19
	Posterior	5	7	12
	Inferior	7	13	20
Large	Central	8	14	22
Near Total	Central	15	22	37

78 patients were female and 47 (60.26%) were male. The bilateral ears of 2 female patients were operated on, and the data of 80 ears were examined. found. There was no significant difference in terms of distribution of the gender among the groups (p=0.125). Demographic data and clinical findings are summarized in Table 1.

The external auditory canal's width was sufficient for using an endoscope in all patients in group 1. In none of the patients, Conversion from the endoscopic to the microscopic access was not necessary in any of the patients. The distribution perforation size and localization of the tympanic membrane in the study are summarized in Table 2. After the operation, TM perforation was observed in 3 patients in group 1. Two patients had posterosuperior small perforation, and 1 patient had a large central perforation. In group 2, TM perforation was found in 4 patients in the operation. Anterior moderate perforation in 3 patients, posterosuperior small perforation in 1 patient. There wss no statistical difference in the frequency of pstoperarive TM perforation among the study groups (p=0.309) (Table 2).

In group 1, the preoperative and postoperative ABG were 22.32 ± 5.12 and 7.84 ± 3.41dB, respectively. In group 2, the preoperative and postoperative ABG 21.34 ± 4.12 and 7.87 ± 3.26 dB, respectively. The Preoperative ABG were significantly higher than the postoperative measurements in both groups (Table 1) (p<0.001). When the two groups were compared in terms of the preoperative and postoperative ABG, we found no statistically significant difference among the groups (respectively p=0.445, p=0.380) (Figure 1).

The mean duration of the operation in group 1 was 59.37 ± 3.12 min (range, 48-64 min), and it was 79.42 ± 4.36 min (range, 72-89 min)in group 2. The duration of operation in group 1 was statistically shorter than in the group 2 (p<0.001) (Table 1).

In tympanoplasty with a microscopic approach, external auditory canal curettage was performed to 7 patients, and anterior wall canaloplasty was performed to 5 patients to evaluate the ossicular chain.

NRS-11 scores obtained on the 1st postoperative day, were 1.02±21 in group 1 and 1.74±45 in group 2. There was a statisricaaly significant difference among the groups in terms of NRS-11 scores (p<0.001).

The postoperative follow-up period is between 19 to 27 months. The mean follow-up period in Groups 1 and 2 was 20.6 and 25.4 months, respectively.

Discussion

The main purpose of the tympanoplasty procedure is to eradicate the pathology and to restore the ventilation ability of middle ear . ympanoplasty is a versatile procedure, with techniques adapted based on disease extent, middle ear condition, presence of cholesteatoma, and patient age. Surgical outcomes are therefore influenced by these factors, along with the chosen surgical technique, approach, and the surgeon's expertise. We included only the cases who underwent type 1 tympanoplastyto provide proper standardization of the groups. We excluded cases with cholesteatoma, ossicular chain repair, and the pateints who required revisional surgery.

Various tympanoplasty methods have been described, but there is a trend towards minimally invasive approaches, especially in pediatric patients. Traditioannly, tympanoplasty is performed under the microscope. Endoscopic approaches have become increasingly common recently. Although many studies suggest that the endoscopic approach is more advantageous in selected adult patients , data in the pediatric patients are not sufficient [4-6].

Despite the long-standing success of tympanoplasty performed with a microscope, challenges remain, notably in visualizing the anterior tympanic membrane and certain areas of the middle ear.For these reasons, surgeons have tried alternative methods such as tympanoplasty with an endoscopic approach. In endoscopic approach, the entire tympanic membrane can be observed [6,7]. Use of an angled endoscope is one of the additional advantages. All structures in the ear can be observed with angled endoscopes. It is a minimally invasive procedure that does not require additional procedures for exposure, thus the normal anatomy is not disturbed for exposure [8,9]. Karhuketo et al. [10] have evaluated 29 patients, and found that tympanoplasty with the endoscopic approach is advantageous because it preserves normal anatomical structures, does not require additional procedures, and the success of the operation is as high which is comparable with the microscopic approach.

One of the main advantages of the endoscopic approach is the shorter duration of operation. Since the restoration of hearing and success rates are comparable between the two methods . The postoperative pain is less intense and postoperative care are shorter in endoscopic approach, which is especially important in the pediatric patients [9,11]. Lade et al. [12] compared endoscopic and microscopic type 1 tympanoplasty in a randomized controlled study including 60 patients. Canaloplasty was performed in 5 patients who underwent microscopic tympanoplasty. In the endoscopic approach, the ossicular chain was easily examined, and no additional procedure was required. The success of the operation outcome was similar in the microscopic and endoscopic approaches, and they showed the endoscopic approach as an alternative method in their studies [12]. Similar results were obtained in our study. In our tympanoplasty with a microscopic approach, external auditory canal curettage was performed on 7 patients, nd anterior wall canaloplasty was performed on 5 patients to evaluate the ossicular chain. In the endoscopic approach, extra intervention was not required.

In the study conducted by Osama et al. [13] the success rate of tympanoplasty with the endoscopic approach was found to be 90%, and it was reports as 96% by Ayacha et al. [14]. In our study, the graft success rate in endoscopic tympanoplasty was 94.55%.

In the meta-analysis conducted by Manna et al. [15] it was stated that the results related to restoration of hearing in the endoscopic approach were not superior to microscopic, but the incidence of canaloplasty was low. Therefore, an endoscopic approach is recommended in tympanoplasty and stapes surgeries due to lower chorda tympani damage rate and pain levels.

Even if there is no difference in the success rates between the two approaches in the pediatric patient group, endoscopic approach is kore superior due to lower rates of need for postoperative care. With the endoscopic approach, the need for canaloplasty has decreased, and in suitable procedures, the surgeries can be performed without elevating the external auditory canal flap [16]. Especially in pediatric patients, external auditory canal aspiration is a difficult procedure. Lower number of interventions in the external auditory canal results in faster recovery [17]. In our study, the duration of postoperative follow-up were lower in the endoscopic tympanoplasty group. Some of the patients were informed of their follow-up and did not come to the controls because they had no complaints. We observed less need for postoperative care and the need of external auditory canal aspiration in the endoscopic group.

A key challenge in pediatric otological surgery is the narrow external auditory canal. While children's canals typically achieve sufficient width for 2.7 mm endoscopes by age five [18, 19], the feasibility of endoscopic intervention through this narrow bony canal has been a subject of inquiry. Our study, focusing on type 1 tympanoplasty in children aged seven and older, demonstrated the adequacy of the endoscopic method in all cases. This aligns with findings by Ito et al. [18], who reported successful endoscopic middle ear surgery even in children with abnormally narrow canals. However, because our study focused exclusively on type 1 tympanoplasty, we cannot extrapolate these findings to more complex cases. The inherent limitations of single-handed endoscopic surgery, such as bleeding control, suction, and drilling, remain relevant considerations.

Several studies have compared endoscopic and microscopic type 1 tympanoplasty. Choi et al. [20] reported statistically lower postoperative pain in the endoscopic group on the first postoperative day, a finding corroborated by our own study. However, Kuo et al. [21, 22] found no significant difference in postoperative pain or complications. While audiologic outcomes may not differ significantly between approaches, factors influencing patient comfort, such as postoperative care and pain management, are important considerations. Furthermore, some publications suggest superior hearing outcomes with the endoscopic approach [23, 24]. A recent study by Kaur et al. [23] demonstrated higher graft acceptance rates and better hearing improvement with endoscopic transcanal tympanoplasty compared to the microscopic postauricular approach. They also suggested that platelet-rich plasma (PRP) may further enhance outcomes with both techniques. Ultimately, functional outcomes in middle ear

surgery are influenced by various factors, including disease severity and surgeon experience.

Conclusion

Postoperative surveillance is important aafter pediatric tympanoplasty. Endoscopic tympanoplasty offers a compelling treatment option, achieving similar hearing restoration rates to microscopic techniques but with reduced postoperative pain and care requirements.

Conflict of interest statement

None.

Ethical approval

Ethical approval was obtained from Acıbadem University Clinical Research Ethics Committee for this study (decision no: 2020-08/6).

Author contributions

CH and DT contributed to the conception and design of the study, data collection, analysis, manuscript writing, and final approval. Specifically, CH was involved in the study design and gave final approval of the manuscript, while DT focused on data collection, analysis, and drafting the manuscript. All co-authors accept full responsibility for every aspect of the study and the completed manuscript.

References

1. Sheehy JL, Anderson RG. Myringoplasty. A review of 472 cases. Ann Otol Rhinol Laryngol. 1980;89(4 Pt 1):331-4.
2. Vrabec JT, Deskin RW, Grady JJ. Meta-analysis of pediatric tympanoplasty. Arch Otolaryngol Head Neck Surg. 1999;125(5):530-4.
3. Collins WO, Telischi FF, Balkany TJ, Buchman CA. Pediatric tympanoplasty: effect of contralateral ear status on outcomes. Arch Otolaryngol Head Neck Surg. 2003;129(6):646-51.
4. Roberts JE, Rosenfeld RM, Zeisel SA. Otitis media and speech and language: a meta-analysis of prospective studies. Pediatrics. 2004;113(3 Pt 1):e238-48.
5. da Costa SS, Rosito LP, Dornelles C. Sensorineural hearing loss in patients with chronic otitis media. Eur Arch Otorhinolaryngol. 2009;266(2):221-4.
6. Darrouzet V, Duclos JY, Portmann D, Bebear JP. Preference for the closed technique in the management of cholesteatoma of the middle ear in children: a retrospective study of 215 consecutive patients treated over 10 years. Am J Otol. 2000;21(4):474-81.
7. Aoki K. Advantages of endoscopically assisted surgery for attic cholesteatoma. Diagn Ther Endosc. 2001;7(3-4):99-107.
8. Yadav SP, Aggarwal N, Julaha M, Goel A. Endoscope-assisted myringoplasty. Singapore Med J. 2009;50(5):510-2.
9. Harugop AS, Mudhol RS, Godhi RA. A comparative study of endoscope assisted myringoplasty and micrsoscope assisted myringoplasty. Indian J Otolaryngol Head Neck Surg. 2008;60(4):298-302.
10. Lakpathi G, Sudarshan Reddy L, Anand. Comparative Study of Endoscope Assisted Myringoplasty and Microscopic Myringoplasty. Indian J Otolaryngol Head Neck Surg. 2016;68(2):185-90.
11. Karhuketo TS, Ilomaki JH, Puhakka HJ. Tympanoscope-assisted myringoplasty. ORL J Otorhinolaryngol Relat Spec. 2001;63(6):353-7; discussion 8.
12. Lade H, Choudhary SR, Vashishth A. Endoscopic vs microscopic myringoplasty: a different perspective. Eur Arch Otorhinolaryngol. 2014;271(7):1897-902.
13. Ayache S. Cartilaginous myringoplasty: the endoscopic transcanal procedure. Eur Arch Otorhinolaryngol. 2013;270(3):853-60.
14. Awad OG, Hamid KA. Endoscopic type 1 tympanoplasty in pediatric patients using tragal cartilage. JAMA Otolaryngol Head Neck Surg. 2015;141(6):532-8.
15. Manna S, Kaul VF, Gray ML, Wanna GB. Endoscopic Versus Microscopic Middle Ear Surgery: A Meta-analysis of Outcomes Following Tympanoplasty and Stapes Surgery. Otol Neurotol. 2019;40(8):983-93.
16. Gokgoz MC, Tasli H, Helvacioglu B. Results of endoscopic transcanal tympanoplasty performed by a young surgeon in a secondary hospital. Braz J Otorhinolaryngol. 2020;86(3):364-9.
17. Gulsen S, Baltaci A. Comparison of endoscopic transcanal and microscopic approach in Type 1 tympanoplasty. Braz J Otorhinolaryngol. 2021;87(2):157-63.
18. Ito T, Kubota T, Watanabe T, Futai K, Furukawa T, Kakehata S. Transcanal endoscopic ear surgery for pediatric population with a narrow external auditory canal. Int J Pediatr Otorhinolaryngol. 2015 Dec;79(12):2265-9. doi: 10.1016/j.ijporl.2015.10.019. Epub 2015 Oct 24. PMID: 26527072.
19. Isaacson G. Endoscopic anatomy of the pediatric middle ear. Otolaryngol Head Neck Surg. 2014 Jan;150(1):6-15. doi: 10.1177/0194599813509589. Epub 2013 Oct 23. PMID: 24154745.
20. Choi N, Noh Y, Park W, et al. Comparison of Endoscopic Tympanoplasty to Microscopic Tympanoplasty. Clin Exp Otorhinolaryngol. 2017;10(1):44-49. doi:10.21053/ceo.2016.00080.
21. Kuo CH, Wu HM. In response to Letter to the Editor entitled "Commentary on: Comparison of endoscopic and microscopic tympanoplasty". Eur Arch Otorhinolaryngol. 2017;274(12):4275-6.
22. Dündar R, Kulduk E, Soy FK, et al. Endoscopic versus microscopic approach to type 1 tympanoplasty in children. Int J Pediatr Otorhinolaryngol. 2014;78(7):1084-1089.
23. Kaur J, Deshmukh PT, Gaurkar SS, et al. Comparative Study of Endoscopic Transcanal Tympanoplasty and Tympanoplasty by Conventional Postaural Approach in a Tertiary Care Hospital in Central India. Cureus. 2024;16(8):e67081. Published 2024 Aug 17. doi:10.7759/cureus.67081.
24. Yang Q, Wang B, Zhang J, Liu H, Xu M, Zhang W. Comparison of endoscopic and microscopic tympanoplasty in patients with chronic otitis media. Eur Arch Otorhinolaryngol. 2022;279(10):4801-4807. doi:10.1007/s00405-022-07273-2.