



Original Article

Pediatric Type 1 Cartilage Tympanoplasty: Comparison between Graft Success Rates and Hearing Results in Adults

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OBJECTIVE: It is an ongoing debate whether tympanoplasty should be performed in the pediatric age group. The purpose of this study was to analyze and compare the anatomical and functional outcomes of type I cartilage tympanoplasty in children and adults.

MATERIALS and METHODS: The file records of patients who underwent type 1 cartilage tympanoplasty were retrospectively reviewed. In total, 133 patients who underwent type 1 tympanoplasty for chronic otitis media were included. Tragal cartilage grafts were used in all patients. The patients were divided into two groups: pediatric (age ≤ 16 years, n=54) and adult (age > 18 years, n=79) groups. The graft success rates and hearing results between the two groups were compared.

RESULTS: The graft success rate was 90.2% (120/133) in the study group. At the end of the 24-month follow-up, the graft was intact in 48 of the 54 (88.9%) patients in the pediatric group and 72 of the 79 patients in the adult group (91.1%) (p=0.769). The functional success rate (postoperative air-bone gap < 20 dB) obtained in the study group was 90.2% (120/133). The functional success rate was 88.9% (48/54) in the pediatric group and 91.1% (72/79) in the adult group (p=0.255).

CONCLUSION: The graft success rates and hearing results obtained with cartilage grafts are similar in children and adults. Therefore, cartilage grafts may be safely used in pediatric patients, similar to their use in adults.

KEYWORDS: Chronic otitis, pediatric tympanoplasty, tragal cartilage

INTRODUCTION

Tympanoplasty is a widely performed procedure in otorhinolaryngology clinics worldwide to eradicate middle ear disease and restore hearing. Although tympanoplasty is frequently performed in pediatric patients, there is still no consensus on the necessity and timing of surgery. Factors such as Eustachian tube dysfunction, immature immune system, and frequent upper respiratory tract infections are believed to affect the success of pediatric tympanoplasty, and it has been supposed that tympanoplasty is generally less successful when performed in the pediatric population^[1]. Therefore, some authors do not recommend tympanoplasty in children^[2,3].

Various graft materials such as temporalis muscle fascia, perichondrium, cartilage, fat, fascia lata, vein, and skin have been used to repair tympanic membrane perforations. The most commonly used graft materials in tympanoplasty is the temporalis muscle fascia, and the success rate is reported to be between 60% and 99% in adults and between 35% and 94% in children^[1-5]. Recently, many surgeons prefer cartilage graft for revision cases, subtotal perforations, and risky cases such as atelectasis and retraction due to the high stability of the cartilage and its resistance to negative middle ear pressure. A number of studies have reported better perforation closure rates with cartilage grafts than fascia grafts, with similar hearing results^[6,7]. However, cartilage grafts are not routinely used in pediatric tympanoplasty due to concerns such as limited data on long-term results, uncertainty about the determination of the most appropriate time for pediatric tympanoplasty, and thought that cartilage grafts might affect negatively hearing results.

There are very few studies reported in the scientific literature that compare the graft success rates and hearing results of pediatric and adult cartilage tympanoplasties. This study investigated the graft success rates and hearing results of type 1 cartilage tympanoplasty performed in children, and the results were compared with those obtained in adults.

MATERIALS and METHODS

The charts of patients who had primary type I cartilage tympanoplasty in Medical Sciences University Konya Training and Research Hospital between August 2010 and December 2014 were retrospectively analyzed. This study was approved by our Local Ethics Committee and adhered to the principles outlined in the Declaration of Helsinki. Age, gender, surgical approach, pre- and postoperative

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audiological test results, anatomic success in the postoperative term, and complications were noted. All patients had had tympanic membrane perforations for at least 1 year prior to the surgery. The exclusion criteria were the presence of cholesteatoma or atelectasis, purulent ear discharge 3 months before surgery, performing mastoidectomy or ossicular chain reconstruction during surgery, and revision cases. All patients preoperatively underwent computerized tomography (CT) of the temporal bone and audiograms.

A total of 133 patients who fulfilled the inclusion criteria and did not have the exclusion criteria were included. There were 54 (40.6%) patients who were ≤16 years of age (Group 1) and 79 (59.4%) patients who were >18 years of age (Group 2). Among the 54 pediatric patients, there were 24 males (44.4%), and 30 females (55.6%), with a mean age of 9 (8–16) years. There were 38 males (48%) and 41 females (51%) among a total of 79 adult patients, and their mean age was 30 (19–64) years (Table 1).

The patients were called for follow-up visits 3, 6, and 12 months after the surgery. Later, the patients were annually followed up, and audiograms were obtained. The audiogram obtained 24 months after surgery was used for statistical analysis. The hearing outcomes of the patients were analyzed by tonal audiometry by comparing the pre- and postoperative 24-month hearing thresholds measured at 0.5, 1, 2, 4, and 6 kHz. Pure tone averages (PTAs) and air–bone gaps (ABGs) were calculated based on the means of the thresholds at 0.5, 1, and 2 kHz.

At the end of 24-month follow-up, anatomical success was defined as the lack of perforation, retraction, and lateralization of the graft and functional success was defined as the postoperative ABG being lower than 20 dB. Surgical success was defined as success in both anatomical and functional aspects.

Patients with graft failure were re-operated on. Cartilage, temporalis fascia, or fat was used as the graft materials in accordance with the size of the perforation.

Surgical Technique

A postauricular approach was used when the patient was under general anesthesia, supplemented with the local infiltration of 2% lidocaine with 1:100,000 epinephrine (Jetosel; Osel, Turkey). The ossicular chain was intact and mobile in all patients. No patient underwent ossicular chain reconstruction. Cartilage island grafts were prepared from the tragal cartilage and were used as graft materials in all patients. The outer 2 mm of the tragal cartilage was left in place to have better cosmetic results. The perichondrium was removed from the convex surface of the tragal cartilage, and its thickness was reduced to 0.5 mm. The graft was placed in the form of a chondroperichondrial island graft using the overlay–underlay technique and was supported with spongostan (spongostan standard; Ethicon, USA). The patients stayed in the hospital on the night of surgery and were discharged the next day.

Statistical Analysis

Categorical data were presented as number (n) and percentage (%). Continuous data were presented as mean±standard deviation. The Wilcoxon signed-rank test was used to compare pre- and postoperative non-parametric continuous variables and ABGs. The significance of intergroup differences was analyzed using Student’s t-test, and the

Table 1. Characteristics of the patients

	Children (n=54) (Group 1)	Adults (n=79) (Group 2)	p
Gender			
Female (%)	30 (55.6)	41 (51.9)	0.812
Male (%)	24 (44.4)	38 (48.1)	
Age, years	9 (8–16)	30 (30–57)	<0.001*
Graft success (%)			
Yes	48 (88.9)	72 (91.1)	0.769
No	6 (11)	7 (8.9)	
Functional success (%)			
Yes	48 (88.9)	72 (91.1)	0.255
No	6 (11)	7 (8.9)	
Surgical success (%)			
Yes	48 (88.9)	72 (91.1)	0.255
No	6 (11)	7 (8.9)	

*Statistically significant

significance of the difference of the medians was analyzed with the Mann–Whitney U test. Categorical variables were analyzed with Pearson’s Chi-square or Fisher’s exact tests. SPSS 15 (SPSS Inc.; Chicago, IL, USA) was used for data analysis. p<0.05 was considered to be statistically significant.

RESULTS

The overall graft success rate was 90.2% (120/133). Intact grafts were determined in 48 (88.9%) of the 54 pediatric patients and 72 (91.1%) of the 79 adult patients 24 months after the surgery (p=0.769, Fisher’s exact test). The overall functional success rate (postoperative ABG<20 dB) was 90.2% (120/133). The functional success rate was 88.9% (48/54) in Group 1 and 91.1% (72/79) in Group 2 (p=0.255, Fisher’s exact test). Surgical success (intact graft+postoperative ABG<20 dB) was obtained in 120 (90.2%) patients; the rate was 88.9% (48/54) in Group 1 and 91.1% (72/79) in Group 2 (p=0.255) (Table 1).

The mean pre- and postoperative PTAs were 30.02±7.64 (15–45) dB and 19.54±8.03 (8–48) dB in Group 1 and 31.87±7.99 (7–50) dB and 22.24±8.82 (5–38) dB in Group 2, respectively. The differences between the mean pre- and postoperative PTAs were statistically significant in both groups (p<0.001) (Table 2).

The pre- and postoperative ABGs were 20.74±5.73 dB and 12.98±5.63 dB in Group 1 and 19.94±7.71 dB and 12.81±7.53 dB in Group 2, respectively. The differences between the mean pre- and postoperative ABGs were statistically significant in both groups (p<0.001) (Table 2).

The comparison between groups 1 and 2 for pre- and postoperative ABGs and ABG gain, as well as pre- and postoperative PTAs and PTA gain, did not reveal any statistically significant result (p>0.05 for all) (Table 2).

DISCUSSION

Only a few studies have compared the anatomical and audiological results of cartilage tympanoplasty between children and adults. In this

Table 2. The mean pre- and postoperative pure-tone average (PTA) and air-bone gap (ABG) of the patients

	Children (n=54) (Group 1)	Adults (n=79) (Group 2)	p ¹
ABG			
Preop	20.74±5.73	19.94±7.71	0.516
Postop	12.98±5.63	12.81±7.53	0.887
p ²	<0.001*	<0.001*	
ABG gain	7.75±7.17	7.12±8.79	0.662
PTA			
Preop	30.02±7.64 (15-45)	31.87±7.99 (7-50)	0.231
Postop	19.54±8.03 (8-48)	22.24±8.82 (5-38)	0.058
p ²	<0.001*	<0.001*	
PTA gain	10.48±8.02 (1-25)	9.62±8.81	0.567

Preop: preoperative; Postop: postoperative; ABG: air-bone gap; p¹: comparison of children and adults; p²: comparison of preoperative and postoperative results within the same group; PTA: pure tone average

study, we compared the results of cartilage tympanoplasty in adult and pediatric patients and found that the anatomical and functional success rates were similar between the two groups.

Many studies have reported that the success rate of cartilage grafts for closing tympanic membrane perforations is higher than that of other graft materials. While the success rate of using temporal muscle fascia was 75% in the study conducted by Kazikdas et al.^[8] they achieved a success rate of 95.7% in the cartilage group. Similarly, in the study conducted by Callioglu et al.^[9] that compared the results of fascia tympanoplasty and cartilage tympanoplasty, they achieved a success rate of 95.2% in the cartilage group and 80% in the fascia group. El Hennawi et al.^[10] reported success rates of 86% for pediatric cartilage tympanoplasty. A recent study conducted on a pediatric population by Iacovou et al.^[11] reported the closure rate of tympanic membrane perforations to be 92.4% in the cartilage group and 84.3% in the fascia group. The total graft success rate achieved after 24 months in our study was 90.2% (120/133). The graft was successful in 48 of the 54 pediatric patients (88.9%) and 72 of the 79 (91.1%) adult patients.

Although relatively better results are obtained in cartilage tympanoplasty than in fascia tympanoplasty, the use of cartilage is still debated. It has been believed that cartilage causes a mass effect on the conductive system and negatively affects hearing results as it is hard and not very flexible. Even though it provides good graft stabilization, some researchers believe that the hearing results of cartilage are not as good as the anatomical results. However, there is no evidence in the scientific literature proving that cartilage has negative effects on hearing results^[12]. Gerber et al.^[13] analyzed the hearing results of cartilage and fascia tympanoplasty in a frequency-specific manner and compared two groups; they observed that there was no significant difference between the groups. Levinson et al.^[14] reported that ABGs were reduced to 10 dB in 65% and to 20 dB in 86% of patients who underwent cartilage tympanoplasty. Dornhoffer^[15] did not find any significant difference in hearing gains after cartilage-perichondrium grafting and perichondrium grafting alone.

Friedman et al.^[16] identified the mean pre- and postoperative ABG levels as 20.7 dB and 8.5 dB, respectively, in 119 pediatric patients who underwent type 1 cartilage tympanoplasty and reported that the difference was statistically significant. Yilmaz et al.^[17] in a series of 136 patients (45 pediatric patients and 91 adult patients), compared the results of pediatric and adult cartilage tympanoplasty. Similar to our study results, they obtained similar results for the graft success rates and hearing results in both groups. In our study, we found the ABG gain to be 7.75±7.17 dB in Group 1 and 7.12±8.79 dB in Group 2 (p=0.662). We also found an improvement in the PTA result at 10.48±8.02 (1–25) dB in Group 1 and 9.62±8.81 (5–30) dB in Group 2 (p=0.567). Our results have shown that while significant graft success rates are being obtained in groups 1 and 2 (p<0.001 for both groups), there is no difference between the hearing gains of the groups. The functional success (postoperative ABG<20 dB) was found to be 88.9% in Group 1 and 91.1% in Group 2. Surgical success was obtained in 88.9% in Group 1 and in 91.1% in Group 2 (p=0.255).

Age at surgery has been debated in pediatric tympanoplasty. Some authors claim that surgery should be performed without delay, but others believe that it should not be performed until puberty, unless it is an absolute necessity. Although various publications have indicated that age is not an important factor, this issue is still controversial due to reasons such as different monitoring periods (between 3 and 24 months) and success criteria (an intact membrane is considered as a success in some cases, while the observation of retraction or effusion is considered as a failure in others). Koch et al.^[2] analyzed 64 consecutive pediatric tympanoplasty patients and concluded that the age of the patient affected surgical outcome. They could not demonstrate a significant relationship between any other factor and the success rate. They proposed that tympanoplasty can be performed in children 8 years and older. However, some researchers have suggested that tympanoplasty should be postponed until the age of 7, 10, 11, and 12 years in children^[18-21]. Vrabec et al.^[22] performed a meta-analysis of 30 studies including a 30-year period and reported age-specific data. They concluded that age contributed to postoperative successful recovery rates and that other parameters did not have any significant relationships with a good outcome. Interestingly, in 25 of the 30 studies analyzed, it has been reported that independently, age is not a factor that affects the results of tympanoplasty in children. Albera et al.^[23] analyzed preoperative factors that could affect the success of tympanoplasty in adult and pediatric patients. Failure was defined as a persisting perforation of the tympanic membrane or the development of recurring perforations. Researchers have concluded that tympanoplasty can be performed in children and that its results are equivalent to those obtained in adults. Parallel to this, Çaylan et al.^[24] and Denoyelle et al.^[25] reported that age of a child did not affect the success of surgery. In a recent meta-analysis performed by Hardman et al.^[26] it was found that age was not a significant factor affecting the closure rate. In our study, the youngest child operated in the pediatric group was 8 years old, and the mean age was 9 (range, 8–16) years, and the success rate was similar to that in the adult group.

Some authors have claimed that more successful outcomes were obtained with perioperatively dry ears; however, others reported that moist or discharging ears did not negatively affect the outcomes. Uyar et al.^[27] analyzed multiple preoperative factors, including otorrhea, in 41 pediatric patients who underwent tympanoplasty. They determined that the graft success rates were higher and that postoperative

hearing was better in patients with preoperatively dry ears. They recommended that ears with initial discharge should be medically treated and that tympanoplasty should be performed after a 3-month period without any ear discharge. Although some authors have reported that preoperative otorrhea did not affect tympanoplasty success, tympanoplasty was performed following a non-discharge period of at least 3 months, particularly in children^[23, 24, 28]. If there is a hypertrophic adenoid tissue that requires surgery, first, adenoidectomy is performed, and then, tympanoplasty is performed in the following months.

Cartilage grafts are being more frequently used in our practice, both in children and adults. In this study, patients with intact ossicular chains were included to analyze the effect of the cartilage graft alone on hearing. However, cartilage tympanoplasty is not without its disadvantages. Cosmetic deformities can be seen in the donor area. It is important to leave the outer 2 mm of the tragal cartilage to prevent cosmetic deformities. Another disadvantage is the inability to perform tympanometry to evaluate the status of the middle ear after cartilage tympanoplasty because the cartilage is hard and less flexible. In addition, the intubation of the tympanic membrane is difficult following cartilage tympanoplasty.

Our study has some limitations. First, the number of patients is small. Second, our patients included a pediatric age group older than 8 years, and our results are not representative of all pediatric patients. Third, we did not compare the results of the cartilage graft with other graft materials. Fourth, our study is retrospective and carries the disadvantages of retrospective studies including selection bias. However, we believe that our study still has value because it compared the anatomical and functional results of type 1 cartilage tympanoplasty between children and adults.

In conclusion, the long-term graft success rates and hearing results of primary type 1 cartilage tympanoplasty seem to be comparable in adults and children. Further randomized controlled studies on a larger patient population are needed to further clarify our results.

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Informed Consent: N/A.

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