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Research Article

Long-Term Results of Tragal Cartilage Type 1 Tympanoplasty

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Abstract

Aim: Tympanoplasty is one of the most frequently performed operations by ear, nose, and throat specialists. Surgical treatment of tympanoplasty aims to obtain a healthy ear membrane and minimise hearing loss. The purpose of this study was to evaluate the success of the graft and functional hearing outcomes of patients applied with tragal cartilage type 1 tympanoplasty operation in our clinic.

Materials and Methods: This study included 43 patients who underwent tragal cartilage type 1 tympanoplasty operation between January 2016 and November 2020. A retrospective evaluation was made of the preoperative pure tone audiometry (PTA) values and the operative findings. In the follow-up examination, the graft status and PTA results were recorded. The graft success and improvements in hearing were evaluated in all the patients.

Results: A total of 43 patients were evaluated, comprising 24 males and 19 females with a mean age of 31.2 years (range, 13-58 years). The operation was performed on the right ear of 22 patients and the left ear of 21. The tympanoplasty operation was performed with an endaural approach in 6 cases and a postauricular approach in 37. The mean follow-up period was 20.8 months (range, 12-39 months). The rate of graft success of all the patients was 88.4%. The mean air conduction threshold, air-bone gap, and bone conduction threshold values at 500, 1000, 2000, and 4000 Hz were determined to have statistically significantly decreased postoperatively in comparison with the preoperative values ($p<0.05$).

Conclusion: In tragal cartilage type 1 tympanoplasty operations, high rates of graft success were obtained and a dramatic gain in hearing postoperatively.

Keywords: Cartilage type 1 tympanoplasty, hearing gain, graft success

INTRODUCTION

Chronic otitis media (COM) is an ear disease frequently seen in both children and adults. The clinical findings of the disease are tympanic membrane perforation and intermittent recurrent ear discharge. In the suppurative period of the disease, medical treatment is applied, but the ultimate treatment of COM is surgery. Tympanoplasty is the most frequently performed operation in the treatment of COM. The primary purpose of treatment with tympanoplasty is to obtain a healthy ear membrane and middle ear mucosa, and to correct hearing loss (1).

The factors important in the success of tympanoplasty are operation preparation, the localisation and dimensions of the perforation, the surgical technique used, the functional status of the Eustachian tube, the presence of nasal pathologies, the skill of the surgeon, and the graft materials used. Tympanoplasty was first applied by Wullstein in 1952, followed by Zoellner in 1955, and since then various graft materials have been used to repair perforations in the tympanic membrane (2,3). These graft materials include skin, periostium, perichondrium, dura mater, cartilage, vessels, fat tissue, and temporal muscle fascia (4). In recent years, cartilage has been used more as graft material (5). Cartilage has the properties of resistance to graft retraction, resorption, and negative pressure, has good connections with the surrounding tissue, and appropriate elasticity for sound transmisson (6,7).

The purpose of this study was to compare the preoperative and postoperative pure tone audiometry results of patients applied with tragal cartilage type 1 tympanoplasty operation, to determine the postoperative hearing gain and evaluate the postoperative tragal cartilage graft success.

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MATERIAL AND METHOD

The study included 43 patients on whom tragal cartilage type 1 tympanoplasty operation was performed for a diagnosis of non-suppurative chronic otitis media in the Ear, Nose, and Throat Clinic of Karaman Training and Research Hospital in the period January 2016 - November 2020. The patients forming the study group were those with no cholesteatoma, intact ossicle chain, healthy middle ear mucosa and no ear infection for a minimum of 3 months preoperatively. The study exclusion criteria were defined as damage or fixation in the ossicle chain, a history of mastoidectomy or revision tympanoplasty, the presence of sensorineural or mixed type hearing loss, or incomplete preoperative audiometry results or non-attendance of postoperative follow-up examinations.

The study protocol was approved by the Ethics Committee of Karamanoğlu Mehmetbey University Medical Faculty (decision no:02, dated:07.12.2020). All procedures were applied in compliance with the principles of the Helsinki Declaration. All the study participants provided written informed consent.

The preoperative pure tone audiometry (PTA) values and the operative findings were retrieved from the hospital archives and recorded. To be able to evaluate the long-term graft success and hearing outcomes, the graft status was evaluated with endoscopic ear examination and hearing outcomes with the PTA test at the postoperative 12-month follow-up examination. The air conduction thresholds, the mean air conduction thresholds, the mean bone conduction thresholds, and the mean air-bone gap thresholds in the PTA test at 500, 1000, 2000, and 4000 Hz were recorded preoperatively and postoperatively. Then the preoperative and postoperative results were compared. The air and bone conduction threshold mean values were calculated as the arithmetic mean of the values at 500, 1000, 2000, and 4000 Hz.

Surgical Technique

All the graft materials were prepared from tragal cartilage. The general reconstruction was made using a perichondrium cartilage island graft, starting with the harvesting of the cartilage from the tragal area (8). In order not to disrupt the cosmetic appearance, an incision was made leaving a 2mm cartilage crown in the dome of the tragal cartilage. Protecting the perichondrium on both surfaces of the cartilage, it was dissected from the surrounding tissues, excised and removed. By elevating the perichondrium on the convex surface of the tragal cartilage, the perichondrium formed the cartilage island graft. Cartilage excisions were made from the edges of the tragal cartilage in line with the size of the perforation in such as way as to preserve the perichondrium. Then at the point where the tragal cartilage meets the manubrium mallei, an incision was made to open a space. De-epithelialisation of the perforation edges of the tympanic membrane was performed using a pick. A tympanomeatal flap was formed and elevated, then the middle ear space below the anulus was reached. The integrity of the ossicle chain, mobility, and middle ear mucosa were checked by dissecting the tympanic membrane from the manubrium mallei. The perichondriun cartilage island graft prepared from the tragal cartilage was placed using the underlay technique. The cartilage graft was supported by placing Gelfoam and Spongostan in the middle ear space. The tympanomeatal flap was then laid out in place and it was checked whether or not the perforation was fully covered by the graft. After ensuring that the perforation was fully covered, the tympanomeatal flap was supported with the placement of Gelfoam and Spongostan.

Statistical Analysis

Statistical analyses were performed using IBM SPSS vn. 22.0 software. Conformity of continuous variable to normal distribution was assessed with Q-Q and normal curve with histogram plots. Normally distributed continuous variables were analyzed with the independent samples t-test. The level of statistical significance was set as $p<0.05$.

RESULTS

A total of 43 patients were evaluated, comprising 24 (55.8%) males and 19 (44.2%) females with a mean age of 31.2 years (range, 13-58 years). The operation was performed on the right ear of 22 (51.1%) patients and the left ear of 21 (48.9%). The tympanoplasty operation was performed with an endaural approach in 6 (14%) cases and a postauricular approach in 37 (86%). The mean follow-up period was 20.8 months (range, 12-39 months).

The tympanic membrane perforation was determined to be fully covered in 38 (88.4%) cases, and in the 5 (11.6%) cases where the tympanic membrane perforation was not closed, the perforation was observed to be minimal (Table 1). Ossicle chain reconstruction was not performed in any patient.

Table 1. Patient demographic data

Age (years)		**31.2 (13-58)**
Gender	Female	19 (44.2%)
	Male	24 (55.8%)
Operated ear	Right	22 (51.1%)
	Left	21 (48.9%)
Graft success	Intact	38 (88.4%)
	Perforated	5 (11.6%)

In the preoperative PTA test of the 43 ears applied with tympanoplasty, the air conduction mean threshold values were recorded as 29.53±6.97 dB at 500 Hz, 27.79±6.2 dB at 1000 Hz, 28.13±6.72 dB at 2000 Hz, and 33.25±7.55 dB at 4000 Hz. The postoperative air conduction mean threshold values were seen to be 20.81±5.66 dB at 500 Hz, 20.23±5.34 dB at 1000 Hz, 18.83±6.34 dB at 2000 Hz, and 27.79±6.66 dB at 4000 Hz. The improvements in postoperative hearing levels at all frequencies were determined to be statistically significant ($p<0.05$). Preoperatively, the bone conduction threshold was mean 12.76±5.34 dB, the air conduction threshold was mean 30.06±5.2 dB and the air-

bone gap threshold value was mean 17.65±4.71 dB. The postoperative values were determined to be mean bone conduction threshold of 11.3±4.87 dB, mean air conduction threshold of 22.18±4.24 dB and air-bone gap threshold value of 10.88±4.07 dB. With the exception of the bone conduction value, all the other findings were determined to be statistically significant (p<0.05) (Table 2).

Table 2. Preoperative and postoperative pure tone audiometry results

	Preoperative (dB)	Postoperative (dB)	P value
500 Hz (air conduction threshold)	29.53±6.97	20.81±5.66	<0.001
1000 Hz (air conduction threshold)	27.79±6.2	20.23±5.34	<0.001
2000 Hz (air conduction threshold)	28.13±6.72	18.83±6.34	<0.001
4000 Hz (air conduction threshold)	33.25±7.55	27.79±6.66	<0.001
Mean air conduction threshold	30.06±5.2	22.18±4.24	<0.001
Mean bone conduction threshold	12.76±5.34	11.3±4.87	0.188
Mean air-bone gap threshold	17.65±4.71	10.88±4.07	<0.001

dB: Decibel, Hz: Hertz

DISCUSSION

The aim of surgical treatment for chronic otitis media is to obtain a healthy ear and functional hearing (9). To be able to achieve this, the graft must be intact after the operation, and the incoming sound waves must be able to be sufficiently conducted to the middle ear. Various surgical techniques and graft materials are used in tympanoplasty operations to obtain this success.

As the structure of cartilage grafts used until recently is hard and thick, there was the belief that the hearing outcomes of patients applied with cartilage tympanoplasty would be less successful compared to other tympanoplasty grafts. However, recent studies have shown that in addition to the successful membrane coverage of cartilage tympanoplasty, audiologically it has provided similar hearing results as structurally thinner and more flexible grafts such as the temporal fascia and perichondrum (10,11). Of all autografts, cartilage graft is the most resistant to absorption and is well connected to the surrounding tissue (12). It is appropriate for sound vibration in Eustachian tube dysfunction because of the hard structure and resistance to negative pressure and flexibility (13).

In an extensive study by Dornhoffer, published in 2003, the functional results of cartilage tympanoplasty were shown to be very good (14). Yurttas et al. reported a 93% membrane success rate in cartilage tympanoplasty (15), and in another study, Abdelhameed et al. also reported graft success rate of 92% (16). In the current study, the tragal cartilage graft success rate was found to be 88.4%. In 5 patients in the current series, an opening was determined in the anterior of the graft, but the postoperative membrane perforation was seen to be extremely small in these patients compared to the size of the preoperative perforation. The hearing functions were observed to be better than the preoperative results. Thus, the success rate of cartilage tympanoplasty graft in this study was consistent with previous findings in literature.

Karaman et al. reported that cartilage was a highly appropriate graft material in tympanoplasty in respect of hearing and graft success. Graft success was reported to be 97%, and of the functional results, there were improvements in the air-bone gap with values reported of 20.2 dB at 500 Hz, 23.58 dB at 1000 Hz, 22.23 dB at 2000 Hz, and 24.79 dB at 4000 Hz (17). Yilmaz et al. evaluated cartilage tympanoplasty in both adult and pediatric patients. Graft success rate was found to be 92.6%, and the preoperative and postoperative mean air conduction threshold values were found to be 34.8±8.5 dB and 23.4±9.1 dB, respectively in adults, and 30.6±7.7 dB and 17.8±7.8 dB in children (7). The cartilage graft success and hearing improvements in the current study were evaluated in the follow-up period of mean 20.8 months (range, 12-39 months). The success of the tragal cartilage graft was found to be 88.4%. In the postoperative PTA test, the mean air conduction threshold values were found to be 20.81±5.66 dB at 500 Hz, 20.23±5.34 dB at 1000 Hz, 18.83±6.34 dB at 2000 Hz, and 27.79±6.66 dB at 4000 Hz. The postoperative air conduction threshold was determined to be 22.18±4.24 dB and the air-bone gap was 10.88±4.07 dB. The mean postoperative air conduction threshold values at 500, 1000, 2000, and 4000 Hz, and the mean air-bone gap values were observed to be statistically significantly lower than the preoperative values (p<0.05). Approximately 7 dB closure was determined in the mean air-bone gap.

CONCLUSION

The findings of this study demonstrated that the long-term results of the tragal cartilage tympanoplasty technique were extremely good in respect of graft success and hearing improvements. It can be considered that the recent positive results of perforation closure rates and hearing gains of cartilage tympanoplasty will ensure that this

technique becomes more widespread.

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Conflict of Interest: *The authors declare that they have no competing interest.*

Ethical approval: *The study protocol was approved by the Ethics Committee of Karamanoğlu Mehmetbey University Medical Faculty (decision no:02, dated:07.12.2020).*

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