



Comparison of graft success rate between cartilage and fascia in endoscopic tympanoplasty: Our long-term results

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ABSTRACT

Objectives: This study aims to present our long-term results of endoscopic tympanoplasty and to compare the perforation closure rates of cartilage grafts versus fascia grafts.

Patients and Methods: A total of 112 ears of 103 patients (35 males, 68 females; mean age 33.6 years; range, 9 to 78 years) who underwent endoscopic tympanoplasty due to chronic otitis media between October 2011 and July 2014 were included in this retrospective study. The operations were divided into two groups according to the graft material type as the fascia group (n=43) and cartilage group (n=69). Demographic data of the patients and perforation closure rates according to the graft material type used were recorded.

Results: The mean follow-up was 51.4 months. The graft intake rate of the cartilage and fascia groups were 89.8% and 90.7%, respectively (p=1.000). The overall perforation closure rate was found to be 90.2%.

Conclusion: Endoscopic tympanoplasty is an effective and less invasive new surgical access technique in otology in which satisfactory results for graft intake rates can be achieved even in the beginning stage. The cartilage graft use in endoscopic tympanoplasty also yields similar and comparable anatomic success results with the fascia graft.

Keywords: Cartilage, chronic otitis media, endoscopic tympanoplasty, fascia, graft success.

Tympanoplasty is described as the eradication of the disease with the reconstruction of the tympanic membrane (TM) and ossicular chain to restore sound pressure transmission for hearing.^[1-3] After the first attempts to close the TM perforation with cicatrizing agents and packing methods, Berthold was the first author repairing TM perforation with a skin graft surgically.^[4] With the introduction of modern

tympanoplasty classification by Wullstein and Zollner in the 1950s, various modified and advanced techniques have been developed by several authors.^[2] Connective tissue graft materials have become popular after the first use of fascia lata by Zöllner in 1956.^[5] Most commonly used graft materials are temporalis muscle fascia, cartilage, perichondrium, and fat.^[6-8]

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In parallel with the technological advances in magnification and lightning power, operating microscope (OM) has become a traditional instrument in modern otologic surgery, leading to a significant improvement in both surgical technique and success.^[9,10]

Rigid endoscopes have been used in otolaryngology practice after the introduction of Hopkins' rods, particularly in rhinology, since the 1950s.^[11] The use of endoscopes in otology was first adopted for preoperative evaluation, imaging, diagnosis, and documentation.^[12] However, current use of endoscopes in otologic surgery has become widely expanded, such as in tympanoplasty, otosclerosis, cholesteatoma, retraction pocket surgeries, resection of benign neoplasms of the middle ear, and limited pathologies of petrous apex, inner ear, and internal acoustic meatus.^[13-15] Major superiority of endoscopes against OM is the ability to bypass a narrow external ear canal and to visualize the hidden spaces of the middle ear ME cavity such as sinus tympani, anterior epitympanum, and retrotympanium.^[16,17] On the contrary, the main disadvantages include single-handed manipulation, loss of three-dimensional view, excessive heat dissipation, and frequent staining of endoscope tip with blood.^[10,18]

Although there are several prospective and retrospective clinical studies of microscopic tympanoplasty (MT) outcomes with respect to the graft materials, there is only one study comparing the perforation closure success between cartilage and fascia in endoscopic tympanoplasty (ET) up to date.^[19,20] In the present study, we aimed to present our long-term results of ET in our clinic and to compare the perforation closure rates of cartilage grafts versus fascia grafts.

PATIENTS AND METHODS

This retrospective study included 156 ET surgeries which were performed in Dışkapı Yıldırım Beyazıt Training and Research Hospital, Department of Otorhinolaryngology Head and Neck Surgery. However, 32 patients had missing follow-up data and the inlay butterfly cartilage graft technique was employed to posteriorly or anteriorly localized central perforations smaller than 50% of TM in 12 patients and these were excluded from the study. *Exclusion*

criteria were as follows: having a revision surgery, endoscopic assisted tympanoplasties, endoscopic inlay butterfly cartilage myringoplasty, or mastoidectomy + ET and patients with missing follow-up data. Finally, a total of 112 ears of 103 patients (35 males, 68 females; mean age 33.6 years; range, 9 to 78 years) who underwent ET due to chronic otitis media between October 2011 and July 2014. The operations were divided into two groups according to the graft material type as the fascia group (n=43) and cartilage group (n=69). Demographic data of the patients and perforation closure rates with anatomic success rates according to the graft material type used were recorded.

A written informed consent was obtained from each patient. The study protocol was approved by the local Ethics Committee (No. 19/02-26.01.2015). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Surgical technique

All surgeries were performed with 0° and 30° 3 mm 14 cm rigid endoscopes with a high definition camera under general anesthesia by a single surgeon. After local anesthetic infiltration, the hair and cerumen in the canal were cleaned to avoid the staining of the endoscope tip for better visualization. In perforations anterior to manubrium mallei and a perforation size greater than 50% of TM, a cartilage graft was used, while the over-underlay technique was preferred for graft replacement. Tragal cartilage was thinned down to approximately 0.5 mm in thickness and its medial facet perichondrium was removed. A thin wedge resection of cartilage was made at 12 o'clock position with intact perichondrium as a notch for manubrium mallei. On the other hand, for posteriorly localized perforations smaller than 50% of TM, the temporalis muscle fascia with an underlay technique was used.

A tympanomeatal flap incision was designed according to the side of operation and perforation size. In right ears of the cartilage group, the horizontal incision was used approximately 1 cm away from the annulus and completed in vertical-oblique plane 3-mm away from annulus superiorly at 1 o'clock and inferiorly



Figure 1. Anterior quadrant perforation of right tympanic membrane.



Figure 2. A transcanal incision.



Figure 3. Tympanomeatal flap elevation.



Figure 4. Tragal cartilage graft with a notch for manubrium mallei.



Figure 5. Over-underlay graft replacement.



Figure 6. A postoperative view of tympanic membrane.

Table 1. Graft success rates according to the type of graft material

	Number of surgery	Number of graft success	Percentage of graft success	<i>p</i>
	<i>n</i>	<i>n</i>	%	
Fascia group	43	39	90.7	1.000
Cartilage group	69	62	89.8	
Total	112	101	90.2	

5 o'clock positions. However, in left ears of the cartilage group, a horizontal incision was used approximately 1 cm away from the annulus and completed in vertical-oblique plane 3 mm away from annulus superiorly at 11 o'clock and inferiorly 7 o'clock positions. In the fascia group, a similar incision, but superiorly at 12 o'clock and inferiorly 6 o'clock positions in the vertical plane was used (Figures 1-6).

Bleeding control was achieved by compression of epinephrine-soaked cottonoids or using a 16-gauge peripheral angiocatheter modification as an aspirator cautery.^[21]

Statistical analysis

Statistical analysis was performed using the IBM SPSS version 22.0 software (IBM Corp., Armonk, NY, USA). Descriptive data were expressed in mean \pm standard deviation (SD) and median (min-max) for continuous variables and number and frequency for nominal variables using the chi-square or Fisher's exact test. The significance of difference for nominal variables was analyzed using the Spearman chi-square test. A *p* value of <0.05 was considered statistically significant.

RESULTS

Of all patients included in the study, nine were operated from both ears and four of them were operated in the same session. The mean follow-up was 51.4 (range, 39 to 69) months.

All operations were divided into two groups according to the graft material used as the temporalis muscle fascia group and cartilage group. Audiological results were not included in the study. Only perforation closure rates were evaluated. Accordingly, the perforation closure rates were 90.7% (*n*=39) and 89.8% (*n*=62)

in the fascia and cartilage group, respectively (*p*=1.000). The overall perforation closure rate was 90.2% (*n*=101) (Table 1). There was no need to perform canaloplasty in any surgeries, and no anterior blunting or graft lateralization was observed. The graft success rates according to the type of graft material are shown in Table 1.

DISCUSSION

The surgical success is influenced by two main factors: surgical technique and the patient. The route of approach (retroauricular, endaural), the technique of graft replacement (overlay, underlay, over-underlay), the type of graft material, and grade of the surgeon are critical contributing factors for surgical technique. Age, perforation site and size, the condition of the middle ear, mastoid and eustachian tube, status of contralateral ear, history of ear surgery are the other factors associated with the patient for postoperative success.^[5,22,23] In our study, different types of ossiculoplasty techniques were used in a wide spectrum of chronic otitis patients from dry small central perforations to tympanosclerosis and middle ear cholesteatoma. The patients were not homogenous with respect to ossicular pathologies. Therefore, we evaluated only perforation closure rates rather than the audiological findings.

Surgical success and patient satisfaction are the crucial for the motivation of otologic surgeons. The perforation closure rate varies ranging between 75 and 100% in microscopic surgery in the literature.^[24] On the other hand, there are few studies regarding the success rates of ET. El-Guindy,^[25] Usami et al.,^[26] Raj and Meher,^[27] and Yadav et al.^[28] reported endoscopic myringoplasty graft rates as 91.7%, 81.8%, 90%, and 80%, respectively. Marchioni et al.^[29] concluded that 77.7% of retraction pocket

patients had well-ventilated attic space with a mean follow-up of 20.1 months after ET. In a study of Tarabichi,^[10] the ET success rates were 92% in medial grafting and 100% in lateral grafting technique. In the present study, we were unable to divide tympanoplasty surgeries into subgroups according to the types of middle ear pathologies and we found an overall success rate of 90.2%, consistent with the results reported in the literature. Therefore, similar results can be obtained via endoscopic approach. In practice, while shifting the surgical technique from microsurgery to endoscopic surgery, there would be a difficulty in manipulation due to single-handed use at the beginning. The most challenging step is the elevation of the fascia and handling with the hemorrhages from the external ear canal. With the help of hypotensive anesthesia and practice, it would be easier to achieve this step soon.

There are mainly two types of classical grafting technique which is an important factor in the surgical success. Overlay and underlay techniques have their own advantages and disadvantages depending on the perforation site and size, and overhanging of the anterior canal.^[4] Over-underlay technique is a combination of these two techniques to increase the exposure of the anterior portion of the middle ear and perforation and to avoid graft lateralization and blunting of anterior tympanomeatal angle.^[30,31] Therefore, in patients with perforation anterior to manubrium mallei and perforation size greater than 50% of TM, over-underlay technique with a cartilage graft was employed and comparable results (89.8%) were achieved for the underlay technique with a fascia graft (90.7%) used in smaller and posterior perforations. Also, no anterior blunting or graft lateralization was observed during follow-up.

Cartilage has been used in otologic surgery for ossicular reconstruction and grafting since the 1960s.^[32] Several designs of cartilage graft types have been defined to date, and graft intake rate varies between 80 and 100%.^[3,8,33] Ayache^[6] reported a success rate of 96% in endoscopic cartilage myringoplasty in 30 patients after one-year follow-up. In our study, the success rate of the cartilage group was 89.8% with a mean follow-up of 51.4 months. In Ayache's study,

the majority of the perforations were smaller than 50% of TM localized anteroinferiorly, and only myringoplasty operations were included. In addition, marginal perforations and retraction pockets were excluded. This may explain the lower rates of graft intake in our study.

There is only one study available in the literature comparing the cartilage and fascia success rates in ET. In their prospective study, Mohanty et al.^[20] compared the type 1 ET success rate of 87 cartilage graft surgeries with 100 fascia graft surgeries. The overall success rates of cartilage and fascia group were 91.9% and 79%, respectively, indicating no statistically significant difference. Our findings were similar in the cartilage group, while the fascia success rate was higher than the Mohanty's study. This can be attributed to the localization of the perforation. Our fascia group perforation site involved the posterior quadrant; however, only anterior perforations were included in the Mohanty's study.

The main limitation of this study is that there was no audiological outcome due to heterogeneous pathologies of the ossicles and different types of ossiculoplasties. The other limitation is the retrospective design of the study. Finally, not only the perforation site, but also the grafting technique of the groups were not identical to make a more homogenous comparison.

In conclusion, endoscopic ear surgery is a new developing surgical access technique in the practice of otology. This technique is less invasive, less morbid, and has certain advantages to visualize the hidden places in the middle ear cavity. In the present study, the use of cartilage grafts in ET yielded comparable anatomic success rates with respect to the fascia graft. Nonetheless, further large-scale, prospective studies are needed to gain a better understanding of the role of cartilage graft use in ET. Our study results suggest that, even in the beginning stage, ET yields satisfactory results in posterior perforations with fascia grafts and in anterior perforations with cartilage grafts in the long-term. We believe that more favorable results can be achieved with the gain of experience of surgical practice.

Declaration of conflicting interests

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