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## Abstract

**Introduction:** Tympanic membrane perforation(TMP) is a common cause of visits to the otolaryngology clinic. For decades, various surgical methods and various grafts have been used to treat TMP. This study aimed to compare the efficacy of Butterfly Dermal Allograft(BDA) and Fat myringoplasty for the treatment of TMP.

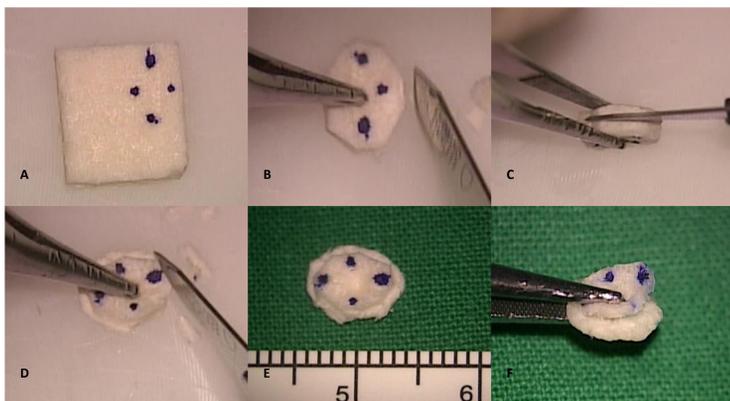
**Methods:** We retrospectively analyzed 40 patients who underwent BDA (n = 20) and Fat myringoplasty (n = 20) for tympanic membrane perforation performed by a single surgeon between January 2019 and December 2021. The hearing outcomes, graft success rate, complications, operation time and hospital stay were recorded and compared between groups. Hearing outcomes were determined by pure-tone audiometry.

**Results:** There was no significant difference between the BDA and Fat groups regarding demographic characteristics. There was no significant difference in the pre- and post-operative air conduction, bone conduction thresholds, and air-bone gap values between the two groups, but a significant audiologic improvement was observed in both groups ( $p < 0.05$ ). In terms of recurrence of tympanic membrane perforation, postoperative otorrhea, and discomfort symptoms, there was no significant difference between groups( $p > 0.05$ ). The operation time and hospital stay were shorter in the BDA group than in the Fat group ( $p < 0.05$ ).

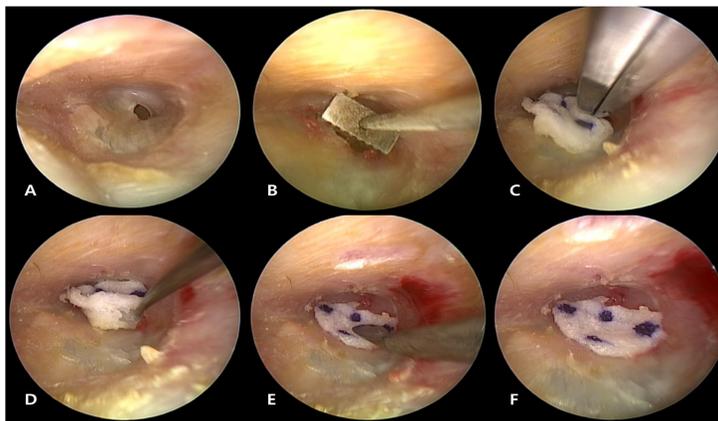
**Conclusions:** BDA myringoplasty is as safe and medically efficacious as Fat myringoplasty, shortens the operation time and hospital stay.

## Introduction

Tympanic membrane perforations (TMP) are common in otology and require surgical repair when they don't heal on their own. Various graft materials and techniques have been used for TMP repair, including fat tissue myringoplasty. Fat myringoplasty is advantageous due to easier graft harvesting and simple outpatient procedures. However, it has limitations in large perforations and anterior perforations, and it involves incisions and potential infections. Cartilage grafts have also been used for tympanoplasty, and AlloDerm<sup>®</sup> showed promise in animal and human studies. To overcome limitations of fat myringoplasty and Inlay tympanoplasty with AlloDerm<sup>®</sup>, a butterfly-shaped graft using acellular dermal allograft (BDA) is introduced. This study compares the outcomes of BDA myringoplasty using MegaDerm<sup>®</sup> to fat tissue myringoplasty, offering a novel approach for TMP repair.



**Fig. 1.** Images showing the steps of butterfly dermal allograft preparation: (A) A design drawn according to the size of the perforation on the MegaDerm<sup>®</sup> (L & C BIO Corp., Korea). (B) A MegaDerm<sup>®</sup> that had been cut 1-2 mm larger than the size of the perforation. (C) The edges are engraved using an 11-blade scalpel. (D) The size of the lateral side is made smaller than the size of the medial side. (E) and (F) Fully prepared MegaDerm<sup>®</sup> grafts.



**Fig. 2.** A) Tympanic membrane perforation prior to surgery. (B) After margin trimming, the size of the tympanic perforation was measured using a ruler. (C) Using alligator forceps, the medial side of the MegaDerm<sup>®</sup> graft was inserted into the middle ear cavity. (D) Using a pick, the medial side was finely inserted into the middle ear cavity. (E) Using a right-angled pick and a duckbill, the lateral side was arranged so that it touched the outer surface of the TM (F) Postoperative endoscopic images of Megaderm butterfly graft.

## Methods and Materials

We retrospectively analyzed patients who underwent a transcanal endoscopic myringoplasty with BDA or a transcanal endoscopic myringoplasty with ear lobule fat tissue between January 2019 and December 2021 at a tertiary academic medical center. Pre and postoperative pure tone audiometry (PTA) was performed to determine the air and bone conduction (BC) thresholds and air-bone gap (ABG) values. We have also performed speech audiometry before surgery and measured the size and area of the perforation.

### \* Surgical Technique (Megaderm butterfly allograft) :

We began by refreshing the margins of the TM perforation using a pick. Next, we shaped the MegaDerm<sup>®</sup> to be 2 mm wider than the diameter of the TM perforation (as shown in Figure 1B). Using a number 11 blade scalpel, we made a 1 mm deep incision along the circumferential border of the BDA graft, creating the distinctive butterfly shape (depicted in Figure 1C). To ensure ease of insertion, we deliberately made the lateral side of the MegaDerm<sup>®</sup> graft smaller than the medial side, allowing for direct inspection and insertion of the medial side into the middle ear cavity (illustrated in Figures 1D–1F). The insertion process involved the medial side of the MegaDerm<sup>®</sup> graft being carefully placed into the middle ear cavity using a pick and right-angled pick, while the lateral side of the MegaDerm<sup>®</sup> remained situated in the external auditory canal area, as depicted in Figures 2A–2F.

## Results

The surgical and functional results of 40 patients who underwent BDA myringoplasty (n = 20) and fat myringoplasty (n = 20) were analyzed and assigned to the BDA group and fat group, respectively. There was no significant difference in the pre and postoperative PTA measurements between the groups (Tables 2 and 3), but a significant audiological improvement was observed postoperatively in both groups ( $p < 0.05$ ).

The duration of surgery was significantly shorter in the BDA group than in the fat group ( $p < 0.05$ ). The average hospital stay was  $2.10 \pm 0.72$  and  $1.70 \pm 0.47$  days in the fat and BDA groups, respectively. After  $\geq 3$  months' follow-up, one (5.0%) and zero (0.0%) patients had experienced recurrent perforation in the fat and BDA groups, respectively. There was no significant difference between the groups in terms of recurrent perforation rates ( $p > 0.05$ ).

**Table 1.** Comparison of audiological outcomes (Pre vs. Post)

	Butterfly dermal allograft group			Fat group		
	Preop	Postop	p-value*	Preop	Postop	p-value*
AC (dB)	31.04 ± 13.01	17.50 ± 7.86	0.001	29.08 ± 20.12	18.42 ± 11.53	0.001
BC (dB)	8.88 ± 6.73	7.66 ± 5.50	0.009	11.71 ± 12.43	9.42 ± 9.48	0.009
ABG (dB)	22.16 ± 9.78	9.83 ± 5.11	0.001	17.38 ± 10.76	9.00 ± 7.19	0.413

**Table 2.** Comparison of postoperative complications, operation time, and admission duration.

	Butterfly dermal allograft group	Fat group	p-value
Graft closure Rate (%)	20/20 (100.0)	19/20 (95.0)	0.677
<b>Complications</b>			
Re-perforation (%)	0 (0)	1 (5.0)	0.677
Otorrhea (%)	0 (0)	3 (15.0)	0.072
Otalgia (%)	0 (0)	0 (0)	1.000
Donor site complications (%)	0 (0)	1 (5.0)	0.311
Re-operation (%)	0 (0)	1 (5.0)	0.311
Granulation tissue (%)	0 (0)	0 (0)	1.000
Operation time (minutes)	39.85 ± 6.44	50.85 ± 13.52	0.002
Admission duration (days)	1.70 ± 0.47	2.10 ± 0.72	0.044

## Discussion

Otitis media with tympanic membrane perforation (TMP) is a common condition treated in otolaryngology, involving various graft materials and surgical techniques. Fat tissue myringoplasty is commonly used for its simplicity and effectiveness but has limitations in treating medium to large TMPs. Butterfly cartilage myringoplasty, introduced by Eavey in 1998[1], offers an alternative for larger perforations, particularly in the anterior quadrant.[2] However, both methods have drawbacks, including donor site damage and limited graft material.[3]

In this study, a novel approach was used by creating a butterfly graft using MegaDerm<sup>®</sup> to capitalize on its high engraftment rate and efficacy for small to medium TM perforations.[4] Comparatively, fat myringoplasty had a lower success rate than perichondrium or fascia. Additionally, endoscopic butterfly inlay myringoplasty showed similar success rates to other techniques, with shorter operation times. Acellular allograft dermal matrix emerged as a promising alternative for TMP treatment, with similar results to autografts.[5]

This study introduced butterfly myringotomy using an acellular dermal allograft, simplifying the procedure and potentially reducing surgery time and hospital stay compared to fat myringoplasty. While this study had limitations in sample size, follow-up duration, and comparisons with cartilage butterfly myringoplasty, it suggests a promising avenue for further research in TMP treatment.

## Conclusions

In conclusion, Butterfly dermal-allograft myringoplasty shortens the operation time and hospitalization period compared to fat myringoplasty. Further, the hearing improvement and complications associated with Butterfly dermal-allograft myringoplasty were similar to those associated with fat myringoplasty. Therefore, Butterfly dermal-allograft myringoplasty is a safe and efficacious surgical procedure for the treatment of TMP.

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