International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 1, January 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.1.2025.78

ORIGINAL RESEARCH

Surgical Outcomes of Tympanoplasty with Various Graft Materials in Chronic Otitis Media

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Received: 17 November, 2024 Accepted: 25 December, 2024 Published: 23 January, 2025

ABSTRACT

Aim: To evaluate and compare the surgical outcomes of tympanoplasty using temporalis fascia, cartilage, and perichondrium graft materials in patients with chronic otitis media. **Material and Methods:** This prospective study included 90 patients with chronic otitis media, divided into three groups of 30 each based on the graft material used: temporalis fascia (Group A), cartilage (Group B), and perichondrium (Group C). Patients underwent tympanoplasty using a standardized postauricular approach. Surgical outcomes were assessed through graft success rates, hearing improvement, and postoperative complications. Statistical analysis was conducted using SPSS version 25.0, with significance set at $p < 0.05$. **Results:** Graft success rates were 86.67% in Group A, 90.00% in Group B, and 93.33% in Group C, with no statistically significant difference ($p = 0.58$). The mean hearing improvement was highest in Group C (16.55 dB) compared to Groups A and B (14.95 dB each), though not statistically significant ($p = 0.49$). Postoperative complications, including infection and residual perforation, were low and comparable across all groups ($p > 0.05$). Multiple regression analysis identified graft material ($p < 0.05$) and preoperative air-bone gap ($p = 0.05$) as significant predictors of surgical outcomes. **Conclusion:** Tympanoplasty using all three graft materials demonstrated high success rates and significant hearing improvement, with perichondrium showing a slight advantage in outcomes. The low complication rates across groups affirm the safety of these materials, emphasizing the importance of tailored graft selection based on individual patient factors.

Keywords: Tympanoplasty, Chronic otitis media, Temporalis fascia, Cartilage graft, Perichondrium

INTRODUCTION

Chronic otitis media (COM) is a common and persistent middle ear condition characterized by recurrent or persistent infection, inflammation, and perforation of the tympanic membrane. This condition often leads to hearing impairment, otorrhea, and, in some cases, significant complications such as cholesteatoma, ossicular chain erosion, and intracranial infections. The primary goal in managing COM is to restore the anatomical integrity of the tympanic membrane and improve hearing while preventing recurrence of infection or further complications. Tympanoplasty, a surgical procedure to repair the tympanic membrane and reconstruct the middle ear, has long been established as a cornerstone of treatment for patients with COM.[1]Tympanoplasty aims to achieve two fundamental outcomes: a successful closure of the tympanic membrane perforation and a measurable improvement in hearing. The procedure involves the use of graft materials to reconstruct the tympanic membrane and, in some cases, the ossicular chain. Over the years, various graft materials have been utilized, with the choice largely dependent on the surgeon's preference, the size and location of the perforation, and patient-specific anatomical considerations. Among the most commonly used graft materials are temporalis fascia, cartilage, and perichondrium. Each of these materials offers distinct advantages and challenges, making it crucial to understand their individual characteristics and their impact on surgical outcomes.[2] Temporalis fascia has been the most widely used graft material for decades due to its accessibility, ease of harvest, and favorable handling properties. Its thin, pliable structure allows for excellent adaptation to the tympanic membrane defect, and it is known to integrate well with the surrounding tissue during the healing process. However, temporalis fascia grafts may lack the rigidity needed to resist retraction or atrophy in cases of larger or subtotal perforations or in patients with compromised Eustachian tube function.[3] Cartilage has gained popularity as an alternative graft

Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.1.2025.78

material in tympanoplasty, particularly in cases where structural support and resistance to retraction are critical. Harvested from the tragus or conchal cartilage, this material provides additional rigidity while maintaining good biocompatibility. Cartilage grafts are often used in patients with recurrent perforations, anterior perforations, or atelectatic tympanic membranes, where the risk of graft failure is higher. However, the increased thickness of cartilage grafts may affect sound conduction, leading to concerns about potential compromise in hearing outcomes.[4]Perichondrium, the fibrous connective tissue layer surrounding cartilage, is another commonly used graft material. It is often harvested along with cartilage or used separately, depending on the surgical approach and the surgeon's preference. Perichondrium offers a balance between the pliability of temporalis fascia and the rigidity of cartilage, making it an appealing option for certain clinical scenarios. Its ability to provide structural support while maintaining satisfactory hearing outcomes has been a subject of interest in recent studies.Despite the widespread use of these graft materials, there is ongoing debate about their relative effectiveness in achieving optimal surgical and functional outcomes. Key considerations include graft success rates, hearing improvement, resistance to retraction, and the incidence of postoperative complications such as infection, residual perforation, or graft displacement. Additionally, factors such as patient age, the size and location of the perforation, and the presence of comorbidities or Eustachian tube dysfunction can significantly influence the outcomes of tympanoplasty, making the choice of graft material a critical decision in surgical planning.[5] In evaluating the success of tympanoplasty, it is essential to consider both anatomical and functional outcomes. Anatomical success is defined by the complete closure of the tympanic membrane perforation and the absence of complications such as retraction pockets, lateralization, or extrusion of the graft material. Functional success, on the other hand, is measured by improvement in hearing, typically assessed through preoperative and postoperative audiometric testing. The air-bone gap, a key indicator of conductive hearing loss, is often used as a parameter to evaluate hearing improvement following tympanoplasty. The choice of graft material plays a pivotal role in achieving both anatomical and functional success, and understanding the nuances of each material is essential for optimizing patient outcomes.[6] The surgical approach also impacts the outcomes of tympanoplasty. While traditional microscopic techniques remain the standard of care, endoscopic tympanoplasty has emerged as an alternative approach in recent years. Endoscopic techniques offer advantages such as improved visualization of the middle ear structures, reduced surgical trauma, and shorter operative times. However, the choice of surgical technique is often influenced by the surgeon's expertise and the specific clinical scenario, further underscoring the complexity of decision-making in tympanoplasty.[7] Postoperative care and follow-up are integral to the success of tympanoplasty. Patients are typically advised to avoid water exposure to the operated ear and to adhere to a regimen of topical and systemic antibiotics to prevent infection. Regular follow-up visits are necessary to monitor graft integrity, assess hearing improvement, and address any complications. High follow-up compliance rates are essential for accurate evaluation of outcomes and for identifying factors that may influence surgical success or failure.[8]

MATERIAL AND METHODS

This study was conducted as a prospective clinical study to evaluate the surgical outcomes of tympanoplasty using various graft materials in patients with chronic otitis media. Ethical approval was obtained from the institutional ethics committee and written informed consent was obtained from all participants prior to enrollment.A total of 90 patients diagnosed with chronic otitis media were enrolled in the study. Patients were selected based on predefined inclusion and exclusion criteria.

Inclusion Criteria

1. Adults aged 18–65 years.
2. Diagnosed with chronic otitis media with tympanic membrane perforation.
3. Medically stable with no active ear discharge for at least four weeks before surgery.
4. Willing to provide informed consent and attend follow-up visits.

Exclusion Criteria

1. Presence of cholesteatoma or other middle ear pathology requiring mastoidectomy.
2. Previous middle ear surgeries.
3. Patients with systemic conditions affecting wound healing (e.g., diabetes mellitus, immunosuppressive disorders).
4. Patients unable to comply with the follow-up schedule.

Sample Size and Grouping

Patients were divided into three groups of 30 each, based on the type of graft material used during tympanoplasty:

- **Group A:** Temporalis fascia.
- **Group B:** Cartilage.
- **Group C:** Perichondrium.

Randomization was performed using a computer-generated randomization sequence to assign patients to one of the three groups.

Surgical Procedure

All surgeries were performed under general anesthesia to ensure patient comfort and optimal surgical conditions. The patients were positioned supine with

DOI: 10.69605/ijlbpr_14.1.2025.78

the head turned to the opposite side, providing easy access to the operative ear. The surgical field was thoroughly cleaned with povidone-iodine solution, and sterile drapes were applied to maintain a fully aseptic environment throughout the procedure.

A standard postauricular approach was utilized in all cases. An incision was made approximately 1 cm posterior to the postauricular sulcus. The skin and subcutaneous tissues were carefully elevated, exposing the underlying temporalis fascia, which was harvested when needed. The posterior canal wall skin flap was then elevated, allowing access to the tympanic membrane and middle ear structures.

The preparation of the graft materials varied according to the type of graft being used. For **temporalis fascia**, a small horizontal incision was made in the temporal region approximately 1.5–2 cm above the ear, and the fascia was harvested from the ipsilateral side. After carefully cleaning the fascia of any soft tissue attachments, it was allowed to dry slightly for better handling, and thinning was performed to ensure pliability. For **cartilage grafts**, the tragus or conchal bowl was used as the donor site. An incision was made behind the tragus to expose and excise the cartilage, with care taken to preserve sufficient perichondrium on one or both sides. The cartilage was then trimmed and shaped to match the size and shape of the tympanic membrane perforation. Its thickness was reduced as necessary to balance structural integrity and flexibility. **Perichondrium** was harvested either from the tragus or pinna. It was carefully separated from the cartilage and prepared as a standalone graft. To maintain flexibility, the perichondrium was hydrated in saline until placement.

The edges of the tympanic membrane perforation were meticulously freshened using a micro-sickle knife to promote proper graft adherence. Depending on the perforation's size and location, the graft was placed using one of two techniques. In the **underlay technique**, the graft was positioned medial to the remaining tympanic membrane and the malleus handle, which was the preferred method for larger or subtotal perforations. In the **overlay technique**, the graft was positioned lateral to the tympanic membrane to ensure adequate overlap with the perforation edges. This method was typically used for anterior perforations or revision surgeries.

During the procedure, the middle ear was thoroughly examined for adhesions, granulation tissue, or ossicular chain abnormalities. Any adhesions encountered were lysed, and granulation tissue was carefully removed. The ossicular chain was evaluated for mobility, and any abnormalities were documented.

The prepared graft material, whether temporalis fascia, cartilage, or perichondrium, was positioned over the perforation site with precision. Gel foam soaked in saline or antibiotic solution was placed in the middle ear to support the graft. Additional gel foam was positioned in the external auditory canal to stabilize the graft and prevent displacement during the early healing period.

The postauricular incision was closed in layers, with absorbable sutures used for the deeper layers and either non-absorbable sutures or skin glue used for the skin closure. A sterile mastoid dressing was applied to protect the surgical site and maintain a clean environment.

Postoperative care included strict instructions for patients to avoid water exposure to the operated ear until complete healing was confirmed. Antibiotics and analgesics were prescribed for one week to minimize the risk of infection and manage postoperative pain. Ototopical drops were initiated after the first postoperative visit, typically 1–2 weeks following surgery. Follow-up visits were scheduled at 2 weeks, 3 months, 6 months, and 12 months to evaluate clinical outcomes and audiometric improvements.

Patients were evaluated preoperatively and postoperatively at 3 months, 6 months, and 12 months to assess surgical and functional outcomes. The primary outcome measures included graft success rate, defined as intact tympanic membrane closure without re-perforation, and hearing improvement, which was evaluated using pure-tone audiometry and measured as a reduction in the air-bone gap. Additionally, postoperative complications such as infection, residual perforation, graft displacement, or lateralization were documented. Baseline demographic data, clinical history, and preoperative audiometric findings were recorded for all patients. Follow-up evaluations included audiometric tests and otoscopic examinations to monitor the integrity of the graft and overall functional improvement.

Statistical Analysis

Data were entered into statistical software, e.g., SPSS version 25.0 and analyzed. Continuous variables were expressed as means ± standard deviations, while categorical variables were presented as frequencies and percentages. Comparative analysis between groups was conducted using the chi-square test for categorical variables and one-way ANOVA for continuous variables. Statistical significance was set at a p-value of <0.05.

RESULTS

Table 1: Demographic Data of Patients

The demographic analysis showed no statistically significant differences among the three groups regarding age and gender distribution. The mean age of patients was 35.67 years in Group A (Temporalis Fascia), 37.25 years in Group B (Cartilage), and 36.80 years in Group C (Perichondrium) with a p-value of 0.78, indicating similar age profiles. Gender distribution was also balanced across the groups, with males accounting for 60.00%, 56.67%, and 50.00% in Groups A, B, and C, respectively (p = 0.65). This uniformity in demographic characteristics ensures comparability among the groups.

Online ISSN: 2250-3137
Print ISSN: 2977-0122
DOI: 10.69605/ijlbpr_14.1.2025.78

Table 2: Graft Success Rates

The graft success rate was highest in Group C (Perichondrium) at 93.33%, followed by Group B (Cartilage) at 90.00%, and Group A (Temporalis Fascia) at 86.67%. Although there was an observable trend favoring Group C, the differences were not statistically significant (p = 0.58). Conversely, graft failure rates were lowest in Group C at 6.67%, followed by Group B at 10.00%, and highest in Group A at 13.33%. These findings suggest that perichondrium may offer a marginal advantage in graft integrity over other materials.

Table 3: Hearing Improvement Data

The hearing improvement outcomes revealed no statistically significant differences between the groups. The mean preoperative air-bone gap was similar across the groups (p = 0.85), ranging from 29.80 dB in Group B to 30.50 dB in Group C. Postoperatively, the air-bone gap was reduced to 15.30 dB in Group A, 14.85 dB in Group B, and 13.95 dB in Group C, with a p-value of 0.63. The mean hearing improvement was highest in Group C (16.55 dB), followed by Groups A and B (14.95 dB each), though the difference was not statistically significant (p = 0.49). Hearing improvement percentages followed a similar trend, with Group C showing the highest improvement at 54.26%, indicating a potential clinical advantage of perichondrium grafts.

Table 4: Postoperative Complications

The postoperative complication rates were comparable among the groups. Infection occurred in 6.67% of patients in Group A, and in 3.33% of patients in Groups B and C, with no statistically significant difference (p = 0.81). Residual perforation was observed in 6.67% of patients in Groups A and B, and in 3.33% of patients in Group C (p = 0.90). Graft displacement was rare, with only one case each in Groups A and B and none in Group C (p = 0.70). Similarly, lateralization occurred in one patient (3.33%) in Group A and none in the other groups (p = 0.55). Overall, the complication rates were low and comparable across the groups, demonstrating the safety of all three graft materials.

Table 5: Follow-up Compliance Rates

Follow-up compliance was high in all groups, with rates of 90.00% in Group A, 93.33% in Group B, and 96.67% in Group C (p = 0.67). Non-compliance rates were correspondingly low, with 10.00%, 6.67%, and 3.33% in Groups A, B, and C, respectively. The high compliance rates across all groups ensured reliable assessment of outcomes.

Table 6: Multiple Regression Analysis of Factors Affecting Surgical Outcomes

The multiple regression analysis identified graft material as a significant predictor of surgical outcomes. Compared to temporalis fascia (reference group), cartilage had a positive coefficient (β = 0.12, p = 0.02), and perichondrium showed an even stronger association (β = 0.15, p = 0.004), indicating their superiority in achieving favorable outcomes. Preoperative air-bone gap also negatively influenced surgical outcomes (β = -0.02, p = 0.05), suggesting that larger preoperative gaps were associated with slightly poorer results. Other variables, including age (p = 0.62), gender (p = 0.45), and infection (p = 0.10), did not significantly affect outcomes.

Table 1: Demographic Data of Patients

Parameter	Group A (Temporalis Fascia)	Group B (Cartilage)	Group C (Perichondrium)	p-value
Mean Age (Years)	35.67	37.25	36.80	0.78
Gender				
Male (n)	18	17	15	0.65
Male (%)	60.00	56.67	50.00	
Female (n)	12	13	15	
Female (%)	40.00	43.33	50.00	

Table 2: Graft Success Rates

Parameter	Group A (Temporalis Fascia)	Group B (Cartilage)	Group C (Perichondrium)	p-value
Graft Success (n)	26	27	28	0.58
Graft Success (%)	86.67	90.00	93.33	
Graft Failure (n)	4	3	2	
Graft Failure (%)	13.33	10.00	6.67	

Table 3: Hearing Improvement Data

Parameter	Group A (Temporalis Fascia)	Group B (Cartilage)	Group C (Perichondrium)	p-value
Mean Preoperative Air-Bone Gap (dB)	30.25	29.80	30.50	0.85

DOI: 10.69605/ijlbpr_14.1.2025.78

Mean Postoperative Air-Bone Gap (dB)	15.30	14.85	13.95	0.63
Mean Hearing Improvement (dB)	14.95	14.95	16.55	0.49
Hearing Improvement (%)	49.42	50.17	54.26	

Table 4: Postoperative Complications

Parameter	Group A (Temporalis Fascia)	Group B (Cartilage)	Group C (Perichondrium)	p-value
Infection (n)	2	1	1	0.81
Infection (%)	6.67	3.33	3.33	
Residual Perforation (n)	2	2	1	0.90
Residual Perforation (%)	6.67	6.67	3.33	
Graft Displacement (n)	1	1	0	0.70
Graft Displacement (%)	3.33	3.33	0.00	
Lateralization (n)	1	0	0	0.55
Lateralization (%)	3.33	0.00	0.00	

Table 5: Follow-up Compliance Rates

Parameter	Group A (Temporalis Fascia)	Group B (Cartilage)	Group C (Perichondrium)	p-value
Follow-up Compliance (n)	27	28	29	0.67
Follow-up Compliance (%)	90.00	93.33	96.67	
Non-Compliance (n)	3	2	1	
Non-Compliance (%)	10.00	6.67	3.33	

Table 6: Multiple Regression Analysis of Factors Affecting Surgical Outcomes

Variable	Coefficient (β)	Standard Error (SE)	t-value	p-value
Graft Material (Cartilage)	0.12	0.05	2.40	0.02*
Graft Material (Perichondrium)	0.15	0.05	3.00	0.004*
Age	-0.01	0.02	-0.50	0.62
Gender (Male)	0.03	0.04	0.75	0.45
Preoperative Air-Bone Gap (dB)	-0.02	0.01	-2.00	0.05
Infection	-0.10	0.06	-1.67	0.10

DISCUSSION

The results of this study evaluating surgical outcomes of tympanoplasty with different graft materials, including temporalis fascia, cartilage, and perichondrium, were compared with findings from existing literature. The demographic characteristics of the patients in this study showed no statistically significant differences across the three groups in terms of age (p = 0.78) and gender distribution (p = 0.65). These findings align with those of Umapathy and Dekker (2020), who reported no significant impact of age or gender on graft success rates in their analysis of 120 tympanoplasty cases.[9] Furthermore, the mean ages reported in this study (35.67 to 37.25 years) are consistent with the average age group undergoing tympanoplasty as reported by Mohan et al. (2017), who observed a mean age of 36.5 years in a comparable cohort.[10]The overall graft success rates in this study ranged from 86.67% in Group A (temporalis fascia) to 93.33% in Group C (perichondrium). These findings are consistent with the study by Indorewala et al. (2005), which reported success rates of 87% for temporalis fascia and 92% for perichondrium.[11] Similarly, studies by Shetty et al. (2018) found graft success rates of 89% for cartilage, further corroborating the 90% success rate observed in this study.[12] The higher success rate observed with perichondrium (93.33%) may be attributed to its strength and pliability, which allow better adaptation to the tympanic membrane, as previously suggested by Vrabec et al. (2008).[13]The hearing improvement data showed that Group C (perichondrium) achieved the highest mean improvement (16.55 dB) compared to Group A and B (14.95 dB each). These results align with findings by Onal et al. (2012), who reported that cartilage grafts achieved hearing improvement of 15.2 dB, comparable to this study.[14] Furthermore, the mean postoperative air-bone gap in Group C (13.95 dB) was slightly better than Group A (15.30 dB) and Group B (14.85 dB), supporting the conclusion that perichondrium may offer a marginal advantage in functional outcomes. Similar trends were noted in the study by Vaidya et al. (2015), which demonstrated better functional outcomes with perichondrium grafts compared to temporalis fascia.[15]The rates of postoperative complications in this study were low across all groups, with no statistically significant differences observed. Infection rates ranged from

DOI: 10.69605/ijlbpr_14.1.2025.78

3.33% to 6.67%, which is consistent with the findings of Wilson et al. (2019), who reported an overall infection rate of 4.5% in tympanoplasty procedures.[16] Residual perforations were observed in 6.67% of cases in Groups A and B and 3.33% in Group C, aligning with studies by Yung et al. (2011), which documented residual perforation rates of 5% to 7%. Graft displacement and lateralization were rare, further supporting the safety of all three graft materials.[17]The high follow-up compliance rates in this study (90.00% to 96.67%) ensured reliable data collection. These rates are comparable to those reported by Gupta et al. (2020), who achieved a follow-up compliance rate of 92% in their prospective tympanoplasty study. This consistency in follow-up further strengthens the validity of the findings.[18]Multiple regression analysis identified graft material as a significant predictor of surgical success. Compared to temporalis fascia, cartilage had a coefficient of $\beta = 0.12$ ($p = 0.02$), while perichondrium had a stronger coefficient of $\beta = 0.15$ ($p = 0.004$). These findings are supported by Ghanem et al. (2006), who demonstrated the superior performance of cartilage and perichondrium in achieving long-term graft stability and functional outcomes.[19] Preoperative air-bone gap also negatively influenced surgical outcomes ($\beta = -0.02$, $p = 0.05$), a finding consistent with previous studies by Ruhl et al. (2014), indicating that larger preoperative gaps may predict slightly poorer results. Other factors, including age, gender, and infection, did not significantly affect outcomes in this study.[20]

CONCLUSION

This study demonstrates that tympanoplasty using perichondrium, cartilage, and temporalis fascia grafts yields high graft success rates and significant hearing improvement, with perichondrium showing a marginal advantage in both anatomical and functional outcomes. All three graft materials were safe, with low rates of postoperative complications such as infection, residual perforation, and graft displacement. Factors such as graft material and preoperative air-bone gap significantly influenced surgical outcomes, emphasizing the importance of individualized graft selection based on patient-specific factors. Overall, tympanoplasty remains a reliable and effective treatment for chronic otitis media, with graft material choice playing a pivotal role in optimizing outcomes.

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Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.1.2025.78

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