



# International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958

P-ISSN: 2706-6630

Impact Factor (RJIF): 6.72

IJOS 2025; 1(1): 48.50

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Received: 05-04-2016

Accepted: 22-04-2016

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## Comparative study of different tympanic membrane repair techniques in chronic otitis media

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**DOI:** <https://www.doi.org/10.22271/ortho.2015.v1.i1a.3818>

### Abstract

**Background and Objectives:** Chronic otitis media (COM) often causes the tympanic membrane to break, which can cause hearing loss and infections that come back. Different methods are used to fix the tympanic membrane, such as underlay, overlay, and grafting with temporalis fascia or cartilage. The objective of this study was to evaluate the morphological and functional outcomes of various tympanic membrane restoration procedures in patients with chronic otitis media.

**Material and Methods:** This prospective study included 70 patients diagnosed with chronic otitis media with tympanic membrane perforation. Patients were categorized into three groups according to the surgical repair technique: underlay tympanoplasty (n=25), overlay tympanoplasty (n=25), and cartilage graft tympanoplasty (n=20). The preoperative evaluation comprised otoscopic examination, pure tone audiometry, and assessment of the perforation's size and location. Three and six months after surgery, we looked at the results to see how well the graft was taken, how much better the hearing was (by measuring the air-bone gap), and any problems that came up after surgery. A statistical study was conducted to evaluate the efficacy and safety of the approaches.

**Results:** The underlay tympanoplasty group had the highest graft uptake rate (92%), whereas the overlay group had the lowest (88%) and the cartilage graft group had the lowest (90%) ( $p > 0.05$ ). The mean improvement in hearing was  $16.5 \pm 5.2$  dB for the underlay group,  $14.8 \pm 6.1$  dB for the overlay group, and  $15.6 \pm 4.8$  dB for the cartilage graft group. There was no statistically significant difference between the groups ( $p = 0.38$ ). There were very few problems after surgery, and in a few cases, there was modest temporary otorrhea and tympanic membrane retraction.

**Conclusion:** All three tympanic membrane repair methods had high success rates for grafts and similar improvements in hearing. The surgeon's preference, the characteristics of the perforation, and the patient's individual needs may all play a role in choosing the best procedure. Early intervention and meticulous surgical planning can enhance both morphological and functional outcomes in individuals with chronic otitis media.

**Keywords:** Chronic otitis media, tympanoplasty, underlay technique, overlay technique, cartilage graft

### Introduction

Chronic otitis media (COM) is an ongoing inflammatory disorder of the middle ear that frequently leads to rupture of the tympanic membrane. This illness can cause conductive hearing loss, infections that happen again and again, and a lower quality of life. Tympanoplasty, or tympanic membrane repair, is the usual surgery that aims to restore the membrane's integrity, stop infections from coming back, and improve hearing <sup>[1, 2]</sup>.

There are a number of ways to fix the tympanic membrane, such as underlay, overlay, and cartilage transplant tympanoplasty. The underlay approach puts the graft on the inside of the remaining tympanic membrane and annulus. The overlay technique puts the graft on the outside of the remaining tympanic membrane. Cartilage graft tympanoplasty employs cartilage, typically sourced from the tragus or concha, to enhance structural rigidity and resistance to retraction, especially in cases with extensive or subtotal holes <sup>[3-5]</sup>.

There is still a lot of discussion over the best way to do it, even though it is widely used. This is because different procedures have different rates of graft uptake, hearing improvement, surgical difficulty, and problems after surgery <sup>[6, 7]</sup>. Comparative studies are crucial for informing surgical decision-making, particularly in environments with a high incidence of chronic otitis media <sup>[8, 9]</sup>.

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The current study sought to compare the anatomical and functional outcomes of underlay, overlay, and cartilage graft tympanic membrane repair techniques in patients with chronic otitis media, assessing graft integration, auditory enhancement, and postoperative complications over a six-month follow-up period.

### Material and Methods

This research was carried out in the Department of ENT, Mahavir Institute of Medical Sciences, Vikarabad, Ranga Reddy District, Telangana, India - 501102. The study period spanned from February 2015 to January 2016. Seventy individuals with chronic otitis media and perforation of the tympanic membrane were included. Patients were divided into three groups according to the tympanic membrane repair method: underlay tympanoplasty (n=25), overlay tympanoplasty (n=25), and cartilage graft tympanoplasty (n=20). Before the surgery, the patient had a full medical history taken, an otoscopic and microscopic exam, a pure tone audiometry (PTA) test, and an assessment of the size and location of the tympanic membrane hole. Experienced otologic surgeons did the surgeries under general or local anesthesia, following established procedures for each method.

### Inclusion criteria

- Patients aged 18-60 years diagnosed with chronic otitis media with tympanic membrane perforation.
- Dry ear for at least 6 weeks prior to surgery.
- Conductive hearing loss confirmed by pure tone audiometry.
- Consent to participate in the study and attend follow-up visits.

### Exclusion criteria

- History of previous tympanoplasty or mastoid surgery.
- Presence of cholesteatoma or active middle ear infection.
- Sensorineural hearing loss or mixed hearing loss.
- Systemic conditions affecting wound healing

### Results

A total of 70 patients with chronic otitis media were included: 25 underwent underlay tympanoplasty, 25 underwent overlay tympanoplasty, and 20 underwent cartilage graft tympanoplasty. Demographic characteristics, graft uptake, hearing outcomes, and postoperative complications are summarized below.

**Table 1:** Demographic Characteristics of Study Groups (n = 70)

| Parameter                               | Underlay (n=25) | Overlay (n=25)  | Cartilage (n=20) | p-value |
|-----------------------------------------|-----------------|-----------------|------------------|---------|
| Age (years, mean $\pm$ SD)              | 35.4 $\pm$ 10.2 | 36.8 $\pm$ 11.0 | 37.1 $\pm$ 9.8   | 0.76    |
| Male:Female ratio                       | 14:11           | 13:12           | 11:9             | 0.88    |
| Perforation size (small/moderate/large) | 10/9/6          | 9/10/6          | 7/8/5            | 0.91    |

The three groups were comparable in age, sex distribution, and perforation size ( $p>0.05$ ), indicating successful matching

for baseline characteristics.

**Table 2:** Graft Uptake Rates at 6 Months Postoperatively

| Technique       | Complete Uptake (n) | Partial/Failure (n) | Uptake Rate (%) |
|-----------------|---------------------|---------------------|-----------------|
| Underlay        | 23                  | 2                   | 92              |
| Overlay         | 22                  | 3                   | 88              |
| Cartilage Graft | 18                  | 2                   | 90              |

Graft uptake was highest in the underlay group (92%), followed by cartilage graft (90%) and overlay (88%). Differences among groups were not statistically significant

( $p>0.05$ ), indicating all techniques had high anatomical success rates.

**Table 3:** Hearing Improvement (Air-Bone Gap Reduction in dB)

| Technique       | Preoperative ABG (mean $\pm$ SD) | Postoperative ABG (mean $\pm$ SD) | Mean Improvement (dB) | p-value |
|-----------------|----------------------------------|-----------------------------------|-----------------------|---------|
| Underlay        | 28.5 $\pm$ 5.3                   | 12.0 $\pm$ 3.5                    | 16.5 $\pm$ 5.2        | -       |
| Overlay         | 29.0 $\pm$ 6.0                   | 14.2 $\pm$ 4.8                    | 14.8 $\pm$ 6.1        | -       |
| Cartilage Graft | 27.8 $\pm$ 5.5                   | 12.2 $\pm$ 3.7                    | 15.6 $\pm$ 4.8        | 0.38    |

All three techniques achieved significant improvement in hearing. Mean air-bone gap reduction ranged from 14.8 dB to

16.5 dB, with no statistically significant differences among the groups ( $p = 0.38$ ).

**Table 4:** Postoperative Complications

| Complication                       | Underlay (n=25) | Overlay (n=25) | Cartilage (n=20) | Total (n=70) |
|------------------------------------|-----------------|----------------|------------------|--------------|
| Mild transient otorrhea            | 2               | 3              | 1                | 6            |
| Tympanic membrane retraction       | 1               | 2              | 1                | 4            |
| Residual perforation/reperforation | 2               | 3              | 2                | 7            |
| Infection requiring treatment      | 1               | 1              | 0                | 2            |

Postoperative complications were minimal across all groups. Mild transient otorrhea and tympanic membrane retraction were the most common. No major complications occurred, supporting the safety of all three techniques.

### Discussion

Conductive hearing loss and repeated middle ear infections can be caused by chronic otitis media with tympanic membrane perforation. When it comes to repairing membrane

integrity, increasing hearing, and avoiding additional problems, tympanoplasty is still the gold standard surgical surgery. Anatomical and functional outcomes were evaluated in 70 patients using three commonly utilized tympanic membrane repair techniques: overlay, graft tympanoplasty (cartilage replacement), and overlay (tympanic membrane repair)<sup>[10-12]</sup>.

With graft absorption rates of 92% in the underlay group, 90% in the cartilage graft group, and 88% in the overlay group, our results show that all three procedures are effective. All three methods successfully close the tympanic membrane anatomically, which is in line with other research that found graft success rates between 85% and 95%. Surgeon expertise, patient selection, and perforation features may be more important than technique choice alone, since small variations in uptake rates across approaches were not statistically significant<sup>[13-15]</sup>.

The three groups showed comparable hearing improvement, as determined by the reduction of the air-bone gap: overlay 14.8 dB, cartilage graft 15.6 dB, and overlay 16.5 dB. It can be inferred that the functional outputs produced by the three strategies are equivalent. These findings are in line with the existing literature, which demonstrates that the key factors influencing postoperative auditory improvement are accurate graft implantation and effective hole closure<sup>[16]</sup>. When dealing with big or subtotal perforations, it is common practice to use cartilage grafts. These grafts not only provide extra rigidity but also resistance to retraction, which is great for patients' hearing<sup>[17]</sup>.

Minor postoperative problems, such as temporary ear infections, retraction of the tympanic membrane, and residual perforation, were few and far between. We did not see any significant problems, such as infection or sensorineural hearing loss. These results demonstrate that all three procedures are safe when executed by qualified otologic surgeons<sup>[18]</sup>.

Individual factors such as perforation size and position, middle ear state, surgeon preference, and the condition of the ear canal should be considered before deciding on a tympanoplasty approach. Due to its simplicity and high uptake rates, underlay tympanoplasty is a good choice for small to moderate holes. However, cartilage grafts are better for big or high-risk perforations because they prevent retraction and reperforation. When dealing with anterior or subtotal holes, overlay tympanoplasty is still a viable option<sup>[19, 20]</sup>.

## Conclusion

Patients with chronic otitis media showed high graft uptake rates, substantial hearing improvement, and low surgical complications with all three tympanic membrane restoration techniques underlay, overlay, and cartilage graft tympanoplasty. In terms of functional and anatomical outcomes, none of the methods differed significantly. Perforation features, surgeon expertise, and patient-specific considerations should all play a role in deciding which surgical approach to choose. Patients with chronic otitis media can improve their morphological and auditory outcomes with timely and suitable surgical surgery.

## Funding

None

## Conflict of Interest

None

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### How to Cite This Article

Sridhar KV, Gangadhar Y. Comparative study of different tympanic membrane repair techniques in chronic otitis media. *International Journal of Orthopaedics Sciences* 2015; 1(1): 48.50

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