CLINICAL STUDY

COMPARISON OF CARTILAGE AND FASCIA GRAFT IN TYPE I TYMPANOPLASTY: OUR EARLY RESULTS

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SUMMARY

Objective: This study aimed to compare the audiological and healing outcomes between the fascia and cartilage grafts in type I tympanoplasty.

Materials and Methods: This retrospective study was performed on 43 patients who had underwent type I tympanoplasty without mastoidectomy at our hospital from January 2014 to February 2016. Eighteen patients (10 male and 8 female) underwent type I tympanoplasty using cartilage graft (group 1) and 25 patients (15 male and 10 female) using fascia graft (group 2). Successful hearing is defined as average postoperative air-bone gap (ABG) closure rate to 20 dB, more than 15 dB improvement of pure tone audiometry average air conduction thresholds (PTA) or postoperative mean air conduction thresholds of 30 dB or better. The ages, sexes, success rates of graft take and hearing results were compared between the groups.

Results: In both groups, there was a statistically significant improvement in terms of mean air conduction thresholds and decrease in mean ABG postoperatively ($p=0.001$; $p<0.001$) The PTA changes in terms of success and rate of graft take showed no statistically significant difference between the groups ($p>0.05$).

Conclusion: Both cartilage and fascia are effective graft materials in type I tympanoplasty and they are not superior to each other.

Keywords: Cartilage, Fascia, Graft, Tympanoplasty

TİP 1 TİMPANOPLASTİDE KIKIRDAK VE FASYA GREFTLERİN KARŞILAŞTIRILMASI: ERKEN SONUÇLARIMIZ

ÖZET

Amaç: Bu çalışmanın amacı tip 1 timpanoplastide greft materyali olarak kullanılan kıkırdak ve fasyanın, işitme sonuçları ve greft başarısı açısından karşılaştırmaktır.

Gereç ve Yöntem: Bu retrospektif çalışmaya hastanemizde Ocak 2014 ve Şubat 2016 tarihleri arasında mastoidektomisiz tip 1 timpanoplasti ameliyatı yapılan 43 hasta dahil edildi. On sekiz hastada (10 erkek ve 8 kadın) greft materyali olarak kıkırdak kullanılırken (Grup 1), 25 hastada (15 erkek ve 10 kadın) fasya (Grup 2) kullanıldı. Ameliyat sonrası hava-kemik aralığında (HKA) ≥ 20 dB kapanma, saf ses işitme eşiklerinde (SSE) 15 dB den fazla düzelme veya ameliyat sonrası SSE lerinin ≥ 30 dB olması başarılı işitme sonucu olarak tanımlandı. Gruplar yaş, cinsiyet, greft başarı oranı ve işitme sonuçları açısından karşılaştırıldı.

Bulgular: Her iki grup da operasyon sonrası hava yolu SSE' deki ve preoperatif döneme göre postoperatif HKA değerlerindeki düzelme istatiksel olarak ileri derecede anlamlıydı ($p=0.001$; $p<0,001$). Gruplar arasında işitme sonuçları ve greft başarı oranları arasında istatistiksel olarak anlamlı farklılık saptanmamıştır ($p>0,05$).

Sonuç: Kıkırdak ve fasya, Tip 1 timpanoplasti ameliyatında başarılı greft materyallleridir ve birbirleri üzerine belirgin bir üstünlükleri yoktur.

Anahtar Sözcükler: Fasya, Greft, Kıkırdak, Timpanoplasti

INTRODUCTION

Perforation of the tympanic membrane (TM) is one of the most common otologic pathologies to confront the otolaryngologist.

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Since tympanoplasty was first described by Wullstein and Zoellner in the 1950s, numerous surgical techniques and graft materials, such as temporalis muscle fascia (TMF), periosteum, perichondrium, vein, cartilage, and fat have been used to close TM perforations[1,2].

TMF is one of the most commonly used material for tympanic membrane repairing, with a success rate of 93% to 97% in primary tympanoplasties[3]. However, healing has a much poorer prognosis in cases of tubal dysfunction, adhesive processes, tympanic fibrosis, smoking,

bilateral disease, and defects of the entire tympanic membrane[4]. In these cases, there is a growing interest in the use of cartilage as an alternative to more traditionally used TMF graft. The cartilage which have an appropriate thickness can be used as the graft material, taking advantage of the increased stiffness of the material to help resist the forces that may cause failure, although there have been concerns that these may affect adversely the acoustic transfer and hearing, and another disadvantage is that cartilage graft can mask the formation of cholesteatoma, which could occur if any skin of the retraction pocket is left behind.

The selection of graft material depends on the status of the tympanic membrane (retraction pocket, atelectatic TM etc.), type of procedure, function of the eustachian tube, size of the perforation and the most importantly the surgeon's own experience and choice.

The aim of this study was to compare the audiological and healing outcomes between the TMF and cartilage graft in type I tympanoplasties.

MATERIAL and METHODS

This retrospective study was performed on 43 patients who had underwent type I tympanoplasty without mastoidectomy at our hospital from January 2014 to February 2016. Eighteen patients (10 male and 8 female) underwent type I tympanoplasty using cartilage (group 1) and 25 patients (15 male and 10 female) using TMF graft (group 2).

A homogeneous group was formed to make an accurate comparison. For this purpose, patients with an intact ossicular chain, dry ear for a period of at least 1 month, and normal middle ear mucosa were included in the study. Patients were excluded from the study if they had cholesteatoma, marginal tympanic membrane perforations, a history of any otologic procedure, concomitant mastoidectomy, ossiculoplasty or atelectasis, and syndromes that might affect the middle ear. Patients younger than 16 years of age were also excluded.

All operations were performed under general anesthesia with endotracheal intubation by surgeons (R.O.K and V.G.), and a posterior auricular incision was used. All patients underwent over-under tympanoplasty[5]. The tympanomeatal flap was elevated to expose the handle of the malleus and the tympanum. In cases where TMF was used as a graft material, the graft was harvested from the ipsilateral temporalis muscle. The cartilage grafts were harvested from the tragus or cavum concha or cymba (8, 6 and 4, respectively). The perichondrium on one surface of the cartilage was preserved. The perichondrial surface was placed lateral. The size of the cartilage was reduced considering the size of the perforation and the cartilage graft was cut with a no. 11 blade to obtain an appropriate thickness of the graft ($\leq$ 0.5 mm). Approximately 2 mm width cartilage resection was done vertically from the center of the cartilage for malleus handle and the lateral process by preserving perichondrium. The graft was under the tympanic membrane remnants or fibrous annulus. Absorbable hemostatic gelatin sponges was used to support the graft. Evaluation of middle ear revealed that ossicular chain was mobile and intact, thus reconstruction was not required.

Audiometric examinations were performed in quiet rooms with an Interacoustics AC–40 clinical audiometer (Assens, Denmark) according to the standards of the company, and all of the tests were carried out by the same audiometrist. Audiologic data were reported in accordance with the recommended methods of the Hearing Committee of the American Academy of Otolaryngology, Head and Neck Surgery, which endorsed a new minimal standard for reporting hearing results in clinical trials[6]. The audiological evaluation was performed before the operation and on the 3th postoperative month. Bone and air conduction pure-tone average thresholds (PTA) were obtained using 500, 1000, 2000 Hz and the mean of 2000-4000 Hz taken as the 3000 Hz hearing thresholds, and air-bone gaps (ABG) were calculated. Successful hearing was defined as ABG average closure to 20 dB, more than 15 dB improvement of PTA or postoperative PTAs of 30 dB or better.

The condition of the membrane graft was recorded in the 3rd month follow up or later with otoendoscopy and recorded on patient follow-up database.

The charts were reviewed for age, sex, graft take, change between pre- and postoperative ABG and PTA.

Our study was approved by the local ethics committee and conducted in accordance with the ethical principles described by the Declaration of Helsinki. Informed consent form was obtained from all participants before the study (Project No: 2016-1118).

The statistical package for the social sciences (SPSS for Windows, version 21.0, IBM Corp., Armonk, NY, USA) software was used for all data analyses. The descriptive data were given as mean ± standard deviations. Student's t test and paired sample t test were used for the two-group comparisons of quantitative data with a normal distribution. Fisher's

Exact test was used for the comparison of qualitative data. A level of $p < 0.01$ was considered significant.

RESULTS

There were a total of 43 patients consisting of 25 males and 18 females included the study. The patients were divided into two groups according to graft material used. Group I consisted of 18 patients (10 males and 8 females) who underwent type I tympanoplasties using cartilage grafts and group 2 consisted of 25 patients (15 males and 10 females) who were operated using TMF grafts. The mean ages of the group 1 and the group 2 were 36.94 and 33.04 years, respectively.

The graft success rate was %88.8 in the cartilage group and %88.0 in the TMF group at 3 months follow up as an early result, which was not different between the groups ($p = 0.657$) (Table 1).

The successful hearing result rate was %72.2 in the cartilage group and %80.0 in the TMF group, which was not different between the groups ($p = 0.717$) (Table 1).

There were no statistically significant differences between the group's preoperative and postoperative ABG ($p = 0.882$ and $p = 0.484$, respectively) (Table 1).

The mean ABG changes of the cartilage and the TMF groups were 9.38 ± 6.23 dB and 10.48 ± 7.61 dB, respectively. There were no statistically significant differences between the group's ABG changes ($p = 0.621$), however the postoperative ABG of the patients in both groups were significantly different than their respective preoperative ABG ($p = 0.001$) (Table 1).

We obtained same results when comparing successful hearing levels and ABG between the groups with intact grafts (Table 2).

Table 1. Comparison of successful hearing levels, graft take rates and Air-Bone Gap (ABG) between the groups

		Group 1 (n=18)	**Group 2 (n=25)**	
		Mean±SD	**Mean ±SD**	
ABG (dB)	**Preop**	23.72±5.18	23.36±9.30	[a]***0.882***
	Postop	14.33±6.75	12.88±6.59	[a]***0.484***
	p	[b]***0.001****	[b]***0.001****	
	Difference	9.38±6.23	10.48±7.61	[a]***0.621***
		n (%)	**n (%)**	
Graft take	**Positive**	16 (%88.8)	22 (%88.0)	[c]***0.657***
	Negative	2 (%11.2)	3(%12.0)	
Successful hearing	**Positive**	13 (%72.2)	20 (%80.0)	[c]***0.717***
	Negative	5 (%27.8)	5 (%20.0)	

*[a]Student t Test [b]Paired Samples Test [c]Fisher's Exact Test *p<0.01*

Table 2. Comparison of successful hearing levels and Air-Bone Gap (ABG) between the groups with intact grafts.

		Group 1 (n=16)	Group 2 (n=22)	
		Mean±SD	**Mean ±SD**	
ABG (dB)	**Preop**	23.37±5.26	23.50±9.65	[a]***0.960***
	Postop	13.43±6.61	12.36±6.86	[a]***0.630***
	p	[b]***0.001****	[b]***0.001****	
	Difference	9.93±6.37	11.13±7.40	[a]***0.596***
		n (%)	**n (%)**	
Successful hearing	**Positive**	12 (%75.0)	20 (%90.9)	[c]***0.650***
	Negative	4 (%25.0)	2 (%9.1)	

[a]*Student t Test* [b]*Paired Samples Test* [c]*Fisher's Exact Test* *$p<0.01$

DISCUSSION

The term tympanoplasty was introduced in 1953 by Wullstein to describe surgical techniques for the reconstruction of the middle-ear hearing mechanism that had been impaired or destroyed by chronic ear disease[7]. Using the classification system designed by Wullstein, a type I tympanoplasty is similar to a myringoplasty in that the goal of the procedure is to address only a TM perforation, although the middle ear is entered by lifting of a tympanomeatal flap[8].

Tympanic membrane perforations result mainly from infectious and traumatic etiologies. When the decision has been made to perform the repair, there are numerous surgical techniques and graft materials available, and most commonly used graft material is TMF because of it convenient location and resistant to infection. However, patient's characteristics such as adhesive TM, revision surgery, eustachian tube dysfunction and retraction pockets play significant roles in the failure of TMF grafting. In that case cartilage graft a maybe better choices in tympanoplasty procedure. Because of its innate structural stability, rigidity, viability and endurance against infections, it is a more predictable graft material than that of TMF. However there have been concerns that these may affect acoustic transfer and hearing adversely[9].

The ideal tympanoplasty procedure aims to restore hearing, resulting in an intact tympanic membrane with an intact or a reconstructed ossicular chain[10]. There are various studies reporting various results using TMF and cartilage grafts[11,12]. The cause of these differences may be the result of different criteria for reporting the success of those procedures[13,14].

In one study, the authors reported that there is no difference in postoperative hearing results when comparing cartilage and TMF grafts in tympanoplasty. Despite the thickness of the cartilage, the hearing results are acceptable[15,16]. On the other hand, there are concerns that the thickness of cartilage is an important point in terms of good hearing results. In a recent study, authors showed that reducing the thickness of cartilage to a thickness of 0.5 mm or less resulted in an acceptable acoustic transfer loss when compared with the tympanic membrane[17-19]. Demirpehlivan et al. reported that cartilage is an effective graft material in terms of graft take success and has no negative effects on hearing results. They concluded that cartilage grafting may be preferred more often for primary

tympanoplasties with low risk[20]. Other studies have shown that hearing results are comparable between cartilage grafts and temporalis fascia grafts[21-23]. Furthermore, some authors reported better hearing results in the cartilage group compared to TMF[24,25].

In our study, we reduced the thickness of cartilage to a thickness of 0.5 mm or less to decrease the stiffness and mass effect of the cartilage. Consistent with the literature, the hearing results and graft take rates of our cartilage graft group was good when compared with the TMF group. On the other hand, the audiologic results and graft take rates were better in TMF group compared to the cartilage group with 3 months follow up but did not differ significantly (Table 1 and 2). However, these early results may differ in the following months such like the cartilage may become thinner and regain a more effective conductive capacity. In our study, we did not use the middle ear risk index (MERI) which generates a numeric indicator of the severity of the middle ear disease to categorize patients according to the severity of the disease[26]. This may also explain our early results as well as the fact that our groups were not homogeneous. Another limitation of our study is that the number of patients were small on both groups. The third and the most important limitation is the short follow up period precluding to draw definite conclusions.

CONCLUSION

In this study, we aimed to compare the graft take rates and hearing improvements in patients treated with TMF or cartilage grafts. Both cartilage and fascia showed good clinical outcomes in terms of anatomic success and hearing results and can be safely used in the reconstruction of tympanic membrane perforations as graft materials in type I tympanoplasties.

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