

ORIGINAL ARTICLE

Cartilage Tympanoplasty with Island Technique: A Comparison with the Temporalis Muscle Fascia Technique

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Objective; To evaluate hearing results and failures of tympanoplasty techniques with either island cartilage or temporalis muscle fascia.

Materials & Methods; Retrospective evaluation of selected cases operated by the same surgery team between 2000 and 2008. A total of 307 patients with a tympanic membrane perforation or retraction due to chronic otitis media were treated surgically with tympanoplasty with or without mastoidectomy. From these 96 cases who had primary repair of tympanic membrane perforation or retraction with intact ossicular chain and normal middle ear were included into the study. Tympanic membrane perforation was reconstructed by using fascia in 36 while cartilage island graft was used in 60 patients. Temporalis muscle fascia was preferred for simple perforations while cartilage was used in more difficult cases such as retractions or total or subtotal perforations. Preoperative and postoperative pure-tone average air-bone gaps were compared at 250, 500, 1000, 2000 and 4000 Hz frequencies. Postoperative failures were compared.

Results; Main outcomes of both techniques were similar for hearing results and prevalence of failures. Closure of air-bone gaps after surgery were 14.98, 12.5, 9.67, 8.67, and 7.01 dB for cartilage group and 15.42, 11.67, 8.34, 7.36, and 8.61 dB for fascia group respectively. The differences were not statistically significant. Graft survival rates were 86.1% in the fascia group and 95% in the cartilage group.

Conclusion; Both techniques show similar functional and hearing results. Cartilage tympanoplasty with island technique may be chosen according to patient's condition like atelectatic ear, adhesive otitis and retraction pockets, totally or sub totally perforation of tympanic membrane or revision tympanoplasty.

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Since the first description of tympanoplasty in 1952 by Wullstein ^[1] and Zollner ^[2], some grafting materials such as fascia ^[3], perichondrium ^[4], periosteum ^[5], vein ^[6], dura mater ^[7], and cartilage ^[8,9] have been used for the closure of tympanic membrane perforations.

Among all, temporalis fascia is the most frequently used grafting material with high success rate of approximately 85-90% of ears with normal ventilation ^[10, 11]. On the other hand, large perforations ^[12], atelectatic or adhesive otitis, or retraction pockets may cause to higher failure

rates such as re-perforation, atelectasis or retraction due to middle ear ventilation problems. Using a more rigid grafting material such as cartilage may help avoiding such failures. Nevertheless there may be some concern regarding poor hearing using this grafting material rather than fascia.

The aim of this study was to compare the hearing test results of patients underwent primary tympanoplasty using either cartilage or fascia, as well as the failure rates of the procedures.

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Materials & Methods

Records of 96 patients who had undergone primary tympanic membrane reconstruction surgery at the Inonu University Department of Otorhinolaryngology, Turkey, between September 2000 and December 2007 were retrospectively evaluated. Patients with ossicular chain defects, cholesteatoma, otorrhea, middle ear granulation or effusion, history of previous middle ear surgery were not included in the study. Patients with less than a 6-month follow-up were not included, either.

Tympanic membrane perforation was reconstructed by using temporalis fascia in 36 patients and chondro-perichondrial graft taken from the tragus in 60 patients. All of the patients in fascia group had only tympanic membrane perforation, and no retraction. In the cartilage used group 5 of 60 patients had retraction while remaining 55 had perforation. The grafting technique was chosen according to the size of the perforation and the presence of retraction. Grafting with temporalis muscle fascia was preferred for simple perforations and cartilage island technique was preferred for more difficult cases such as total or subtotal perforations (n=55) or in those with tympanic membrane retraction (n=5).

All patients were operated by the same team under general anesthesia with using retro-auricular surgical approach. For the fascia group, graft was taken from the temporalis muscle fascia and the muscle fibers were dissected off. Graft was obtained from the tragal cartilage for cartilage used group. Skin incision was performed on the medial side of tragus and a few

millimeters of tragal cartilage was left marginally because of cosmetic reasons (Figure 1). Perichondrium over the convex surface of the graft was dissected off as a flap. Cartilage was used without being tapered. A cartilage strip (not included perichondrium) was removed from the cartilage island to prevent touching the cartilage directly to the manubrium mallei (Figure 2). The size of the island was kept the same with the size of the tympanic membrane perforation. The grafting procedure was performed in an over-underlay fashion (over the malleus, under the annulus) in both groups. Gelfoam (Pharmacia & Up-john Inc., Kalamazoo, MI, USA) was used in the middle ear cavity for supporting the graft medially. A few gelform pieces were put on the graft and the remnant, and then the external auditory canal was filled with Chloramphenicol ophthalmic pomade (Carlo-Erba, TURKEY) at the end of the operation.

Preoperative and postoperative pure-tone audiometric findings of the patients were obtained and hearing differences at 250, 500, 1000, 2000, and 4000 Hz were assessed.

Student's t test was used for the statistical analysis. The difference would be accepted as statistically significant if the value of p was <0.05.

Results

Between 2000 and 2008, 148 tympanoplasties using cartilage (island technique) and 152 with temporalis fascia were performed. Of these procedures, 60 type I cartilage island tympanoplasties and 36 type I



Figure 1. Medial incision to obtain a cartilage graft from the tragus.



Figure 2. Chondroperichondrial island graft with the notch for malleus.

tympanoplasty with temporalis fascia were included in this study. The mean ages of the fascia and cartilage groups were 27 years (range, 13-63 years) and 31 years (range, 12-68 years), respectively. There were 32 women and 28 men in the cartilage group. The fascia group consisted of 16 women and 20 men. The mean follow-up periods for the cartilage group and the temporalis fascia group were 22 months (range, 6-52 months) and 29 months (range, 6-88 months), respectively.

For the cartilage and fascia groups the average hearing improvement in air conduction after surgery calculated at frequencies of 250, 500, 1000, 2000, and 4000 Hz, were 17.12, 16.48, 12.32, 9.09, and 7.19 dB and 15.35, 15.24, 10.36, 8.69, and 10.83 dB, respectively (Figure 3a, 3b). Both groups showed an improvement in the air-bone gap at all frequencies after surgery (Figure 4).

It was not statistically significant for any group ($p>0.05$). Preoperative air-bone gaps and closure of air-bone gaps after surgery for all frequencies in both cartilage island and fascia groups were shown in Table 1 and Figure 5. The differences were not statistically significant ($p>0.05$).

Retraction pocket after surgery observed in none of the patient in cartilage group, whereas observed in 2 patients in fascia group, who then underwent second surgery. In the fascia group, 5 patients needed second surgery because of 4 perforations and 1 lateralization while 3 patients in cartilage group needed second surgery because of two lateralizations and one perforation.

Discussion

Cartilage has been successfully used in middle ear procedures since first time used by Jansen^[8] and

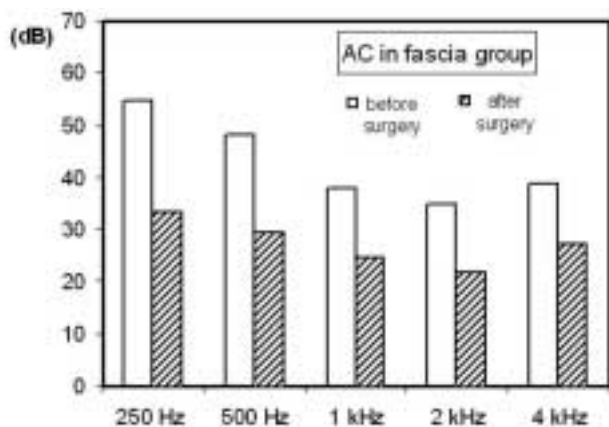


Figure 3a

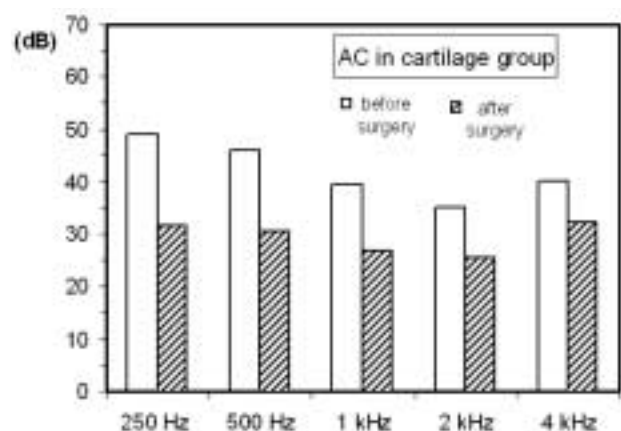


Figure 3b

Figure 3. Air-conduction hearing thresholds before and after the surgery; A. For fascia group, B. For cartilage group.

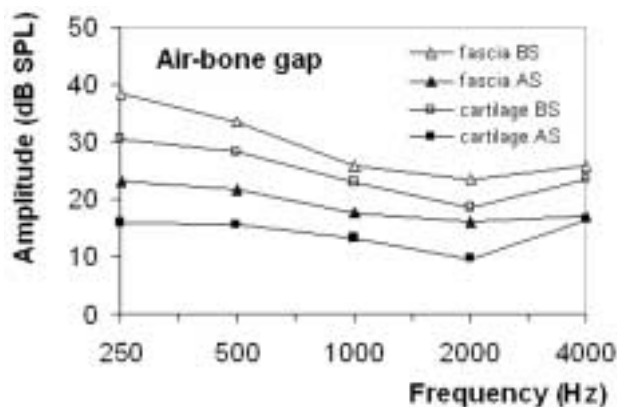


Figure 4. Air-bone gap for fascia and cartilage group before and after surgery.

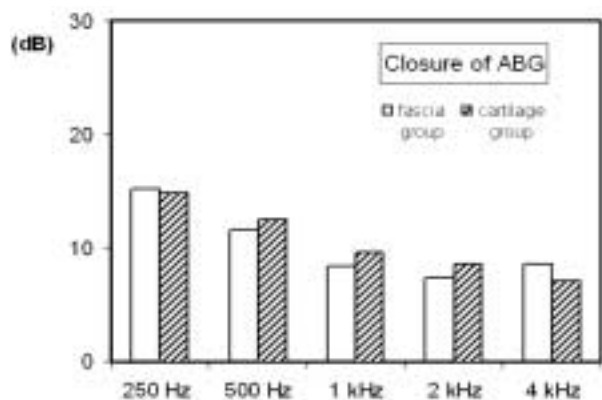


Figure 5. Closure of air-bone gaps after the surgery.

Table 1. Air-bone gap values of fascia and cartilage island technique groups in both preoperative and postoperative stage and closure of air-bone gaps.

	Air-Bone Gap Before Surgery dB	Air-Bone Gap After Surgery dB	Closure of Air-Bone Gap dB
Fascia Group			
250 Hz	38,61	23,19	15,42
500 Hz	33,47	21,80	11,67
1000 Hz	25,97	17,63	8,34
2000 Hz	23,61	16,25	7,36
4000 Hz	25,83	17,22	8,61
Cartilage Group			
250 Hz	30,75	15,87	14,98
500 Hz	28,25	15,75	12,50
1000 Hz	22,92	13,25	9,67
2000 Hz	18,50	9,83	8,67
4000 Hz	23,67	16,66	7,01
p Value	p>0.05	p>0.05	p>0.05

Salen^[9]. It has been shown in both clinical and experimental studies that cartilage is well tolerated with minimal resorption time and survives for a long period with good hearing results^[13-17].

Although one might anticipate a significant conductive hearing loss with cartilage owing to its rigidity and thickness, several studies showed that hearing results with cartilage were not different than those with fascia^[16, 17]. It can be used without any slices as we did but according to Zahnert's experimental study, cartilage slices <500 µm thick are similar to the tympanic membrane in terms of their acoustic properties^[13]. They reported that when the large tympanic membrane defects are reconstructed with thick pieces of cartilage, transmission losses occurred at lower frequencies. Contrary to the mentioned report, even though used the cartilage mostly for total or subtotal tympanic membrane perforations, the results of our study showed better hearing improvement at lower frequencies similar with some others^[17]. In our study, cartilage did not touch directly to the manubrium mallei. Only thin perichondrium touched to the

malleus. This condition may cause better conduction of sounds via malleus to the inner ear. This finding needs to be replicated in further studies.

According to some authors, cartilage may be good for graft stabilization but not for hearing results^[18]. But in the recent studies^[11, 15-17, 19], no significant differences were found for hearing improvement after cartilage and fascia tympanoplasty similar with our results.

Dysfunctions of the Eustachian tube are poorly understood and cause some problems after tympanic membrane reconstruction. The optimal approach would be using cartilage in the tympanic membrane to minimize formation of retraction. Studies have shown that cartilage retains its rigid texture and resists upon resorption and retraction, even in case of continuous Eustachian tube dysfunction^[20]. Because of this situation, it may be better using cartilage graft for the ears with Eustachian tube dysfunction such as retraction. Page et al^[21] reported good postoperative functional outcome after cartilage tympanoplasty for the management of tympanic membrane retraction pockets. In the present study, we did not observe any

retraction in the cartilage group while 5.5% of the patients in the fascia group had retraction after surgery and needed second surgery.

In the present study, graft survival rates were 86.1% in the fascia group and 95% in the cartilage group similar with Sapci et al's ^[11] results. Glasscock et al ^[22] and Milewski ^[23] reported similar good results for cartilage tympanoplasty in their series. For the fascia group, survival rates reported as 78-92% in the literature ^[10, 24]. All of above studies show that cartilage tympanoplasty may have similar or better results than fascia for graft survival rate. Even though the mean follow-up period in the present study was 22 (range 6-52) months for cartilage and 29 (range 6-88) months for fascia groups, the minimum 6 months follow-up period is a limitation of this present study as most of the similar studies in the literature. It would be better if the minimum follow-up period was kept longer than 6 month.

Our study showed that cartilage island tympanoplasty achieves good hearing improvement and low failures. Even though this is not statistically significant when compared with fascia used group, because of the relatively better results, it may be an effective material for the reconstruction of total or subtotal tympanic membrane perforations and retractions and may be recommended as a first choice for this kind of conditions.

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References

1. Wullstein HL. Funktionelle operation in mittelohr mit hilfedes frien spaltlappentransplantates. Arch Ohren Nasen Kehlkopfheilkd 1952; 161: 422-3.
2. Zöllner F. The principles of plastic surgery of the sound-conducting apparatus. J Laryngol Otol. 1955; 69: 657-9.
3. Herman H. Tympanic membrane plastic repair with temporalis fascia. Hals Nas Ohrenh 1960; 9: 136-9.
4. Salen B. Tympanic membrane grafts of full-thickness skin, fascia and cartilage with its perichondrium, an experimental and clinical investigation. Acta Otolaryngol Suppl Stockh 1968; Suppl 244: 5-73.
5. Bocca E, Cis C, Zernotti E. L'impiego di lembi liberi di periostio nella tympanoplastica. Arch Ital Otol 1959; Suppl 40: 205.
6. Tabb HG. Closure of perforation of the tympanic membrane by vein grafts: a preliminary report of 20 cases. Laryngoscope 1960; 70: 271-4.
7. Albrite JP, Leigh BG. Dural homograft (alloplastic) myringoplasty. Laryngoscope 1966; 76: 1687-93.
8. Jansen C. Cartilaga-tympanoplasty. Laryngoscope 1963; 73: 1288-302.
9. Salen B. Myringoplasty using septum cartilage. Acta Otolaryngol 1963; Suppl:188: 82-91.
10. Lau T, Tos M. Tympanoplasty in children. An analysis of late results. Am J Otol 1986; 7: 55-9.
11. Sapci T, Almac S, Usta C, Karavus A, Mercangoz E, Evcimik F. Comparison between tympanoplasties with cartilage-perichondrium composite graft and temporal fascia graft in terms of hearing levels and healing. Kulak Burun Bogaz Ihtis Derg 2006; 16: 255-60.
12. Booth JB. Myringoplasty: the lessons of failure. J Laryngol Otol 1974; 88: 1223-35.
13. Zahnert T, Hüttenbrink K, Mürbe D, Bornitz M. Experimental investigations of the use of cartilage in tympanic membrane reconstruction. Am J Otol 2000; 21: 322-8.
14. Kerr AG, Byrne JET, Smyth GDL. Cartilage homografts in the middle ear: a long-term histologic study. J Laryngol Otol 1973; 87: 1193-9.
15. Dornhoffer JL. Hearing results with cartilage tympanoplasty. Laryngoscope 1997; 107: 1094-9.
16. Matthew JG, Mason JC, Lambert PR. Hearing results after primary cartilage tympanoplasty. Laryngoscope 2000; 110: 1994-9.

17. Kirazli T, Bilgen C, Midilli R, Ogut F. Hearing results after primary cartilage tympanoplasty with island technique. *Otolaryngol Head Neck Surg* 2005; 132: 933-7.
18. Poe DS, Gadre AK. Cartilage tympanoplasty for management of retraction pockets and cholesteatomas. *Laryngoscope* 1993; 103: 614-8.
19. Solmaz MA, Yucel EA, Ozdemir M, Guldiken Y, Deger K. Comparison of hearing levels and tympanic membrane healing obtained by cartilage palisade and temporal fascia tympanoplasty techniques: preliminary results. *Kulak Burun Boğaz İhtis Derg* 2002; 9: 271-4
20. Dornhoffer JL. Cartilage tympanoplasty. *Otolaryngol Clin N Am* 2006; 39: 1161-76.
21. Page C, Charlet L, Strunski V. Cartilage tympanoplasty: postoperative functional results. *Eur Arch Otorhinolaryngol*. In Press.
22. Glasscock ME 3rd, Jackson CG, Nissen AJ, Schwaber MK. Postauricular undersurface tympanic membrane grafting: a fallow up report. *Laryngoscope* 1982; 92: 718-27.
23. Milewski C. Composite graft tympanoplasty in the treatment of ears with advanced middle ear pathology. *Laryngoscope* 1993; 103: 1352-6.
24. Blanshard JD, Robson AK, Smith I, Maw AR. A long-term view of myringoplasty in children. *J Laryngol Otol* 1990; 104: 758-62.

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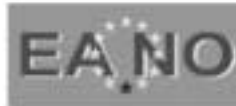
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