

Investigation of myringosclerosis development in different grafting materials after myringo-/tympanoplasty

Miringo-/timpanoplasti sonrası farklı greft materyalleri üzerinde miringoskleroz gelişiminin araştırılması

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ABSTRACT

Objectives: This study aims to investigate the prevalence of myringosclerosis in tragal perichondrium (TP) and temporalis fascia (TF) grafts after myringo-/tympanoplasty.

Patients and Methods: Thirty patients, who were diagnosed with non-suppurative chronic otitis media and administered myringo-/tympanoplasty under general anesthesia using TP or TF as grafting material in our clinic between January 2012 and May 2013, were recruited in this retrospective case-control study. Patients were divided into two groups according to used graft material as group 1 (TP) (9 males, 6 females; median age 35.4 years; range 20 to 62 years) and group 2 (TF) (7 males, 8 females; median age 39.8 years; range 19 to 63 years). Occurrence of myringosclerosis on the intact tympanic membrane grafts was evaluated postoperatively by the same surgeon under surgical microscope.

Results: Postoperative myringosclerosis was detected in six patients (40%) in TP group and 13 patients (86.7%) in TF group.

Conclusion: Prevalence of myringosclerosis on graft materials used in myringo-/tympanoplasty was lower in TP group compared to TF group. We believe that this may be due to different vascular structures of different graft tissues and that the low predisposition of perichondrium towards development of myringosclerosis can be considered as an advantage for this graft. We hope that this study adds a new dimension to etiopathogenesis of myringosclerosis and assists otologists in the prevention and treatment of this lesion.

Keywords: Myringosclerosis; temporalis fascia; tragal perichondrium; tympanoplasty.

ÖZ

Amaç: Bu çalışmada miringo-/timpanoplasti sonrası tragal perikondrium (TP) ve temporal kas fasiya (TF) greftlerinde miringoskleroz prevalansı araştırıldı.

Hastalar ve Yöntemler: Bu retrospektif olgu-kontrol çalışmasına Ocak 2012 - Mayıs 2013 tarihleri arasında kliniğimizde non-süpüratif kronik orta kulak iltihabı tanısı konularak genel anestezi altında miringo-/timpanoplasti uygulanan ve greft materyali olarak TP ya da TF kullanılan 30 hasta dahil edildi. Hastalar kullanılan greft materyaline göre grup 1 (TP) (9 erkek, 6 kadın; ort. yaş 35.4 yıl; dağılım 20-62 yıl) ve grup 2 (TF) (7 erkek, 8 kadın; ort. yaş 39.8 yıl; dağılım 19-63 yıl) olmak üzere iki gruba ayrıldı. İntakt timpanik zar greftleri üzerinde ameliyat sonrası miringoskleroz gelişimi aynı cerrah tarafından cerrahi mikroskop altında değerlendirildi.

Bulgular: Ameliyat sonrası miringoskleroz TP grubunda altı hastada (%40), TF grubunda 13 hastada (%86.7) saptandı.

Sonuç: Miringo-/timpanoplastide kullanılan greft materyallerinde miringoskleroz prevalansı TP grubunda TF grubuna göre daha düşük idi. Bu durumun farklı greft dokularının farklı vasküler yapısından kaynaklandığına ve perikondriumun miringoskleroz gelişimine düşük yatkınlığının bu greft için avantaj sayılabileceğine inanıyoruz. Bu çalışmanın miringoskleroz etyopatogenezine yeni bir boyut kazandırarak otohistlere bu lezyonu önleme veya tedavi etmede yardımcı olacağını umut ediyoruz.

Anahtar Sözcükler: Miringoskleroz; temporal kas fasiyası; tragal perikondrium; timpanoplasti.



Various tissues have been investigated as an option for grafting material for myringo-/tympanoplasty, including fascia lata (Zöllner), vein (Shea), temporalis fascia (Ortegren), periosteum (Domenech and Bocca), fat (Ringenberg), cartilage and perichondrium (Jansen).^[1] Besides these well-known options, lesser-known and more complicated materials such as dura mater, pericardium, amniotic membrane, cornea, peritoneum and aortic valve have also been tried.^[2-7] Each material has its own advantages and disadvantages, which determine the surgeons' choice of graft for the procedure. Among these materials, tragal perichondrium (TP) and temporalis fascia (TF) have gained greater popularity because of their clear advantages. Although the published success rates of TP and TF in myringo-/tympanoplasty vary, both materials mostly fulfill the criteria required for an ideal grafting material, including low rejection rate, sufficient quantity, good tensile strength, conductive properties similar to that of the tympanic membrane, and easy availability.^[8-10]

Myringosclerosis (MS) may be defined as an irreversible, non-specific end result of chronic inflammation of the tympanic membrane.^[11] Lesions are characterized by hyalinization, calcification and degeneration, especially of the lamina propria, and may either be localized or diffuse throughout any part of the tympanic membrane. Although otologists frequently encounter MS during routine physical examinations or during surgery, the exact cause of this lesion is still undefined. Possible factors related to the formation of MS include "mechanical injury, production of free oxygen-derived radicals also known as reactive oxygen species (ROS), inflammation, myringotomy, ventilation tube (VT) insertion, recurrent otitis media, middle ear infections, various chemical agents, genetic tendency, immunity, and local metabolic changes".^[12]

In the current study, we aimed to investigate the prevalence of MS in tragal perichondrium and temporalis fascia in order to compare their propensity to form MS on their structure. Additionally, we aimed to clarify the etiopathogenesis and contributing factors of MS with this observation.

PATIENTS AND METHODS

The ethics committee of our institution approved the study, and informed consent was obtained from all participants.

In total, 30 patients who had been diagnosed as having non-suppurative chronic otitis media with safe perforations and who had been managed with myringo-/tympanoplasty using TP or TF as grafting material were recruited for this study. The operations were performed in the otorhinolaryngology department of our institution between January 2012 and May 2013. Equal numbers of patients (n=15) were grafted with the two different graft materials. Group 1 (TP) consisted of 9 men and 6 women (mean age 35.5±2.2 years; range 20 to 62 years), and group 2 (TF) consisted of 7 men and 8 women (mean age 39.8±2.2 years; range 19 to 63 years).

Perforations were limited to one quadrant, and were situated on the pars tensa in both groups, thus the dimensions of the perforations were accepted as similar (>2 to <5 mm in size). All perforated drums were free of MS preoperatively. The middle ear mucosa and ossicular chain of all patients were healthy and free of squamous epithelium or gross tympanosclerotic lesions.

All operations were performed under general anesthesia by the same surgical team. The retro-auricular approach was used, and the grafting materials were harvested from the temporalis muscle as fascia or the tragal cartilage as perichondrium. Temporalis fascia was harvested via the same post-auricular incision (Figure 1). For harvesting of TP, an incision was made approximately 2 mm medial from the tragal crest line (Figure 2), then the tragal cartilage was excised and the perichondrium harvested in continuity from both surfaces. The tragal cartilage was then replaced and the skin incision closed.

Under a surgical microscope, the edges of the perforation were vitalized by excision of the epithelium. There was no preoperative visible MS or tympanosclerosis on the tympanic membrane remnants or in the middle ear of the patients. The tympanomeatal flap was lifted in order to allow entry into the middle ear. Ossicular continuity and mobility was confirmed. The harvested graft material (TP or TF) was placed using an underlay technique just medial to the malleus, and reinforced medially with gel foam. After



Figure 1. Postauricular incision and temporalis muscle fascia.



Figure 2. Tragal incision and tragal cartilage perichondrium.

repositioning the meatal flap, more gel foam was placed laterally in order to prevent flap and graft lateralization. The external auditory meatus was filled with antibiotic-soaked gel foam to stabilize the flap. The incision was closed and a dressing applied. Postoperative physical examination of the intact tympanic membranes was performed after 12 weeks under surgical microscope in order to determine the occurrence of MS on the surface of the grafts.

Statistical analysis

For statistical analysis, SPSS for Windows version 15.0 software program (SPSS Inc., Chicago, IL, USA) was used. Pearson chi-square test was used for comparison of categorical variables. $P < 0.05$ was considered statistically significant.

RESULTS

Postoperative MS was observed in six patients with TP (40%) and 13 patients with TF (86.7%). Postoperative MS development was significantly higher in the TF group when compared with TP group (86.7% vs. 40% respectively; $p = 0.008$). Postoperative oto-endoscopic view of an intact TP graft with MS is shown in Figure 3. Distributions of the MS lesions according to patient and type of grafting material are summarized in Table 1.

DISCUSSION

Since the first description of tympanoplasty by Wullstein, there has been an ongoing search for the optimum graft material in order to achieve the most natural neo-tympanic membrane structure and dynamics postoperatively.^[1] An ideal graft material for tympanic membrane closure should meet some basic criteria, including “low rejection rate, sufficient quantity, good tensile strength, conductive properties similar to that of natural tympanic membrane and easy

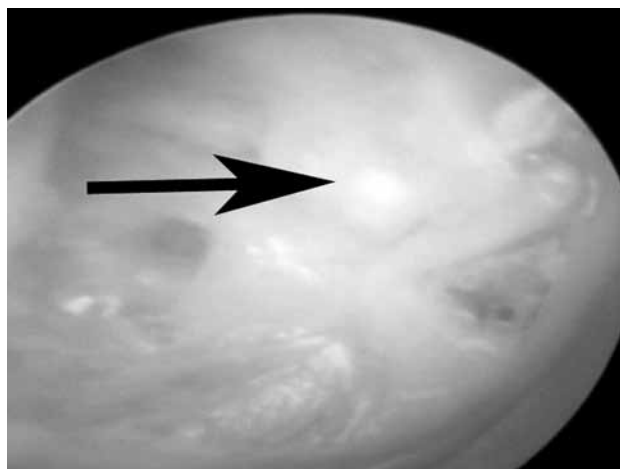


Figure 3. Tragal perichondrium with myringosclerosis.

Table 1. Patients, graft types and myringosclerosis

Patient no	Graft type		Myringosclerosis (+/-)
	Perichondrium (P)	Fascia (F)	
1	P		+
2		F	+
3		F	+
4	P		-
5	P		-
6		F	+
7		F	+
8	P		+
9		F	+
10	P		-
11		F	+
12		F	+
13	P		-
14	P		+
15	P		-
16	P		+
17		F	-
18	P		-
19		F	+
20		F	-
21	P		-
22	P		-
23		F	+
24		F	+
25	P		-
26		F	+
27		F	+
28	P		+
29		F	+
30	P		+

availability.”^[10] Studies that have compared the morphological and functional properties of the various graft materials have reported conflicting and variable results.^[13] In a comparative study, Dabholkar et al.^[8] showed that TP and TF had similar dimensional stability (graft uptake) and audiological results (hearing gain). In another comparative study, Kim et al.^[14] demonstrated that the audiological results after cartilage alone or cartilage-perichondrium composite graft were comparable with those after TF tympanoplasty. In addition to these studies showing comparable results between the three most preferred grafting materials, Onal et al.^[15] in their comparative study

(temporalis muscle fascia vs. perichondrium/cartilage island flap) demonstrated that cartilage was audiological superior to fascia for closure of the air-bone gap. Although these and many other recent studies compared two of the most important parameters related to graft materials, it was not our primary goal to investigate graft uptake ratios or audiological outcomes, but rather to observe the incidence of MS in these graft materials.

In a recent study, Ozbay et al.^[16] demonstrated that the presence of MS in the residual membrane and in the contralateral tympanic membrane and tympanosclerosis in the middle ear cleft have a significant role in the development of postoperative MS in the neo-tympanum. Additionally they also determined that type of the surgical intervention, location and extent of perforation, presence of cholesteatoma, and granulation tissue in the middle ear have no significant role in the development of postoperative MS in the neo-tympanum. In our study, residual membrane and middle ear mucosa were free of sclerosis, cholesteatoma and granulation tissue, and all patients had the same type of surgery as myringo-/tympanoplasty. However we did not evaluate the status of the contralateral tympanic membrane of the patients.

The etiology of MS formation seems to be related to blood perfusion of the tympanic membrane or to molecules (such as free oxygen radicals) that are mainly associated with the oxygen and/or blood supply status of the related tissue.^[17] In addition to these main factors, it is known that the vascularization process of the neo-tympanum has different characteristics for different grafting materials.^[18] Consequently, graft materials (TP and TF) that have dissimilar neovascularization characteristics during graft intake after myringo-/tympanoplasty should also have different propensities to develop MS on their structures. In agreement with this, we found that development of MS was significantly different in the two different graft materials used in this study ($p < 0.05$). These graft materials have previously been found by histological and clinical studies to have dissimilar vascular architecture.^[18,19] Our observations about the development of MS are also mainly related to these different vascular characteristics of TP and TF. We suggest that the main contributing factor for the different propensities of TP and TF to form MS seems to be

related to their different vascular networks and neovascularization processes. Although in their animal study, Mattsson et al.^[17] concluded that “high oxygen pressure increases the likelihood of formation of the myringosclerotic lesions on rat tympanic membrane possibly related with the formation of oxygen radicals”, our observations are in disagreement with their findings. We believe that the vascular structure of perichondrium may have a protective effect against MS development.

There are several limitations to this study, which should be discussed. The major limitation is that we could not investigate the audiological results of each patient preoperatively and postoperatively via pure tone audiogram and tympanometry. Another limitation of our study is related to the lack of a control for the neo-tympanic membrane with respect to the source of the MS. Third, the lesions may arise from either the host’s tympanic remnant or the grafted tissue; future and more detailed histological studies may be able to identify which of these is the true source. Although these limitations are important, we believe that the low propensity of TP to develop MS might be considered as another advantage of this type of grafting material.

Conclusion

Occurrence of MS in the grafting materials we used in myringo-/tympanoplasty was lower for TP than for TF. We believe that the different vascular structure of these two tissues is the main reason behind this observation and low propensity for MS to arise in perichondrium might be considered as an advantage of perichondrium grafts. This study adds a new dimension to the etiopathogenesis of MS, which we hope will assist otological surgeons to prevent or treat this unnecessary lesion. Further experimental and clinical studies investigating various aspects of this pathology are needed to confirm our results.

Declaration of conflicting interests

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