



## CLINICAL STUDY

# THINNED TRAGAL CARTILAGE ISLAND GRAFT TYMPANOPLASTY: ANATOMICAL AND FUNCTIONAL RESULTS

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### SUMMARY

**Objective:** We aimed to evaluate anatomical and functional results in patients who underwent primary type 1 tympanoplasty using thinned tragal cartilage island graft.

**Material-Method:** The study included 56 patients who underwent Type 1 tympanoplasty surgery using the postauricular sulcus approach and thinning of tragal cartilage graft with the over-underlay technique at the Department of Otorhinolaryngology and Head & Neck Surgery at the Gaziosmanpaşa University, Tokat Hospital between 2018 and 2023. The patients were divided into 3 groups according to the perforation size. We retrospectively analyzed the preoperative and postoperative 500-1000-2000 and 4000 Hz pure tone audiometry results and postoperative graft success rates in 6th months.

**Results:** In 51 of 56 patients in our study, the graft was intact at 6th month postoperatively. Our postoperative graft success rate was 91.07% in thinned tragal cartilage island graft tympanoplasty operations. Postoperative hearing test measurements performed at the 6th month showed statistically significant improvement in postoperative air-bone gap values compared to preoperative tests (p:0,00)

**Conclusion:** These results led us to conclude that thinned tragal cartilage island graft tympanoplasty technique has high graft success rates in addition to airway hearing gain in chronic otitis media cases. For an ideal graft, it is desirable that manipulation is easy and durability is high. In this technique, the ease of graft manipulation not only enhances surgical success but also provides convenience for the surgeon.

**Keywords:** Tympanoplasty, Cartilage, Island Graft

### İNCELTİLMİŞ TRAGAL KARTİLAJ ADA GREFTİ TİMPANOPLASTİ: ANATOMİK VE FONKSİYONEL SONUÇLAR ÖZET

**Amaç:** Çalışmamızda inceltilmiş tragal kartilaj ada grefti kullanılarak primer tip 1 timpanoplasti yapılan hastalarda anatomik ve fonksiyonel sonuçları değerlendirmeyi amaçladık.

**Materyal-Metod:** Tokat Gaziosmanpaşa Üniversitesi hastanesi KBB&BBC Anabilim Dalı'nda 2018-2023 yılları arasında postaurikular sulkus yaklaşımıyla inceltilmiş tragal kartilaj ada grefti kullanılarak over-underlay tekniğiyle Tip 1 timpanoplasti operasyonu yapılan 56 hasta çalışmaya dahil edildi. Hastaların preoperatif ve postoperatif 6. ay 500-1000-2000 ve 4000 Hz saf ses odyometri sonuçlarını ve postoperatif greft başarı oranlarını retrospektif olarak inceledik.

**Bulgular:** Çalışmamızdaki 56 hastanın 51 inde postoperatif 6. ayda greft intakt olarak değerlendirildi. Yaptığımız inceltilmiş tragal kartilaj ada greft timpanoplasti operasyonlarında postoperatif greft başarı oranımız %91,07 olarak bulundu. Postoperatif 6. ayda yapılan işitme testi ölçümlerinde ameliyat sonrası hava-kemik aralığı değerleri, ameliyat öncesi testlere göre istatistiksel olarak anlamlı düzelme izlendi. (p<0,001)

**Sonuç:** Bu sonuçlar kronik otitis media olgularında inceltilmiş tragal kartilaj ada greft timpanoplasti tekniğinin hava yolu işitme kazancına ek olarak greft başarı oranlarının da yüksek olduğu sonucuna varmamızı sağladı. İdeal greft için manuplasyonun kolay ve dayanıklılığın fazla olması arzu edilen bir durumdur. Bu teknikte greft manuplasyonunun kolay olması cerrahi başarıyı artırmakla birlikte cerrah açısından da kolaylık sağladığını söyleyebiliriz.

**Anahtar Sözcükler:** Timpanoplasti, Kartilaj, Ada Greft

## INTRODUCTION

Chronic Otitis Media is one of the most common diseases worldwide, characterized by perforation of the tympanic membrane and inflammation of the middle ear mucosa.

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Tympanoplasty, described by Wullstein and Zöllner in 1952, has been the mainstay of tympanic membrane reconstruction<sup>1</sup>. The long-term goal of middle ear reconstruction is to close the perforation of the tympanic membrane, reconstruct the mechanism of sound conduction and restore a healthy middle ear cavity. Since the description of tympanoplasty, various graft materials and surgical techniques have been described. Glasscock et al.<sup>2</sup> used vascular grafts, Forman<sup>3</sup> used corneal grafts, and Rizer<sup>4</sup> used frozen fascia lata for tympanic membrane reconstruction. Skin, temporal fascia, perichondrium and dura mater are among the grafts used, and temporalis fascia is the most commonly used material due to its 93-97% success rate and acoustic properties<sup>5-8</sup>. Cartilage



tympanoplasty was popularized by Utech in the 1950s<sup>9</sup>. There are data suggesting that cartilage is theoretically better in cases of recurrent perforation, total perforation, chronic mucosal dysfunction or severe atelectatic tympanic membrane<sup>8</sup>. However, with the increasing demand for minimally invasive procedures, tragal cartilage has become an excellent graft of choice, especially in endoscopic tympanoplasties. The ability to place the relatively rigid cartilage easily and precisely with one hand has contributed to this.

It is obvious that cartilage is a good option, considering that ideal graft material should meet the criteria of low rejection rate, sufficient quantity and good tensile strength, conductivity similar to the eardrum and easy availability.

In our study, we aimed to discuss the hearing gains and graft success results of thinned tragal cartilage island graft tympanoplasty operations performed in our clinic in the last 5 years in the light of the literature.

#### **MATERIAL and METHODS**

This retrospective study was performed by examining the files of 69 patients who underwent primary type-1 tympanoplasty using thinned tragal cartilage island graft between January 1, 2018 and January 1, 2023 in the Department of Otorhinolaryngology, Tokat Gaziosmanpaşa University Faculty of Medicine, and the clinical results recorded in our hospital system. The study was conducted with the approval of Tokat Gaziosmanpaşa University Faculty of Medicine Clinical Research Ethics Committee dated March 3, 2023 and numbered 23-KAEK-079.

In order to ensure standardization in the study, patients who underwent thinned tragal cartilage island graft as graft material with postauricular incision and over-underlay technique were included. All patients were evaluated with temporal computed tomography, the ossicular chain was intact, and they underwent type 1 tympanoplasty. All patients were operated on by the same surgeon. Patients younger than 16 years of age were excluded. Postoperative 6th month examination and pure tone audiometric tests were analyzed. Thirteen patients who did not meet these criteria, who did not attend postoperative follow-up regularly,

who did not have recorded audiologic tests in the postoperative period, and who had missing information in their files were excluded from the study. All operations were performed under general anesthesia using a microscopic postauricular approach. Thinned tragal cartilage approximately 0.5 mm thick was used as graft material. The perichondrium on the convex side of the tragal cartilage was dissected and the cartilage was prepared as an island graft and a notch was created in the malleus localization by cartilage excision (Figure-1) and the prepared graft was placed with the over-underlay technique. Postoperative intravenous treatment (ampicillin + sulbactam 3x500 mg) was given and the patient was discharged on the 1st postoperative day followed by oral antibiotherapy (amoxicillin + clavulanic acid 2x1gr) and analgesia for 7 days. After the external auditory canal tampons were removed on postoperative day 7, local antibiotic and steroid drops (ciprofloxacin 3x4, prednisolone 3x4) were applied for 1 week. Follow-up visits have been performed once a week until the 4th postoperative week and then monthly for 6 months (Figure 2).

Preoperative and postoperative 6th month pure tone audiometric tests were performed by the audiometry department of our hospital. Intact graft without medialization or lateralization was accepted as the graft success criterion and the air-bone pathway interval was calculated and documented by averaging four frequencies (500, 1000, 2000 and 4000 Hz) in pure tone audiometry.

Statistical analysis was performed using IBM SPSS version 20 (SPSS Inc., Chicago, IL, USA). Kruskal Wallis analysis of variance and Wilcoxon test were used to compare the groups. Paired t-test was used if suitable for normal distribution and  $p < 0.05$  was considered as significant.

#### **RESULTS**

A total of 56 patients, 22 (39.2%) males and 34 (60.7%) females, were included in our study. The mean age of the patients was  $28.44 \pm 17.20$  years and 33 were right ears and 23 were left ears. Tympanic membrane perforation size was classified in 3 groups as small (<25% perforation area), medium (25-75% perforation area) and large (>75% perforation area). There

were 10 patients with small, 37 patients with medium and 9 patients with large perforations (Table-1). The graft was intact in 51 patients at the 6th postoperative month. Perforation was seen in three patients and graft medialization was seen in two patients. One of these patients was in the group with small perforation size, one patient was in the group with medium perforation size, and one patient was perforated in the group with large perforation size and two patients had graft medialization. Our postoperative graft success rate in thinned tragal cartilage island graft

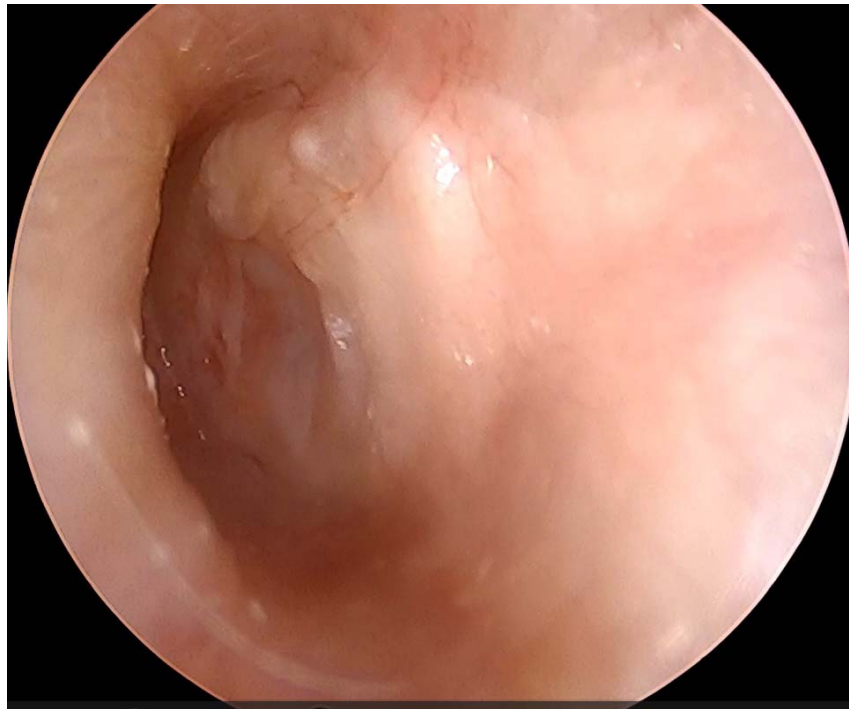
tympanoplasty operations was 91.07%. The preoperative air-bone spacing of the patients was  $27.28 \pm 9.70$ , while the postoperative air-bone spacing was  $15.81 \pm 7.20$  (mean  $\pm$  SD) and statistically significant ( $p: 0.00$ ). When we analyzed the groups according to the perforation size, the improvement in the air-bone spacing was significant in the large and medium groups ( $p: 0.021$ ,  $p: 0.00$ , respectively), while the gain was not statistically significant in the group with small perforation ( $p: 0.475$ ).

**Table-1:** Success rates according to tympanic membrane perforation sizes, ABG:Air-bone gap

Perforation Size	Small (<%25)	Medium (%25-75)	Large (>%75)
Graft Successful (n:51) (91.07%)	9(16%)	36(64.2%)	6 (10.7%)
Graft Unsuccessful (n:5) (8.9%)	1 (1.7%)	1(1.7%)	3 (5.3%)
ABG p values	0.475	0.00	0.021



**Figure 1:** View of thinned tragal cartilage island graft



*Figure 2: Postoperative 1st year postoperative appearance of tragal cartilage island graft*

## DISCUSSION

Although temporal fascia has been the most preferred graft since the description of tympanoplasty, we see that the functional results of many different grafts have been investigated<sup>10,11</sup>. Efforts to reach the ideal graft in long-term period create a tendency in this direction. Retraction pockets formed after the use of temporal fascia predispose to failure due to atrophy, reduction in size and poor stabilization of the temporal fascia<sup>12</sup>. Therefore, cartilage grafts, which are more rigid, have come to the fore. The use of cartilage has excellent results for reconstruction, especially in patients with middle ear pathology and eustachian tube dysfunction<sup>13</sup>. Initially, cartilage grafts were preferred for revision or in patients with a high middle ear risk index (MERI), but over time they have become used more widely. The advantage of cartilage is that it is more resistant to infections, changes in middle ear pressure, lack of capillary nutrition and is well integrated into the tympanic membrane as it is mostly diffusion-fed and also has a low metabolic rate<sup>14,15</sup>.

However, theoretically, a hard material such as cartilage was thought to have negative

audiologic effects. Therefore, the thickness and stiffness of the cartilage have been a source of concern among some surgeons. In the literature, we see that different techniques such as island graft and palisade technique have also been investigated<sup>1,16</sup>. While Zahnert et al. reported that thinned cartilage has better acoustic properties<sup>17</sup>, other studies have shown that full-thickness cartilage applied with different techniques does not make a significant difference in hearing<sup>11,18,19</sup>.

Cavaliere et al. reported that tragal cartilage showed acoustic properties similar to temporal fascia in their series of 612 patients. They also suggested more widespread use of cartilage because of the better success rate of cartilage graft<sup>20</sup>.

Shishegar et al. compared palisade cartilage tympanoplasty with temporal fascia technique and reported 100% graft success in palisade technique and no significant difference between the two grafts in terms of air-bone gap<sup>18</sup>. Rasool et al. described 86% graft success and similar hearing results with temporal fascia in their series of palisade cartilage tympanoplasty<sup>7</sup>.



Balcı et al. evaluated the functional results of both temporal fascia and cartilage in patients with tympanic membrane perforation and normal preoperative hearing and showed that cartilage can be used without fear and has no negative effect on hearing functions<sup>21</sup>. Tek et al. reported that conchal cartilage used in combination with temporal fascia significantly increased the chance of functional success but did not affect hearing levels<sup>22</sup>. Kirazlı et al. compared cartilage island graft with temporal fascia and found that there was no significant difference in terms of postop mean hearing gain<sup>23</sup>. Moreover, the study of Dornhoffer et al supported this result as well<sup>13</sup>. Venkatesan et al. also emphasized that while there was no statistical difference between temporal fascia and tragal island graft in terms of hearing gain, the operation time was shorter in the cartilage group<sup>24</sup>.

In a meta-analysis of 44 studies by Kai chen and colleagues, cartilage tympanoplasty was more successful than temporal fascia, while hearing results were similar<sup>12</sup>.

Tragal cartilage is an ideal graft because it is thin, flat and can be obtained in sufficient size<sup>25</sup>. We performed graft application with under-overlay technique as a surgical method. Although many studies say that the use of full-thickness cartilage does not have a negative effect on hearing, Zahnert et al say that thinned cartilage reduces the loss of acoustic transfer<sup>17</sup>. Nemade et al say that thinned cartilage is ideal in terms of stability and acoustic balance<sup>26</sup>. We think that it is useful to thin the cartilage considering its adequate mechanical stability. At the same time, the use of a thinned cartilage island graft while placing the graft facilitated the compliance and manipulations in the rotator area for the surgeon. As they found in the study of Venkatesa, easier manipulations will also shorten the operation times. However, the preparation of the appropriate cartilage island graft also progresses in a learning curve. Technical errors during the harvesting of the cartilage graft can prevent it from being of the ideal size. Similarly, the failure to preserve the perichondrium can also create difficulties in shaping the graft. Due

to such technical errors, medialization or lateralization of the graft may occur. Furthermore, inadequate support of the placed graft with sponges in the middle ear could also contribute to graft medialization. Our postoperative graft success rate was 91.07% and similar to the cartilage success rates in the literature. In our study, we had a postoperative air bone gain of 12 dB and it was a statistically significant improvement. When we examine the literature, we see that cartilage does not have a negative audiologic effect and graft success rates are high.

The small number of patients and the lack of a control group were limitations of our study. In future studies, the effects of cartilage thickness on hearing outcomes and surgical manipulations in standardized groups can be investigated in more detail.

In conclusion, thinned tragal cartilage island graft has high graft success as well as airway hearing gain; therefore, we can say that it can be easily preferred in tympanoplasty cases.

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