Otolaryngology online journal

ISSN: 2250-0359 **VOLUME 4 ISSUE 2 2014**

The Outcome of Shield Graft Tympanoplasty: A Single Center Descriptive Study at KAMC

Mohamed Sa'ad Eldin Aly, MD[1], Malak Jamal Gazzaz, MBBS[2], Doaa Abdelmoety, MD[3], Ahmed Almadani[4], Mohammed Alamoudi[4]

[1]Department of Otolaryngology-Head & Neck Surgery, King Abdullah Medical City, Makkah, Saudi Arabia
[2]Department of Otolaryngology-Head & Neck Surgery, Umm Al-Qura University, Makkah, Saudi Arabia.
[3]Department of Research Center, King Abdullah Medical City, Makkah, Saudi Arabia
[4]6th year medical students, College of Medicine, Umm Al-Qura University, Makkah, Saudi Arabia.

Abstract

Cartilage has proven to be a favorable graft material to close tympanic membrane perforations.

Objective: In this study we describe our experience with cartilage shield graft tympanoplasty in reconstruction of tympanic membrane perforations.

Study Design: A retrospective review was done on 42 patients. The male to female ratio was 19:23 and the age range 11-72 years. Cases varied between Chronic Otitis Media with Dry Perforation and Ossicular Discontinuity and were treated with cartilage shield graft tympanoplasty type I or III, respectively. The corresponding author performed all operations over a period of 2 years at the department of Otolaryngology Head and Neck Surgery at King Abdullah Medical City, Makkah, Saudi Arabia. **Methods:** Patient and disease information were collected retrospectively and analyzed. **Results:** Graft take was achieved in 42 patients (100%). No statistically significant association between the postoperative pure tone average – air bone gap results and age, sex, or type of tympanoplasty was observed ($p>0.05$). The overall mean preoperative pure tone average – air bone gap was 27.0±10.5 dB, and it decreased to 14.9±7.0 dB 3 months postoperatively. A statistically significant improvement was observed ($p<0.001$). **Conclusion:** Excellent graft take results were achieved and hearing outcomes were satisfactory. Therefore, shield cartilage graft is a valid alternative in all tympanoplasty procedures.

Key words:

Outcome, Shield, Graft, Tympanoplasty, Cartilage

Level of Evidence:

2

Introduction

Tympanoplasty aims to achieve long-lasting reconstruction of the tympanic membrane (TM)[1,2]. Numerous approaches, techniques and grafting materials have been used since its origination by Zollner in 1955 and Wullstein in 1952,[1-4,9]. Temporalis fascia and perichondrium continue to be the most commonly used grafting materials; having nearly 90% of drum closure in primary tympanoplasties[1,9]. Irrespective of the technique being used, however, in certain conditions such as advanced middle ear pathology, retraction pockets, atelectatic ear and revision tympanoplasty; both fascia and perichondrium have encountered atrophy and subsequent failure postoperatively[1,2,5].

In 1959, cartilage was first presented by Utech in middle ear surgery[1]. In 1963, cartilage–perichondrial composite graft was described by Salen and Jansen in reconstructing the TM[6]. The main advocate of cartilage tympanoplasty, however, was Heermann; who used cartilage palisade technique since 1960[6].

Cartilage graft has proven to be promising in closing TM perforations[5]. Different types of cartilages have been used, for instance: tragal, conchal, and costal cartilage[7] . Its' rigidity in comparison to temporalis fascia, manages to prevent resorption, retraction, and reperforation, despite continuous Eustachian tube dysfunction[1, 3-5,9]. It is less likely to cause an inflammatory reaction or an infection postoperatively[7]. Many studies have proven that the middle ear tolerates cartilage very well showing long-lasting survival[2,5,9]. However, it is not without drawbacks. One of the major concerns is functional impairment due to its hard nature allowing probable reduction in TM vibration[5,7-9]. Another potential disadvantage is opacity formation at the TM repair site, which could possibly hide a residual cholesteatoma[6].
Several techniques for cartilage tympanoplasty have been used, such as composite auto graft shield, cartilage palisade tympanoplasty, perichondrium island flap, cartilage butterfly inlay graft, 'Crowncork' technique, cartilage mosaic tympanoplasty and cartilage reinforcement[1,4].
This study describes our experience with cartilage shield graft tympanoplasty in reconstruction of TM perforations with or without ossiculoplasty.

Patients and Methods

A) Patient population

Institutional review board approval was obtained before starting data collection. Data was gathered from files between January 2011 and January 2013. Tympanoplasty was preformed, using tragal cartilage in 42 patients (19 males and 23 females; age range 11-72 years) in the Department of Otolaryngology-Head and Neck Surgery at King Abdullah Medical City (KAMC), Makkah, Saudi Arabia. Thirty-nine were primary procedures and three were revisions in patients operated upon in other centers. Two types of tympanoplasties were preformed: Tympanoplasty type I (intact ossicular chain with tragal cartilage shield graft) in 33 cases (78.6%), and Tympanoplasty type III (partial ossicular reconstruction prosthesis (PORP) with tragal cartilage shield graft) in 9 cases (21.4%).

B) Pre-operative evaluation

An audiogram is performed preoperatively at the following frequencies: 500, 1000, 2000 and 4000Hz.

C) Surgical Procedure

All surgical procedures were performed by the corresponding author (M.S.) according to the KAMC policy of ear surgery, in which (69%) of patients underwent local anesthesia.

Typically, the cartilage piece used was 10mm in width and 15mm in length in children and larger in adults. The perichondrium was then dissected from both sides, choosing the size that is equal to the perforation and excising about 2mm more then the edge of the marked line on the cartilage. A v-shaped notch (fig.1) was removed from the cartilage shield to accommodate the handle of malleus. The cartilage was introduced medial to the TM remnants or the fibrous annulus. The graft was stabilized by placing it medial to the handle of malleus, behind the anterior part of the annulus and in the facial recess posteriorly. The mucoperichondrium was then placed over the cartilage and under the handle of malleus and perforated edges.

The universal TORP (total ossicular reconstruction prosthesis) was used in tympanoplasty type III for reconstructing ossicular discontinuity as a PORP.

(Figure 1) Tragal cartilage: v-shaped notch.

D) Post-operative evaluation

An audiogram was repeated at least 3 months post operatively. Follow up examination of the graft was done at 3, 6, 12 and 24 months postoperatively.

E) Statistical Analysis

Data were analyzed using SPSS version 16.0. Qualitative data were presented as percentages. Quantitative data were presented as mean ± standard deviation or as median and range.

To test a possible association between age, sex or type of tympanoplasty and the postoperative PTA-ABG results, linear regression was used with the change between the pre and postoperative pure tone average air bone gap (PTA-ABG) as the dependent variable and the age, sex and type of tympanoplasty as independent ones.

To compare between the overall pre and postoperative PTA-ABG of tympanoplasty type I, III and both, paired t-test was used. The mean and standard deviation of the PTA-ABG for each Audiogram was calculated at the following frequencies: 500, 1000, 2000 and 4000Hz.

Results

Preoperative clinical examination showed that most TM perforations were subtotal in 36 patients (85.7%), posterior small in 3 patients (7.1%), anterior small in 2 patients (4.8%) and total in 1 patient (2.4%).
The initial diagnosis of Chronic Otitis Media with Dry Perforation was made in 33 cases (78.6%) while Chronic Otitis Media with Ossicular Discontinuity was in 9 cases (21.4%).
Graft take was achieved in the 42 patients (100%), having no perforation, retraction or lateralization. There were no immediate postoperative complications such as: infection, sensorineural hearing loss, facial nerve injury or hematoma.
There was no statistically significant association between the postoperative PTA-ABG results and age, sex, or type of tympanoplasty ($p>0.05$).
The overall mean preoperative PTA-ABG in tympanoplasty type I (intact ossicular chain) was 23.7±9.0 dB. While the overall mean postoperative PTA-ABG was 12.5±5.3 dB. The mean difference between pre and postoperative PTA-ABG was 11.2±8.2 dB. . A statistically significant improvement was observed ($p<0.001$).
The overall mean preoperative PTA-ABG in tympanoplasty type III (cartilage graft and universal TORP) was 38.9±6.3 dB. While the overall mean postoperative PTA-ABG was 23.5±5.9 dB. The mean difference between pre and postoperative PTA-ABG was 15.4±8.8 dB being statistically significant ($p=0.001$).

The overall mean of both tympanoplasty type I and III preoperative PTA-ABG was 27.0±10.5 dB, whereas the postoperative (3 months after surgery) PTA-ABG was 14.9±7.0 dB. The mean difference in pre and postoperative PTA-ABG was 12.1±8.4 dB. A statistically significant improvement was observed ($p<0.001$).
We studied the change in PTA-ABG statistically in the following frequencies: 500, 1000, 2000 and 4000Hz in tympanoplasty type I, III and both. All of which showed a statistically significant decrease postoperatively. See table 1.
All patients were followed up for at least 2 years and none of them had perforation at their last follow up.

PTA-ABG	Type of tympanoplasty											
	Tympanoplasty type I				Tympanoplasty type III				Tympanoplasty type I and III			
Frequency	500	1000	2000	4000	500	1000	2000	4000	500	1000	2000	4000
Preoperative	28.3±14.0	23.3±12.1	17.9±9.4	25.3±11.1	44.4±5.8	41.1±4.1	31.1±10.8	38.9±8.6	31.8±14.3	27.1±13.1	20.7±11.0	28.21±11.9
Postoperative	13.6±8.7	10.6±6.8	9.1±5.1	16.7±10.9	26.1±9.3	22.8±9.4	18.9±7.0	26.1±10.9	16.3±10.1	13.2±8.9	11.2±6.8	18.7±11.4
Difference	14.7±12.7	12.7±12.5	8.8±9.4	8.6±11.2	18.3±12.5	18.3±9.7	12.2±13.7	12.8±14.8	16.6±11.0	14.6±10.7	11.4±8.3	11.8±10.0
P value	0.000	0.000	0.000	0.000	0.02	0.000	0.028	0.032	0.000	0.000	0.000	0.000

(Table 1) Pure tone average – air bone gap (PTA-ABG) results with different types of tympanoplasty.

Discussion

Two goals should be achieved in TM reconstruction: firstly closing the perforation; and secondly obtaining a new TM with near normal sound conduction qualities[3].

Cartilage grafting in middle ear surgeries has been used for a lengthy period of time. Lately, however, it has been considered profoundly to substitute other materials in TM reconstruction[6]. The ultimate benefit of cartilage as grafting material has been believed to be its extremely low metabolic rate[5]. It receives its' nutrients via diffusion[5,9]. It is, also, tremendously easy to operate with due to its' pliability and ability to resist deformation caused by pressure variations[5,6]. Additionally, it incorporates well within the layers of the TM[5,7,9].

Conchal and tragal cartilages are easily harvested and manipulated according to perforation size. Subsequently, it permits precise positioning of the graft in high risk perforations[4,9]. Moreover, it is further appropriate for tympanosclerosis and cases where TORP and PORP are used to prevent estrusion of the prosthesis[4,9].

In the present study, our overall graft take was 100% in both tympanoplasty type I and III; suggesting that cartilage shield graft is an excellent graft material in agreement with the results of different authors. Take rates reported varied from 97%[10], 97.7%[1], 98.2%[5], 98.4%[13], 99.35%[2], to 100%[3,8]. Uslu et al[4] had lower success rates in comparison to the literature, which was attributed to several explanations such as low patients' socioeconomical status, poor postoperative nursing and hygiene, and repeated upper air way infections[4].

Further analysis of patients' data revealed that age and sex had no association with postoperative PTA-ABG, which was in agreement with Cavaliere[2]. On the other hand, our data revealed no association between the types of tympanoplasty and postoperative PTA-ABG, which was in disagreement with Cavaliere[2].

Controversy remains regarding the use of this more rigid material in tympanoplasty. Many surgeons are concerned about the hearing impact, although there is no evidence in the literature to support the belief that cartilage is associated with an unfavorable effect on hearing[1].

Various authors[1,3,7,8,12] have discussed hearing results following cartilage tympanoplasty, it was found to be comparable to those following perichondrium or fascia grafting[1, 3,7-9,12]. Gerber et al[8], Kirazli et al[9] and Gamra et al[1] compared fascia with cartilage tympanoplasty, no significant difference in hearing outcome was found. A systematic review done by Mohamad et al[12], has shown that both cartilage and temporalis fascia give equal and comparable functional results[12]. Mokbel et al[3] reported that postoperative hearing was significantly improved in partial thickness cartilage grafts, full thickness cartilage grafts and temporalis fascia grafts. However, no significant difference in hearing results between partial thickness cartilage and fascia was observed[3]. Zahnert et al[11] determined the acoustic transfer characteristics of cartilage of varying thickness and its mechanical deformation when exposed to fluctuations in atmospheric pressure. It was noted that cartilage plate with a thickness of less than 0.5 mm gave least acoustic transfer loss[11].

On the other hand, Yetiser et al[7] reported that hearing gain in patients with cartilage

grafting is much better than that in patients with fascia tympanoplasty[7].

Aidonis et al[13], Duckert et al[10], Uslu et al[4], and Khan et al[5] have presented their experiences with different techniques in cartilage grafting and achieved good hearing results.

Using full thickness tragal cartilage shield graft, this study corroborates cartilage tympanoplasty hearing results reported by previous authors, in which postoperative PTA-ABG was 14.9±7.0 dB being statistically significant.

Putting in mind the possibility of cartilage graft to form opacity at the TM repair site and hide a residual cholesteatoma[6], none of our patients operated on had cholesteatoma.

Cartilage shield tympanoplasty demonstrates a high degree of reliability, especially for patients at higher risk for graft failure[13].

Conclusion

The results showed excellent graft take rate and no detrimental effect of cartilage tympanoplasty on hearing outcome. In fact, hearing results were satisfactory. Therefore, shield cartilage graft is a valid alternative in all tympanoplasty procedures.

References

1. Gamra OB, Mbarek C, Khammassi K et al. Cartilage graft in type I tympanoplasty: audiological and otological outcome. Eur Arch Otorhinolaryngol 2008; 265:739–742

2. Cavaliere M, Mottola G, Rondinelli M, Iemma M. Tragal cartilage in tympanoplasty: anatomic and functional results in 306 cases. Acta Otorhinolaryngol Ital 2009; 29:27-32.

3. Mokbel KM, Thabet EM. Repair of subtotal tympanic membrane perforation by ultrathin cartilage shield: evaluation of take rate and hearing result. Eur Arch Otorhinolaryngol 2013; 270:33–36.

4. Uslu C, Tek A, Tatlipinar A et al. Cartilage reinforcement tympanoplasty: otological and audiological results. Acta Oto-Laryngologica 2010; 130: 375–383.

5. Khan MM, Parab SR. Primary cartilage tympanoplasty: our technique and results. American Journal of Otolaryngology–Head and Neck Medicine and Surgery 2011; 32:381–387.

6. Yung M. Cartilage tympanoplasty: literature review. The Journal of Laryngology & Otology 2008; 122:663–672.

7. Yetiser S, Hidir Y. Temporalis Fascia and Cartilage-Perichondrium Composite Shield Grafts for Reconstruction of the Tympanic Membrane. Annals of Otology, Rhinology & Laryngology 2009; 118:570-574.

8. Gerber MJ, Mason JC, Lambert PR. Hearing Results After Primary Cartilage Tympanoplasty. Laryngoscope 2000; 110:1994–1999

9. Kirazli T, Bilgen C, Midilli R, Ögüt F. Hearing results after primary cartilage tympanoplasty with island technique. American Academy of Otolaryngology–Head and Neck Surgery 2005; 132:933-937

10. Duckert LG, Müller J, Makielski KH, Helms J. Composite autograft ‘shield’ reconstruction of remnant tympanic membranes. Am J Otol 1995; 16:21–26

11. Zahnert T, Huttenbrink KB, Murbe D, Bornitz M. Experimental investigations of the use of cartilage in tympanic membrane reconstruction. Am J Otol 2000; 21:322–328

12. Mohamad SH, Khan I, Hussain SS. Is Cartilage Tympanoplasty More Effective Than Fascia Tympanoplasty? A Systematic Review. Otology & Neurotology 2012; 33:699-705.

13. Aidonis I, Robertson TC, Sismanis A. Cartilage Shield Tympanoplasty: A Reliable Technique. Otology & Neurotology 2005; 26:838–841.