

A novel myringoplasty technique: the placement of a complementary graft descending from the scutum to support an anterosuperior perforation

Erdal Sakalli^{1,5} · Cengiz Celikyurt² · Sultan Biskin³ · Selcuk Cem Erdurak⁴

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Abstract We describe a novel myringoplasty procedure. We placed a separated fascia graft descending from the scutum, combined with underlay myringoplasty, to support an anterosuperior perforation. We reviewed data from patients who underwent myringoplasty procedures to treat perforations extending into the anterosuperior quadrant of the pars tensa from October 2012 to June 2014. A total of 42 patients who were followed for a minimum of 1 year were enrolled. The same technique was used in all operations. The tympanomeatal flap was elevated from the neck of malleus up to the tip of the lateral process of malleus. The anterior malleolar fold was incised to create an opening running from the neck of the malleus to the anterior tympanic spine. A separate temporal fascia graft (complementary graft) was next inserted through the opening and pushed down into the protympanum. The upper part of the fascia graft was placed over the superior bony wall of the canal. Underlay myringoplasty was then performed. The inferior part of the fascia graft was next spread out to cover the lateral surface of the underlying graft. We measured graft take rate and preoperative and postoperative hearing parameters. The graft success rate was 97.7 % (41/42 patients). The preoperative air-bone gap was

22.56 ± 18.12 dB, and the postoperative air-bone gap was 8.4 ± 10.05 dB. This difference was statistically significant ($P < 0.001$). We believe that this myringoplasty technique is a safe, suitable, and effective for cases with tympanic membrane perforations extending into the anterosuperior quadrant of the pars tensa.

Keywords Anterior perforation · Myringoplasty · Tympanic membrane · Underlay

Introduction

Myringoplasty is an operation used to repair tympanic membrane (TM) perforations and is one of the most common otological surgical procedures. The goal of myringoplasty is to create an intact TM, forming a dry ear that is free of infection. On recovery, a patient is free to engage in unrestricted activities in water (such as swimming) [1]. Two of the most important considerations when planning a myringoplasty procedure are the position and size of the perforation; repair of central and posterior TM perforations is more likely to be successful than repair of anterior perforations [2, 3].

The two recognized myringoplasty procedures are the underlay (medial) and overlay (lateral) techniques. The overlay technique may afford better closure of anterior perforations. However, the potential complications include anterior blunting of the graft, graft lateralization, stenosis of the external ear canal, delayed healing, epithelial pearls, and a risk of inclusion iatrogenic cholesteatoma [4]. In the underlay technique, the graft is placed medial to the TM and the handle of the malleus; this technique is more suitable for treatment of posterior perforations. Repair of anterior perforations remains challenging using the

✉ Erdal Sakalli
erdalkbb1979@hotmail.com

¹ Department of Audiology, School of Health Sciences, Gelisim University, Istanbul, Turkey

² Department of Otorhinolaryngology, Safa Private Hospital, Istanbul, Turkey

³ Department of Otorhinolaryngology, Bulent Ecevit University Medical Faculty, Zonguldak, Turkey

⁴ Department of Audiology, School of Health Sciences, Aydin University, Istanbul, Turkey

⁵ Fevzi cakmak mah. Sisecam bloklari, Emek apt. D:8, Bagcilar, Istanbul, Turkey

underlay technique because of the relatively poor vascularity of the anterior quadrants, the risk of “fall-away”, possible necrosis, and reabsorption of the fascia [5]. To increase the success rate, we developed a novel myringoplasty technique. We placed a graft descending from the scutum. This, combined with the underlay method, was used to repair perforations in the anterosuperior quadrant.

The aim of the present study was to describe a new grafting technique for repair of anterosuperior perforations of the pars tensa and to determine its success rate.

Patients and methods

Patients

We retrospectively reviewed data on 42 patients who underwent myringoplasty to repair perforations extending into the anterosuperior quadrant of the pars tensa from October 2012 to June 2014. Myringoplasty was the only procedure performed in all the cases. Patients with only posterior or inferior perforations, who had undergone previous middle ear surgery or insertion of a ventilation tube, who had cholesteatoma, who exhibited ossicular chain abnormalities, who had cleft palates, or who had undergone prior pharyngeal surgery were excluded. All patients were examined with an operating microscope to confirm the presence of a TM perforation. Perforations were classified by the TM quadrant involved. Perforations were classified as subtotal if >50 % of the pars tensa of the TM was involved. Preoperative pure-tone audiography was performed at frequencies of 500, 1000, 2000, and 3000 Hz. Postoperative visits for otomicroscopic examination were scheduled at 1 week and 1, 3, and 6 months after surgery, and then every 6 months. We recorded age, gender, site, and location of the perforation, pre- and postoperative pure-tone audiographic results, and details of the postoperative TM examinations.

Surgical technique

All surgeries were performed under general anesthesia; all featured postauricular incisions. A large temporalis fascia graft was harvested and dried. Each tympanomeatal incision was performed parallel to and 10 mm distant from the tympanic sulcus, and extended up to the anterior meatal wall. The edges of the perforation were freshened. A tympanomeatal flap was elevated from the posterior meatal wall, the superior meatal wall, the tympanic notch, the posterior and anterior tympanic spines, the superior part of the anterior meatal wall, and the neck of the malleus up to the tip of the lateral process of the malleus. The suprimeatal spine was removed. Canaloplasty was performed by drilling the posterosuperior meatal wall to enlarge the meatus. A portion of

the scutum was removed when the meatus was not sufficiently large to permit adequate manipulation. The tympanomeatal flap was reflected inferolaterally. The opening was extended anteroinferiorly by elevating the fibrocartilaginous ring from the tympanic sulcus to a distance of approximately 3 mm from the anterior tympanic spine. An incision was made through the anterior malleolar fold to create an opening running from the neck of the malleus to the anterior tympanic spine (Fig. 1). The dried fascia graft (10 mm long and 4 mm wide) (complementary graft), with the corners of the leading part rounded off, was inserted through the opening thus created and pushed approximately 5 mm down into the protympanum (Fig. 2). The upper part of the fascia graft was placed over the superior bony wall of the canal. The tympanomeatal flap was replaced. The inferior part of the fascia graft was pulled laterally out of the mesotympanum and bent over to lie on the anterosuperior wall of the external meatus (Fig. 3). Underlay myringoplasty was performed by placing the temporal fascia graft medial to the remnants of the TM, the handle of the malleus, and the lateral of the eustachian tube (Fig. 4). The protympanum and tympanic ostium of the eustachian tube were filled with absorbable gelatin sponge; this pushed the temporal fascia graft laterally. The inferior part of the complementary graft was spread out over the lateral surface of the underlay graft in the anterosuperior quadrant (Fig. 5). An absorbable gelatin sponge was placed laterally over the graft. Myringoplasty was thus completed.

The guidelines of the American Academy of Otolaryngology and Head and Neck Surgery Committee on Hearing and Equilibrium [6] define successful closure of a TM

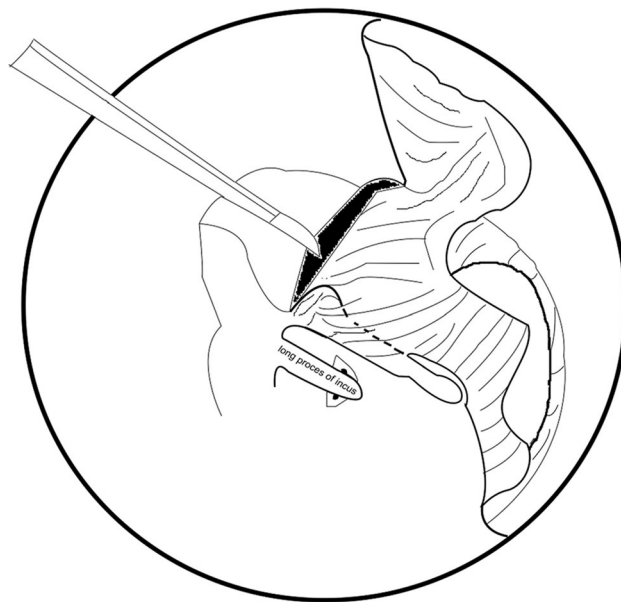


Fig. 1 Tympanomeatal flap was elevated from the neck of the malleus up to the tip of the lateral process of malleus. The incision was made through the anterior malleolar fold to create an opening running from the neck of the malleus to the anterior tympanic spine

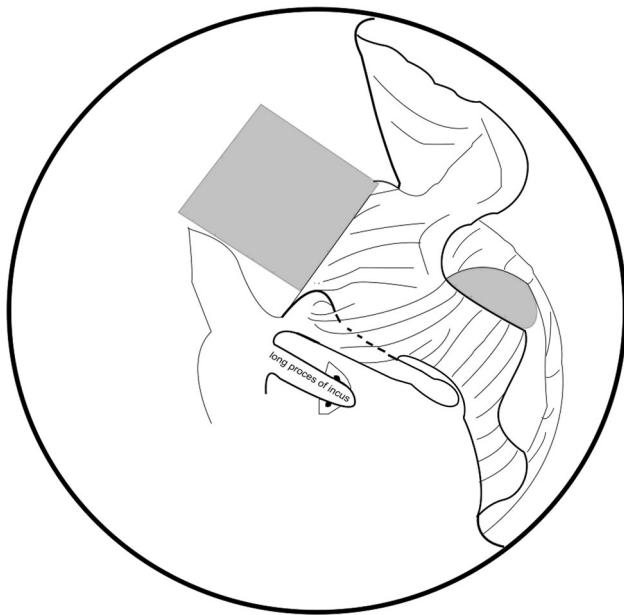


Fig. 2 Piece of the temporal fascia graft (complementary graft) was inserted through the opening and was pushed down into the protympanum

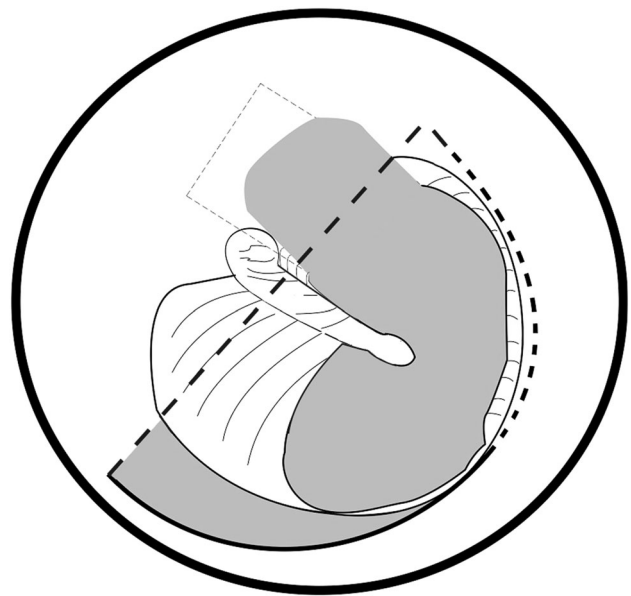


Fig. 4 Underlay myringoplasty was performed. The inferior part of complementary graft seems before it was spread out over the underlay graft

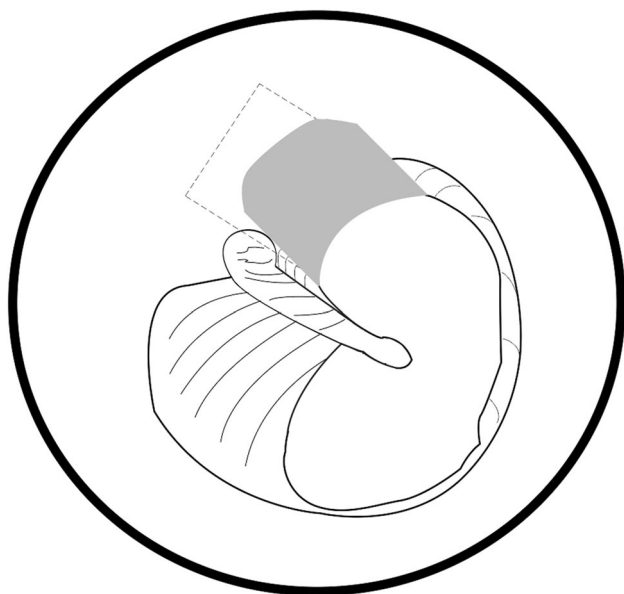


Fig. 3 Dashed line area shows the upper part of the complementary graft over the superior bony wall of the canal under the tympanomeatal flap. The grey area shows the inferior part of the complementary graft which was pulled laterally out of the mesotympanum and bent into the external meatus

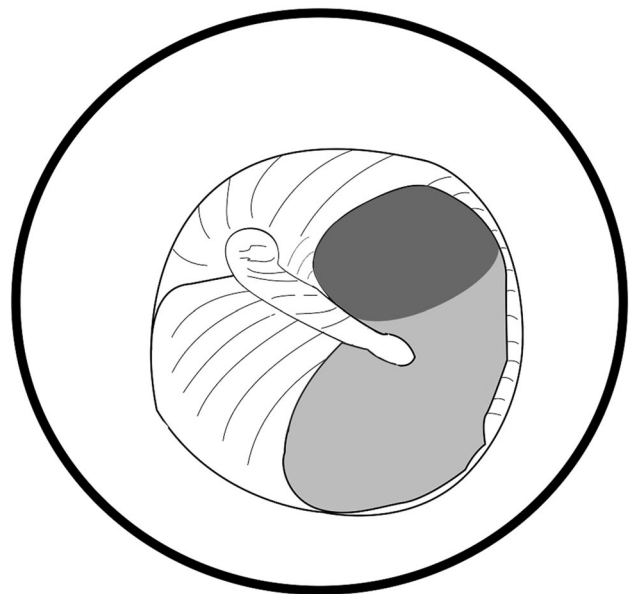


Fig. 5 Inferior part of the complementary graft was spread out over the lateral surface of the underlay graft in the anterosuperior quadrant. The dark area indicates overlap of two grafts

perforation as the presence of an intact TM without perforation, blunting, or retraction at the end of 1 year of follow-up.

The SPSS software version 16 (SPSS Inc., Chicago, IL, USA) was used for data analysis. The paired-samples *t* test was employed to compare differences in audiometric

findings before and after surgery, and a *P* value <0.005 was considered to indicate statistical significance.

Results

A total of 44 patients underwent the novel myringoplasty and 42 cases completed their 1-year follow-ups. We treated 29 (69 %) females and 13 (31 %) males. The median

patient age was 32.4 years (range 17–55 years). Follow-up was performed on all patients at 12–33 months (average 23.6 months) postoperatively. Myringoplasty was performed on the left ears of 24 patients (57.1 %) and on the right ears of 18 (42.9 %). In seven cases, only anterior–superior quadrant perforation was evident. We treated 16 subtotal perforations; in 8, perforations were observed in both anterior quadrants. Eleven cases had perforations in both the anterior quadrants and the posteroinferior quadrant.

Surgical success was defined as an intact graft. The perforation closure rate was 97.7 % (41/42). The anterior margin of the perforation did not fail in any case. Only one patient required re-operation that patient had a residual posteroinferior perforation. The size of this perforation was smaller than that of the initial perforation. We are of the opinion that we initially placed a graft that was too small. In two cases, slight granulation was evident on the grafts; this was treated with silver nitrate patches. There was no failure attributable to postoperative complications, such as wound infection, hematoma, blunting of the anterior part of the TM, anterior fall-away of the fascia, or retraction.

The preoperative air–bone gap was 22.56 ± 18.12 dB and the postoperative gap 8.4 ± 10.05 dB. The difference was statistically significant ($P < 0.001$). There was no increase in the bone conduction level in any case.

Discussion

It is well known that the repair of anterior TM perforations remains challenging for the otolaryngologist. Over the years, various techniques have been developed in efforts to obtain good results in patients with anterior TM perforations. These include the overlay, loop overlay, underlay, and overlay–underlay methods, gel film sandwich grafting, placement of a cartilage shield, and various in-house modifications of these methods. The most significant surgical problems are the lack of anchorage around, and low-level vascularization of, the anterior TM compared to the posterior TM. As vascularization of the anterior TM is poor, repair is associated with greater risks of reabsorption, necrosis, and anterior fall-away of the graft, especially when the underlay technique is employed [7–9].

A high graft take rate can be achieved when the overlay technique is used to repair anterior perforations, but iatrogenic cholesteatoma, anterior marginal blunting, graft lateralization, stenosis of the external ear canal, and squamous cysts are known postoperative complications [4]. To avoid such potential complications, and to achieve high take rates, surgeons have developed modified underlay graft techniques.

Underlay myringoplasty was first described by Shea in 1960; this involves placement of a graft under the TM [10].

The advantages of this technique are to avoid lateralization and anterior blunting. The most significant disadvantage is that the area of contact between the graft and the remnant TM is limited. This may negatively affect the success rate, especially when anterior TM perforations are repaired. In recent studies, the graft take rates when the classical underlay method was used to repair anterior TM perforations were 54.5 % in the study by Hosamani et al. [12] and 66 % in the study by Tek et al. [11]. When new or modified underlay graft techniques are used, the success rates increase to >90 %.

The window shade technique also affords high success rates when used to repair anterior perforations. This method is a combination of the underlay and overlay techniques. In this technique, an inferior and two superior flaps of canal skin (along with the annulus) are elevated. Bony meatotoplasty is often required. The anterior annulus is separately elevated via medial-to-lateral dissection to create a pocket. A graft is placed as an underlay to the pocket before the flaps are replaced [13].

A modified underlay technique termed the anterior tab flap method was developed by Kerr et al. [1]; this features a modified graft flap and anterior quilting of the graft. In this technique, a tunnel is created between the anterior bony canal and the overlying skin, via a small incision. This tunnel is then continued until it enters the middle ear. Two small anterior incisions are created in the fascia graft, yielding a small tab. The graft is positioned in the manner of an underlay graft, and the tab is pushed through the anterior tunnel under the anterior meatal skin. In one study, children with anterior and total TM perforations were divided into two groups, where one underwent anterior tab flap myringoplasty and the other standard underlay myringoplasty. The TM closure rate was higher in the former than the latter group (93.2 and 84.6 %, respectively). No anterior blunting or TM retraction was evident in either group [1].

The anterosuperior anchoring technique described by Knight et al. [2] is used to repair anterior TM perforations. The TM is elevated off the neck of the malleus, superior to the lateral process, and a tunnel is opened into the promontorium. The anterior component of the graft is pulled through the tunnel, from the promontorium up to the anterosuperior bony canal, in a manner similar to that used in the Kerr technique.

In the work of Gerlinger et al. [5], KTP-laser-assisted myringoplasty was used to repair anterior and subtotal perforations. Anterior anchoring was combined with anterior pull-back. Using the KTP-laser, the flap was freed from the handle of the malleus. A pull-back tunnel was created at the border of the anterior quadrant between the annulus and the bony ear canal, further improving graft fixation. The graft was placed medial to the handle of the

malleus and the TM remnant. The graft take rate was 100 %.

In some studies, a mucosal pocket is created between the skin of the anterior canal and the underlying bony canal wall to facilitate graft placement [4, 14]. Faramarzi et al. [15] reported a graft success rate of 91.1 % at follow-up times of 6–31 months.

Schwaber et al. [16] described a modification of the “swing door” technique; this involves underlay graft placement with elevation of inferior and superior canal skin flaps. The graft take rate was 95 %. Sakagami et al. [17] inserted a connective tissue graft through the TM perforation and lifted the graft to contact the edges of the perforation; fibrin glue was used to seal the regions of contact. The graft take rate was 95.7 %.

It is well known that it is difficult to repair anterosuperior TM perforations. Many different surgical procedures (mentioned above) have been developed, with varying results. It is important to have a range of procedures available; not all ears are suited to one particular procedure. To the best of our knowledge, the technique we describe here is novel. Our complementary graft method affords good contact between the remnant TM and the graft and prevents anterior fall-away. As the graft is located medial to the TM, lateralization is not possible. The neck of the malleus and the soft tissue assist the graft to take, because the graft is suspended. We dissect the remnant TM from the neck of the malleus; it is thus necessary to perform manipulations around the ossicles (Fig. 1). No increase in bone conduction was evident (at any frequency) postoperatively, showing that the dissection of the neck of the malleus from the remnant TM did not affect the inner ear. In addition, the anterior part of the TM did not become blunted, and we noted no anterior fall-away of the fascia or retraction. The success rate of 97.7 % upon follow-up at 12–33 months indicates that our procedure is safe and efficacious when used to repair anterosuperior perforations of the TM. The major limitations of our study are the lack of a control group and the retrospective nature of the work. Further studies would be appropriate.

Conclusion

We describe a novel surgical technique for repair of anterosuperior TM perforations; the graft take rate was high. This complementary graft technique eliminates the disadvantages of classical underlay myringoplasty in repair of anterosuperior perforations.

Compliance with ethical standards

Conflict of interest The authors have no have conflict of interest and financial obligations to disclose related to this study.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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