



Endoscopic butterfly inlay myringoplasty for large perforations

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Abstract

Purpose Nowadays, the use of otoendoscopy is becoming increasingly popular in ear surgery. Data on endoscopic tympanoplasty are quite current but not yet sufficient. This study aims to present the anatomical and functional results of endoscopic butterfly inlay myringoplasty in large perforations.

Methods The graft success rates and audiological outcomes of 26 ears of 23 patients who underwent endoscopic cartilage inlay myringoplasty due to large perforation (more than two-thirds of the area of tympanic membrane) from March 2016 to August 2018 were evaluated.

Results The mean follow-up period was 13.3 ± 7.1 (6–32) months. Graft success rate was 96% (25/26 ears). The preoperative mean air–bone gap (ABG) was 21.4 dB and postoperative mean was 14.4 dB. Significant improvement was observed in postoperative air–bone gap values compared to preoperative period (p 0.005).

Conclusions Endoscopic inlay butterfly myringoplasty is a safe surgical technique and has satisfactory anatomic and audiological outcomes in large tympanic perforations.

Keywords Butterfly · Inlay myringoplasty · Endoscopic myringoplasty · Perforation

Introduction

Myringoplasty is the procedure of closing the perforation of the tympanic membrane with graft material without intervening the ossicles or the middle ear. Over time, several surgical techniques have been developed using various graft materials. Butterfly inlay myringoplasty is one of these techniques [1]. This procedure, first described by Eavey in 1998, utilizes insertion of a cartilage graft into the perforation by the transcanal approach [2]. The main advantages of butterfly myringoplasty include short surgery duration by not elevating the tympanomeatal flap and minimal postoperative patient discomfort due to the absence of an ear pack [3, 4]. Due to these advantages, it has become popular in the last decade. While this technique was initially performed using a microscope, the use of endoscopes has become widespread today [4].

Initially, the procedure was described for small perforations with limited use. Over time, it has become a popular method for small- and medium-size perforations. This procedure is generally not preferred in large perforations because of the lack of remnant tympanic membrane to provide sufficient support to the graft material [4–7]. Today, however, the use for large perforations is increasing gradually, because recent studies revealed good graft success rates and audiological outcomes. These studies were performed with a surgical microscope [3, 8]. To our knowledge, although there are previous studies of endoscopic butterfly inlay myringoplasty, there is not any study that presents a patient series with utilization of this technique endoscopically on large perforations.

We aimed to evaluate the anatomical and functional outcomes of patients who underwent endoscopic butterfly inlay myringoplasty for large perforations in this study.

Materials and methods

Local ethics committee approval was obtained for this study (Protocol no.: 171).

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Patients

Patients who underwent endoscopic butterfly myringoplasty in our clinic due to large perforation (more than two-thirds of the area of tympanic membrane) between March 2016 and August 2018 were evaluated. Demographic data of the patients, operated ear sides, follow-up periods, pre- and postoperative pure tone audiometry tests, postoperative complications and the status of the grafts were recorded retrospectively.

Surgical technique

All patients were operated under general anesthesia. Transcanally, 0°, 18 cm, 4 mm endoscope (Karl Storz, Tuttingen, Germany) was used. The middle ear and ossicular chain were evaluated through perforation. The technique was performed in patients who did not have any problem in the ossicular chain. We refreshed the remnant membrane around the perforation by a pick. Since the perforations were large, and also included the manubrium, desepithelization was performed by removing the epithelium of the manubrium. Tympanosclerotic plaque was excised at the perforation edges.

Perichondrium cartilage graft was excised with a medial incision of approximately 3 mm from the top of the tragus for cosmetic purposes. The outer paper sheath of the suture material was placed on the perforation zone to determine the size of the desepithelized perforation. Afterwards this paper was cut to act as a framework, with a notch-shaped incision at the portion facing the manubrium. Then, we prepared a cartilage graft that is approximately 2 mm wider than the measured size and grooved the edges of the graft with a scalpel no. 11 to form 1–2-mm-sized wings that would hold the both sides of the remnant membrane. The notch for manubrium was cut out as the shape of a cake slice. We prepared a slightly deeper groove on the side of the manubrium. The wings of the prepared graft were then placed in the medial, and lateral sides of the perforation. The steps of the surgical procedure are presented in Fig. 1. Afterwards, an antibiotic pack of only 2–3 cm was placed in the external auditory canal.

Postoperative follow-up of patients

Patients were discharged either on the postoperative same day or 1 day later. The pack in the external auditory canal was removed after 1 week. If there was no discharge in the ear, no additional treatment was given. Then, controls were performed in the first, third and sixth months and 1 year.

Provided that there was not any problem at the first year, controls continued annually. We recorded graft problems with endoscope in addition to the audiological evaluations at each control.

Audiological evaluation and statistical analysis

Pure tone audiometry results were evaluated according to guidelines of the Committee on Hearing and Equilibrium [9]. According to these guidelines, postoperative air–bone gap (ABG) values were categorized and evaluated as 0–10 dB, 11–20 dB, 21–30 dB, and > 30 dB. Mean values of pure-tone air and bone conduction thresholds at 0.5, 1, 2 and 4 kHz were calculated from pre- and postoperative pure-tone audiometry at the sixth month follow-up visit. The difference between air and bone averages was used to calculate ABG. In addition, hearing gain was calculated from pre- and postoperative ABG values, and change of high-tone bone conduction levels were noted at 4 kHz. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 20.0 (SPSS Inc.; Chicago, IL, USA). Pre- and postoperative ABGs were analyzed by *t* test.

Results

Twenty-three patients (3 bilateral) and 26 ears were included in our study. 12 (52.1%) of the patients were female and 11 (47.9%) were male. The mean age was 35.4 ± 15.2 years (13–64). The operated ears included 7 (30.4%) right, 13 (56.5%) left and 3 (13.1%) bilateral. The mean follow-up period was 13.3 ± 7.1 (6–32) months.

Postoperative otitis media, iatrogenic cholesteatoma, retraction pocket, graft rejection and lateralization or medialization of the graft were not observed in any of our patients. Anatomic closure was achieved in all patients except 1 patient in the follow-up after 1 month. In this patient, discharge was observed when the external ear pack was removed at the postoperative first week and topical treatment with 0.3% ciprofloxacin was applied for 5 days. After the treatment, the suppuration discontinued, but at the first month follow-up visit, we observed a perforation in the posterior of the graft. We did not document any permanent perforation in remaining patients during the follow-up period and the anatomic graft success rate was 96%.

The preoperative mean ABG was 21.4 dB and postoperative mean was 14.4 dB. Significant improvement was observed in postoperative ABG (p 0.005). Postoperative mean hearing gain was 6.5 dB and postoperative mean change of high-tone (4 kHz) bone conduction level was 2.1 dB. Postoperative ABG results are presented in detail in Table 1.

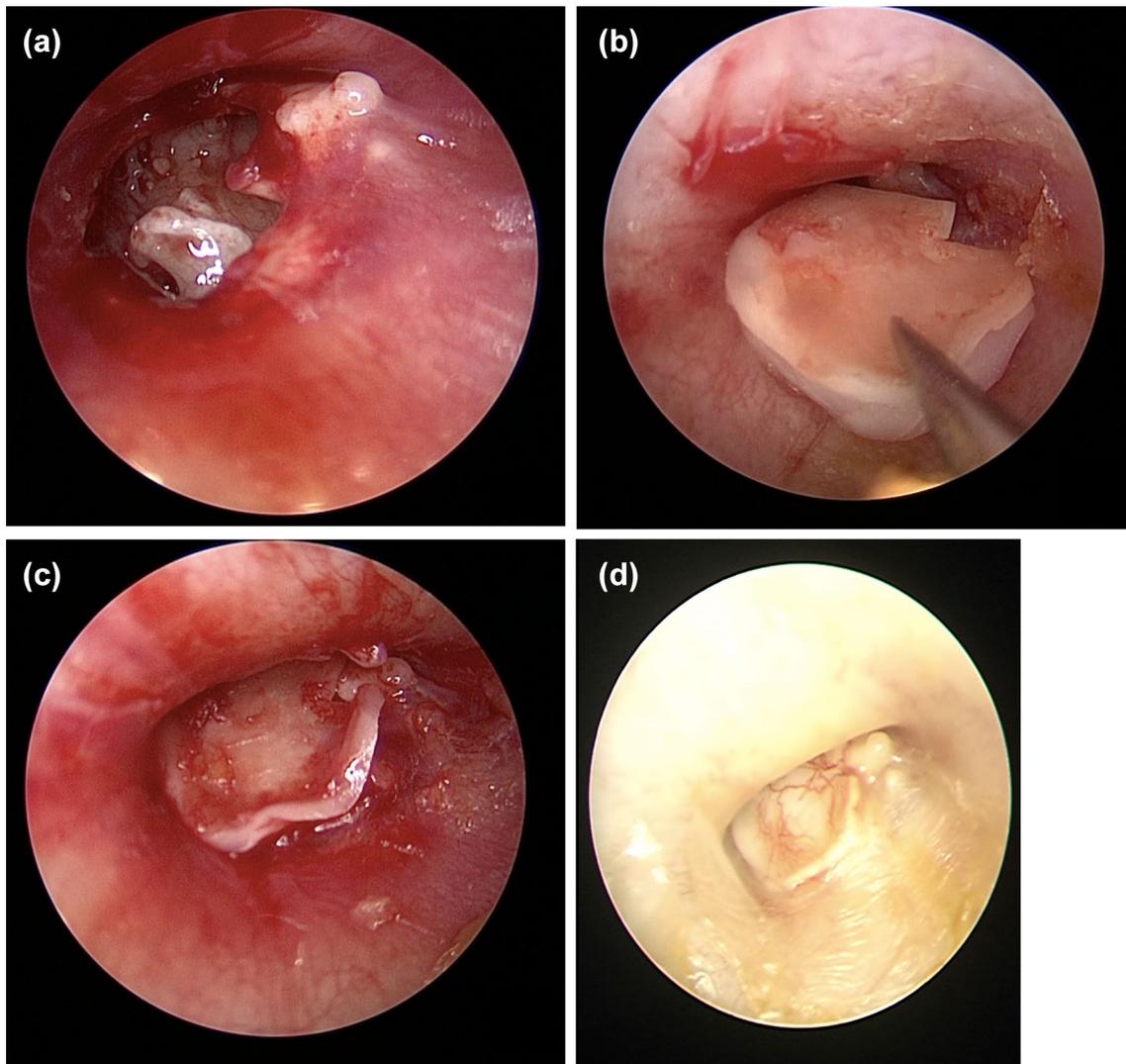


Fig. 1 Desepithelized subtotal perforation (a), cartilage graft prepared matching to perforation size and notched for manubrium (b), placement of graft at perforation site (c), and postoperative sixth month image of the patient (d)

Table 1 Categorized results of the postoperative air–bone gap, postoperative hearing gain, and change of high tone (4 kHz) bone conduction values of categorized patients according to the American Academy of Committee on Hearing and Equilibrium guidelines

	0–10 dB	11–20 dB	21–30 dB	> 30 dB	All patients
Postoperative air–bone gap, <i>n</i> (%)	9 (34.6)	9 (34.6)	5 (19.2)	3 (11.6)	14.4 (2.5–35) dB (mean, min–max)
Hearing gain (dB), mean \pm SD (min–max)	7.1 \pm 3.8 (3–14)	7.2 \pm 4.4 (3–16)	6.6 \pm 3.3 (3–13)	5.3 \pm 1.5 (4–7)	6.5 \pm 4.5 (3–16)
Change of high-tone bone conduction (dB), mean \pm SD (min–max)	2.6 \pm 2.7 (0–7)	2.2 \pm 2.3 (0–6)	1.6 \pm 2.0 (0–5)	2.3 \pm 2.5 (0–5)	2.1 \pm 2.4 (0–7)

SD standard deviation, *min* minimum, *max* maximum

Discussion

Butterfly inlay myringoplasty is a procedure with increasing popularity due to good anatomical success rates and audiological outcomes. It is also preferred in large perforations with graft success rates above 90%, but these are the data of conventional microscopic surgical procedures [3, 8]. We achieved successful anatomical and functional results with endoscopic butterfly inlay myringoplasty for large perforations. Our graft success rate was 96%, postoperative mean ABG was 14.4 dB and hearing gain was 6.5 dB. As far as we know, this study is the first to present the results of the patient series using the endoscopic butterfly inlay myringoplasty procedure for large perforations.

The use of endoscopes in otologic surgeries has been very popular recently. Providing a wide viewing angle, better evaluation of anterior tympanic membrane quadrant, and no need for postauricular incision are the main advantages [4, 10]. Therefore, endoscope is used directly in most otologic surgical procedures, and sometimes it is preferred as a complementary to the microscope.

The use of the endoscope for otologic surgery is relatively recent and the endoscopic procedure for butterfly inlay myringoplasty has recently been described in small- and medium-size perforations [11, 12]. However, the number of studies presenting the results of endoscopic butterfly myringoplasty is limited. Looking at the success rates of graft, Akyigit et al. reported 93.7% [4], Ozgur et al. reported 97.8% in the early period and 95.6% in the late period [5], Karabulut et al. in their series of 56 patients, reported success rate of 98.2% in the early period, and 94.6% in the late period [7], and Eren et al. reported 95.5% [10]. In our study, the graft success rate was 96% similar to the findings of these studies, however, all our patients had large perforations.

Postoperative audiological outcomes were successful after endoscopic butterfly myringoplasty. When the postoperative audiological results were examined in postoperative ABG values, Akyigit et al. reported 8.8 dB in the early period and 7.9 dB in the late period [4], Ozgur et al. reported 9.8 dB in the early period and in 9.1 dB the late period [5], Karabulut et al. reported 20.8 dB in the early period and 12.4 dB in the late period [7], and Eren et al. reported 10.8 dB [10]. In our study, postoperative ABG was 14.4 dB, which was slightly higher than the findings of these studies. This may be related to the larger tympanic membrane perforations of patients in our study.

Theoretically, it is thought that the squamous epithelium in the superficial layer of the tympanic membrane may pass into the middle ear and cause iatrogenic cholesteatoma. However, considering the results of both

endoscopic and microscopic surgeries over the years, no such problem was encountered [3–5]. We also did not observe any cholesteatoma in any of the patients during the follow-up period. We may speculate that despite large perforations, cholesteatoma formation can be prevented by adequate refreshing and complete peeling of the epithelium on the malleus. However, the mean follow-up period was 13.3 months in our study, so we cannot be sure without follow-up durations exceeding 2 years.

Bilateral butterfly tympanoplasty has several advantages in the same session. First, the cartilage graft for both sides can be taken from the first operated side only. This reduces both the number of skin incisions and operation time. Second, the patient experiences a postoperative recovery period once only. Third, time is saved compared to the operations performed in separate sessions. Graft success rates are also high [13]. In our study, 3 patients underwent bilateral butterfly inlay myringoplasty at the same session. Graft was successful in all patients and no postoperative complications were observed. However, because the perforations were large, unilateral tragal cartilage could be used bilaterally only in 1 patient. In the two other patients, tragal cartilage was obtained from both ears.

The condition of middle ear and ossicles can easily be observed through perforation with the help of endoscope in large perforations. Furthermore, with the wide angle view provided by the endoscope, all quadrants of the perforation can be mastered. Therefore, it is possible to successfully perform butterfly inlay myringoplasty in large perforations with the notch grooved for the manubrium. Our study shows that both the postoperative anatomic graft success and the hearing outcomes of the butterfly inlay myringoplasty in large perforations are satisfactory.

The main limitation of our study is the low number of cases. In addition, we lack a comparative arm with a different surgical technique for large perforations. Lastly, follow-up duration is slightly shorter for long-term complications including cholesteatoma.

Conclusion

Endoscopic butterfly inlay myringoplasty seems to be safe and successful in large perforations. Our study documented several advantages including over 95% graft success rate, good hearing gain, low complication rate, short surgical time and minimal postoperative discomfort.

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Compliance with ethical standards

Conflict of interest All the authors declare that they have no conflict of interest.

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