Gulf Journal of Medical Sciences
FE Gulf Publishers
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An empirical study of success rate of the butterfly technique among patients from Peshawar, Pakistan

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Article Info

Volume No: 1 **Issue No:** 1 **Page No:** 36-41

Received: 01-02-25 **Accepted:** 15-04-25 **Published:** 30-05-25

Abstract

Tympanoplasty is widely used as a treatment for minor perforations and has been practiced since ancient times using the available tools of that era. However, this technique has been criticized for certain drawbacks, including prolonged hospital stays, increased morbidity, and post-operative scarring. This has led to the need for a more refined approach. The aim of this study is to evaluate the clinical and audiometric success rates of the tragal cartilage plug or butterfly technique tympanoplasty. A total of 30 patients, aged between 16 and 55 years, were included in the study. The findings revealed that 27 out of 30 patients had successful graft uptake, while the remaining 3 experienced residual perforations, resulting in an overall success rate of 90%. Anatomical success was determined through otoscopy, confirming proper graft placement. Functional success was evaluated using audiograms, which showed a reduction in the Air-Bone (A-B) gap in 25 patients (83.3%). Based on these results, this tympanoplasty technique may be considered a viable alternative for repairing tympanic membrane perforations.

Keywords: Tympanoplasty, Butterfly Technique, Tragal Cartilage.

INTRODUCTION

Initially, Zollner (Zoellner, 1955) and Wullstein (Wullstein, 1952) described the major types of tympanic membrane perforations, and it has remained a topic of debate since then. The surgical repair of these perforations involves several variations, mainly based on the graft materials used. These materials range from fat or adipose tissue, tragal or conchal cartilage, and perichondrium to the most commonly used temporalis fascia. Additionally, there are three primary approaches to tympanoplasty: interlay, overlay, and underlay techniques.

While tympanoplasty is generally effective, it does have some drawbacks. One significant disadvantage is the requirement to elevate the tympanomeatal flap, which increases patient

morbidity and the need for extensive post-operative care. An alternative approach is the transcanal tragal cartilage plug tympanoplasty using Eavey's butterfly technique (Eavey, 1998). This method avoids the need for tympanomeatal flap elevation, thereby reducing common complications such as prolonged hospital stays, bleeding, pain, and increased morbidity. The rigidity of the cartilage and the locking edges provide enhanced graft stability.

This study aims to evaluate the anatomical success of this technique by assessing the rate of complete perforation closure and its functional success through post-operative hearing improvement measured by audiometry. Furthermore, the results will be compared with those of tympanoplasties using other graft materials.

MATERIAL AND METHODS

This study is a one-year prospective investigation conducted at a hospital in Peshawar, Pakistan to evaluate the outcomes of the endoscopic transcanal "cartilage plug or butterfly" underlay cartilage tympanoplasty technique in patients with small to medium-sized central tympanic membrane perforations. The inclusion criteria included the presence of a single or double quadrant small to medium-sized central perforation with clearly visible borders, a dry ear for at least three months, the absence of cholesteatoma, an age range between 16 and 25 years, and a preoperative audiogram showing an air-bone gap (ABG) without sensorineural hearing loss. Based on these criteria, 30 patients were selected for the study.

All patients underwent a thorough general and otorhinolaryngological examination, including audiometry and, when required, a CT scan along with other preoperative assessments. The outcomes were evaluated based on the closure of the perforation, post-operative hearing improvement assessed through audiometry at 3 and 6 months, and the presence of any post-operative complications. Follow-up was conducted for a period of 6 months after surgery to monitor patient progress and detect any issues. Statistical analysis of the results was performed using the Chi-square test with correction by Fisher's exact test.

Technique

In most cases, general anesthesia was administered before performing the surgery to maintain uniformity and facilitate the procedure as a day-care case. A 0°, 2.7 mm rigid otoendoscope was used to visualize the perforation edges clearly. An angled pick was then utilized to freshen the edges of the perforation. To accurately measure the size of the perforation and outline its margins, methylene blue solution was applied, and the edges were marked using a Jobson Horne probe. This meticulous preparation ensured precise assessment and improved the success of the tympanoplasty procedure.

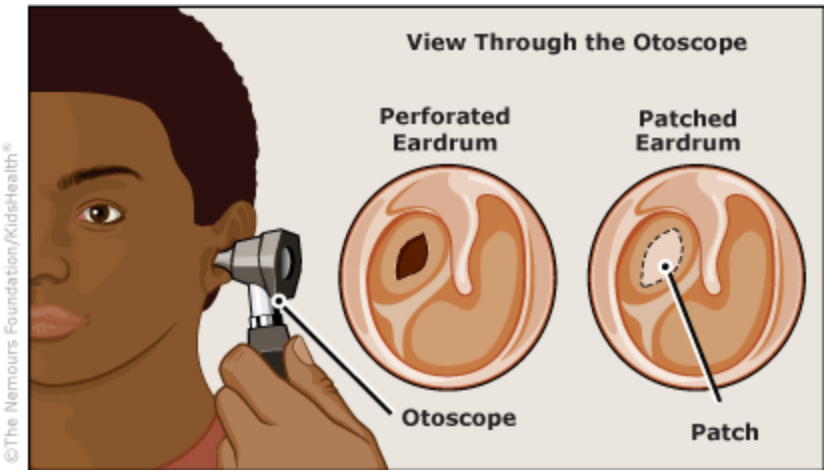

Figure 1: Tympanoplasty

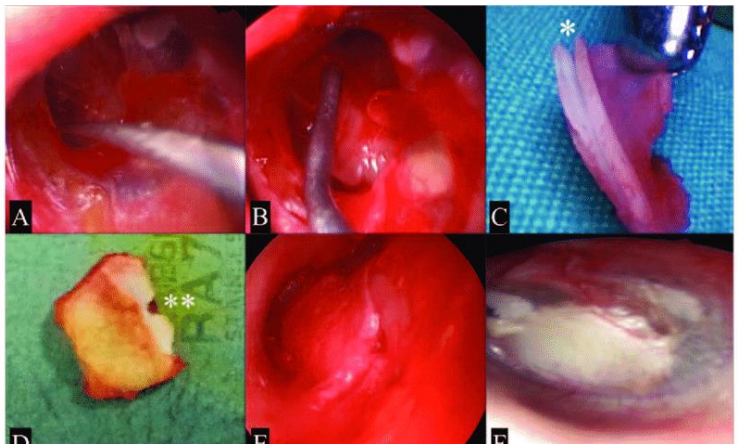

Figure 2: Procedure

The next stage involved imprinting the perforation to obtain a dry gel foam piece and a mold of the appropriate size [Fig. 2]. A small incision, approximately 1.5 centimeters in length, was made across the tragus using a size 15 scalpel blade. An island of cartilage, covered with perichondrium on both sides and approximately 2 mm larger than the freshened perforation, was then harvested.

The harvested graft was held vertically between the thumb and forefinger. While rotating the graft, a 1 mm deep groove was carefully created along the circumferential border of the cartilage disc using the same size 15 scalpel blade. This groove allowed the cartilage flanges to spring open. The separation of the two cartilage surfaces resembled the shape of a "butterfly," giving the technique its name [Fig. 3]. After the graft was prepared, the skin incision on the tragus was closed using 3-0 mersilk sutures.

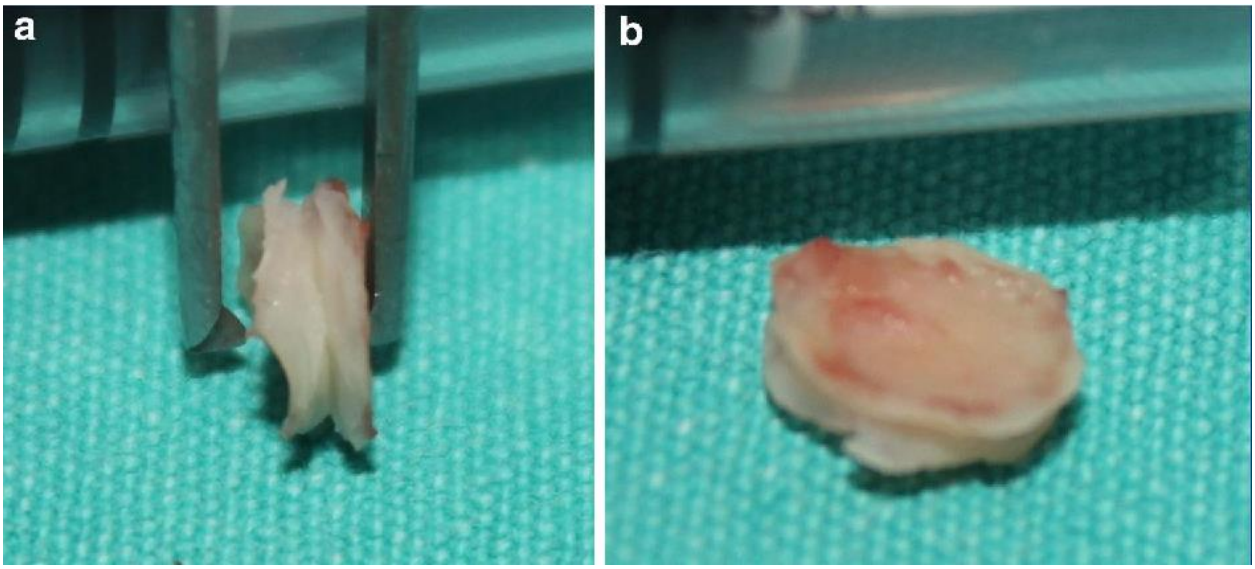

Figure 3: Butterfly technique of two cartilage

The graft was carefully held with crocodile forceps and inserted transcanally, positioning it over the perforation. The groove in the cartilage was aligned with the anterior rim of the perforation, allowing the medial flange to sit medial to the tympanic membrane. The remaining portion of the graft was then adjusted so that the tympanic membrane rested securely within the groove of the cartilage graft, resembling the placement of a grommet. To ensure the graft was properly locked onto the perforation, gentle manipulation was performed using a ball probe. A thin layer of gel foam soaked in antibiotic solution was placed over the graft, and a cotton ball was used to seal the external auditory canal. This step helped secure the graft and promote healing.

RESULTS

The demographic results of the study show that 23 male and 7 female patients participated, with an average age of 32 years and an age range of 16 to 55 years. Among the 30 patients, successful graft uptake was observed in 27 cases, while 3 patients experienced residual perforation, resulting in an overall success rate of 90%. Anatomical success was evaluated through otoscopy, confirming proper graft placement. Functional success was assessed using pure tone audiometry (PTA), which revealed a reduction in the Air-Bone (A-B) gap in 25 patients (83.3%). The decrease in the A-B gap was greater than 20 dB, with a preoperative average of 33.75 dB and a postoperative average of 13.5 dB, showing statistically significant improvement ($p < 0.05$).

Among the 5 patients who showed no improvement, including the 3 cases of graft failure, all were in the older age group of 51 to 55 years, indicating a possible correlation between age and surgical outcomes.

Of the 3 patients with persistent perforation, 2 developed upper respiratory tract infections during the immediate post-operative period, which led to discharge in the external auditory canal. In the remaining case, the graft was found lying within the external auditory canal. Patients were instructed to attend follow-up visits weekly during the first month after surgery and then on a monthly basis for the following six months to monitor their recovery and detect any complications.

Discussion

Wullstein (Wullstein, 1952) introduced the concept of different types and techniques of tympanoplasty, which has since become a widely studied topic. Over time, several variations of the technique have emerged, particularly in the choice of graft materials. Commonly used graft materials include conchal cartilage, tragal cartilage, tragal perichondrium, and temporalis fascia (Eviatar, 1978). These variations aim to improve surgical outcomes and address specific patient needs.

Tragal perichondrial graft and temporalis fascia are closely matched with the tympanic membrane and provide good results both functionally and anatomically (Dhabolkar, Vora, & Sikdar, 2007). For instance, a study (Parida, & Nochikatil, 2011) showed that the graft uptake rate with tragal perichondrium was 80%, while the postoperative graft uptake rate with temporalis fascia was about 85%. Another study reported a success rate of 83% using homologous temporalis fascia (Ahad, 1986). There are also several studies based on tragal cartilage graft. For example, a study by Sozen (Sözen, Orhan, Uçal, Tansuker, Uslu, Coşkun, Yasemin, Korkut, & Dadaş, 2012) involving 246 patients compared tympanoplasties using temporalis muscle, tragal cartilage, and conchal cartilage, reporting a success rate of more than 80% for all three techniques. Another study (Dündar, Soy, Kulduk, Muluk, & Cingi, 2014) reported a 95% success rate using a boomerang-shaped chondroperichondrial graft. Similarly, a study reported a 93% graft uptake rate using a composite graft consisting of perichondrium and the peripheral ring of tragal cartilage (Debasish, Arindam, Sayan, & Arunabha, 2018). This body of research demonstrates that both tragal cartilage and temporalis fascia are effective graft materials, consistently achieving high anatomical and functional success rates in tympanoplasty.

A new technique called cartilage plug or butterfly cartilage tympanoplasty has been introduced and is considered to be pioneered by Eavey in 1998. Based on this technique, the graft functions as a membrane with the aim of making the ear safe and improving hearing. An expert Ghanem (Ghanem, Monroy, Alizade, Nicolau, & Eavey, 2006) suggests that the butterfly technique or cartilage plug instantly locks the graft provided by the tympanoplasty, making it an effective approach. The butterfly edges reduce concerns about graft safety in terms of functional and anatomical displacement and lateralization, leading to a higher success rate in tympanic membrane perforation closure and ensuring the ear remains safe. The benefit of this technique is that it bypasses the need for traditional perforation closure with cartilage plugs. A study (Testa, Teixeira, Ribeiro, Pizarro, & Millas, 2002) mentioned that this technique is associated with decreased morbidity and a success rate of above 95%.

CONCLUSION

The study was aimed to determine the clinical and audiometric success rate of new tragal cartilage plug or butterfly technique tympanoplasty. Based on the study of 30 patients with suitable inclusion criteria, the finding indicate that graft taken up was made by 27 patients out of 30 patients and we found overall success rate of 90%. In sum, our conclusion is that tympanoplasty method is a suitable method and can be used as a good alternative treatment for repairing tympanic membrane perforations.

References

Ahad, S.A. (1986). Myringoplasty using homologous temporalis fascia. *Indian Journal of Otology, 33,* 28-29.

Debasish, G., Arindam, D., Sayan, H., Arunabha, S. (2018). Maximising graft take-up in type 1 tympanoplasty using peripheral cartilage ring and perichondrium. *Indian Journal of Otolaryngology Head and Neck Surgery*, 70, 290-294.

Dhabolkar, J., Vora, K., Sikdar, A. (2007). Comparative study of underlay tympanoplasty with temporalis fascia and tragal perichondrium. *Indian Journal of Otolaryngology Head and Neck Surgery, 59*(2), 116-119.

Dündar, R., Soy, F.K., Kulduk, E., Muluk, N.B., Cingi, C. (2014). A new grafting technique for tympanoplasty: Tympanoplasty with a boomerang-shaped chondroperichondrial graft (TwBSCPG). *European Archives of Oto-Rhino-Laryngology, 271*, 2687-2694

Eavey, R.D. (1998). Inlay tympanoplasty; cartilage butterfly technique. *Laryngoscope, 108,* 657-661.

Eviatar, A. (1978). Tragal perichondrium and cartilage in reconstructive ear surgery. *Laryngoscope, 88*(S11), 1-23.

Ghanem, M.A., Monroy, A., Alizade, F.S., Nicolau, Y., Eavey, R.D. (2006). Butterfly cartilage graft inlay tympanoplasty for large perforations. *Laryngoscope, 116,* 1813-1816.

Lubianca-Neto, J.F. (2000). Inlay butterfly cartilage tympanoplasty (Eavey technique) modified for adults. *Otolaryngol Head Neck Surg, 123*(4), 492-494.

Parida, P.K., Nochikatil, S.K. (2011). A Comparative Study of Temporalis Fascia Graft and Vein Graft in Myringoplasty. *Indian Journal of Otolaryngology Head and Neck Surgery,* 0543-0544.

Rizer, F.M. (1997). Overlay versus underlay tympanoplasty. part 11: the study. *Laryngoscope, 107,* 115-118.

Sözen, E., Orhan, Uçal, Y., Tansuker, H.D., Uslu, Coşkun, B., Yasemin, Korkut, A., Dadaş, B.(2012). Is the tragal cartilage necessary for type 1 tympanoplasties? *Journal of Craniofac Surgery, 23*, e280-283.

Testa, J.R.G., Teixeira, M.S., Ribeiro, K.M., Pizarro, G.U., Millas, I. (2002). Cartilagem tragal com pericôndrio em timpanoplastias. *Revista Brasileira de Otorrinolaringologia (Brazilian Journal of Otolaryngology).68*(5), 920-925.

Wullstein, H.L. (1952). Functional operations in the middle ear with split-thickness skin graft. *Arch Otorhinolaryngol,161*, 422-435.

Zoellner, F. (1955). The principles of plastic surgery of the sound-conducting apparatus. *The Journal of Laryngology & Otology, 69*, 567-569.