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ORIGINAL ARTICLE

EFFICACY OF CORTICAL MASTOIDECTOMY IN TYMPANOPLASTY: A COMPARATIVE STUDY

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Abstract

Background: Chronic Suppurative otitis media (CSOM) is a prevalent cause of hearing loss in developing countries. Tympanoplasty is widely accepted for tympanic membrane repair; however, the benefit of adding cortical mastoidectomy in patients with sclerotic mastoids remains uncertain.

Objective: To compare surgical outcomes—specifically graft uptake, hearing improvement, and postoperative wound healing between patients undergoing tympanoplasty alone and those undergoing tympanoplasty with cortical mastoidectomy.

Material and Methods: This comparative study was conducted over six months in the Department of Otorhinolaryngology at Lady Reading Hospital, Peshawar. A total of 56 patients aged 15 years and above with dry central perforations and radiological or intraoperative evidence of sclerotic mastoids were included. Patients were divided into two groups: Group A underwent tympanoplasty alone, and Group B underwent tympanoplasty combined with cortical mastoidectomy. Graft uptake at 3 months was the primary outcome. Secondary outcomes included air–bone gap (AB-gap) improvement on pure tone audiometry, air and bone conduction thresholds, wound healing status, and postoperative complications. Data were analyzed using SPSS version 26, with significance set at $p \leq 0.05$.

Results: At the 3-month follow-up, graft uptake was higher in Group B (96.4%) compared to Group A (71.4%) ($p = 0.011$). Group B also showed significantly greater AB-gap improvement (18.40 ± 4.91 dB) than Group A (10.09 ± 5.55 dB, $p < 0.001$). Air conduction thresholds were also better in Group B ($p = 0.008$). Postoperative complications were infrequent and similar between groups.

Conclusion: This comparative study suggests that the addition of cortical mastoidectomy to tympanoplasty may lead to improved graft uptake and audio logical outcomes in patients with sclerotic mastoids. These findings support the consideration of cortical mastoidectomy in selected cases of CSOM with poor mastoid pneumatization.

Keywords: Chronic Suppurative otitis media, comparative study, tympanoplasty, cortical mastoidectomy, graft success, hearing improvement
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Introduction:

Chronic Suppurative otitis media (CSOM) remains one of the most prevalent ear diseases globally, especially in developing countries[1]. It is characterized by persistent tympanic membrane perforation, intermittent or continuous otorrhea, and varying degrees of conductive hearing loss. Tympanoplasty is the standard surgical intervention for repairing tympanic membrane perforations[3] and improving hearing function[5]. However, graft uptake success can be affected by several factors including poor mastoid pneumatization, residual infection, and Eustachian tube dysfunction[6].

In patients with sclerotic mastoid bones and a poorly ventilated mastoid air cell system, the risk of persistent middle ear infection and graft failure increases. To address these issues, cortical mastoidectomy is sometimes performed alongside tympanoplasty[2]. This procedure involves the removal of diseased mastoid air cells, which may help in improving middle ear ventilation, reducing the recurrence of infection, and enhancing graft uptake[18]. It is especially considered in patients with sclerotic mastoids or suboptimal Eustachian tube function[8].

Despite its potential benefits, the role of cortical mastoidectomy in conjunction with tympanoplasty remains controversial. Some studies advocate its routine use, particularly in selected patient populations, while others report comparable outcomes with tympanoplasty alone. For

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instance, Paupore et al. (2022) found slightly higher graft failure rates in the tympanoplasty-only group (16.4%) versus those who also underwent mastoidectomy (14.2%)[8]. Similarly, Aggarwal *et al.* (2019) reported a graft uptake rate of 95% when cortical mastoidectomy was added, compared to 80% with tympanoplasty alone[13]. Other studies such as Varshney et al. (2016) have also demonstrated higher graft uptake with mastoidectomy[10].

Conversely, some findings suggest that in ears with a long-standing dry status and healthy middle ear mucosa, tympanoplasty alone may suffice[14, 16]. This variation in reported outcomes has contributed to uncertainty in clinical decision-making, particularly in settings with limited resources. Moreover, there is a lack of local data evaluating the outcomes of tympanoplasty with and without cortical mastoidectomy in patients with radiologically confirmed sclerotic mastoids[4,11].

To address this gap, the present comparative study aims to evaluate and compare surgical outcomes—specifically graft uptake rates, hearing improvement, and wound healing—between tympanoplasty alone and tympanoplasty combined with cortical mastoidectomy in patients with CSOM and sclerotic mastoid bones. The findings are intended to help inform evidence-based surgical practices for managing CSOM in similar patient populations.

Material and Method:

Study Design, Duration, and Setting:
This comparative study was conducted in the Department of Otorhinolaryngology at Lady Reading Hospital, Peshawar, over a six-month period following ethical approval from the institutional review board. The study included 56 patients who were allocated into two groups based on the type of surgery received.

Study Groups:

- Group A: Patients who underwent tympanoplasty alone.
- Group B: Patients who underwent tympanoplasty combined with cortical mastoidectomy.

Sample Size:
A total of 56 patients were included, with 28 patients in each group. The sample size was calculated using the WHO sample size calculator, based on an 80% study power and 95% confidence level, referencing previous studies that reported graft uptake rates of 80% for tympanoplasty alone and 95% for combined surgery.

Inclusion Criteria:

- Male and female patients aged 15 years or older
- Central tympanic membrane perforation with radiological (X-ray or CT) or intraoperative evidence of sclerotic mastoid
- Dry ear for at least one month prior to surgery
- Mild to moderate conductive hearing loss consistent with middle ear pathology
- Normal cochlear (inner ear) function
- Clinically satisfactory Eustachian tube function
- No active infection in the nose, paranasal sinuses, nasopharynx, or throat
- Ability to provide informed consent (and assent where applicable)

Exclusion Criteria:

- Active ear discharge at the time of surgery (wet ear)
- Attic or marginal tympanic membrane perforations
- Age under 15 years
- Moderate to severe hearing loss with a significant sensor neural component
- Single functioning ear (unilateral hearing)
- History of prior mastoid surgery on the affected ear
- Multiple tympanic membrane perforations
- Medical contraindications to surgery or anesthesia
- Inability to comply with postoperative follow-up

Data Collection Procedure:
Preoperative Assessment:
Following institutional ethical approval and with strict adherence to patient confidentiality, all participants underwent a thorough preoperative evaluation. A comprehensive history was recorded, including the duration and pattern of symptoms, history of ear discharge, previous medical or surgical treatments, and associated comorbidities.

Each patient underwent detailed otology examination using otoscopic and an operating microscope to assess the location and size of the tympanic membrane perforation and to evaluate the status of the middle ear mucosa. Examination under magnification was performed to inspect perforation margins, detect granulation tissue or polyps, and evaluate acicular chain integrity.

Hearing function was assessed using tuning fork tests and pure-tone audiometry (PTA), with documentation of air- and bone-conduction thresholds and calculation of the preoperative air–bone gap. Radiological evaluation included X-ray mastoid (Schüller's view) or high-resolution CT of the temporal bone, when indicated, to assess mastoid pneumatization and identify sclerotic changes. Routine

preoperative laboratory investigations (CBC, LFTs, RFTs, urinalysis) and anesthetic fitness assessments were completed for all patients.

Surgical Technique:

All surgeries were carried out via a post-auricular approach under local anesthesia with sedation or under general anesthesia, based on individual patient needs and preferences. In both groups, tympanoplasty was performed using a temporalis fascia graft applied by the underlay technique, following elevation of the tympanomeatal flap. Graft placement and external auditory canal packing were **standardized across cases.**

Group A underwent tympanoplasty alone.

Group B underwent tympanoplasty combined with cortical mastoidectomy, which included exposing Macewen's triangle, opening the mastoid cortex, removal of diseased air cells and mucosa, identification of the mastoid antrum and sinodural angle, and ensuring antral patency. The mastoid cavity was then packed with Gelfoam.

To maintain surgical consistency and reduce variability, all procedures were performed by the same surgeon or a small, dedicated surgical team. The same graft material and intraoperative protocols were applied uniformly to both groups.

Postoperative Care and Follow-up

Postoperatively, patients received intravenous amoxicillin–clavulanate (1.2 g every 12 hours) for the first 48 hours, followed by oral antibiotics for an additional seven days. Analgesics and antihistamines were prescribed as needed. Post-auricular sutures were removed on the 7th postoperative day. Patients were advised to avoid water exposure to the ear, strenuous activities, and Valsalva maneuvers for at least three weeks.

Follow-up visits were scheduled at postoperative day 7, and then at 3 weeks, 6 weeks, and 3 months, with clinical documentation of healing progress at each stage.

Outcome Measures

Primary Outcome:

- Graft uptake at 3 months post-surgery, evaluated through otoscopic or microscopic examination by an ENT specialist who was not involved in the surgical procedures.

Secondary Outcomes:

- Hearing improvement assessed by changes in air-conduction thresholds and air–bone gap on PTA at 6 weeks and 3 months
- Wound healing status
- Postoperative infection
- Complications such as hematoma, facial nerve injury, or the need for revision surgery

Statistical Analysis:

Data were analyzed using SPSS version 26. Continuous variables such as age and hearing thresholds were expressed as mean ± standard deviation and compared between groups using the independent t-test. Categorical variables, including graft uptake rates and complication frequencies, were presented as frequencies and percentages, and analyzed using the Chi-square test. A p-value of ≤ 0.05 was considered statistically significant.

Results:

A total of 56 patients were included in the study, comprising 29 males (51.8%) and 27 females (48.2%). The overall mean age was 36.7 ± 13.0 years (range: 15–58 years). Disease laterality was more common on the right side (57.1%) than the left (42.9%). The mean disease duration across participants was 124.2 ± 68.5 months.

Baseline Characteristics:

Demographic and clinical characteristics were found to be statistically comparable between the two groups, with no significant differences in age, gender distribution, side of involvement, or disease duration (Table 1).

Table 1. Baseline Characteristics of Patients (n = 56)

Variable	Group A: Tympanoplasty Alone (n = 28)	Group B: Tymp + Cortical Mastoidectomy (n = 28)	p-value
Age (years)	38.21 ± 14.22	35.25 ± 11.77	0.399
Gender (M/F)	16 / 12	13 / 15	0.422
Laterality (R/L)	18 / 10	14 / 14	0.280
Disease duration (months)	122.75 ± 69.48	125.64 ± 68.78	0.876

Preoperative Assessment:

All patients presented with dry central perforations and varying degrees of conductive hearing loss. The onset of symptoms was gradual in 89.3% and sudden in 10.7% of cases. Perforation size was categorized as medium (42.9%), small (28.6%), subtotal (16.1%), and large (12.5%). Middle ear mucosa appeared normal in 75%, inflamed in 16.1%, and granulated in 8.9% of cases.

Preoperative hearing assessment showed no significant differences in middle ear mucosal status, Rinne's test, ossicular chain integrity, or audiometric values between the groups (Table 2).

Table 2. Pre-operative Findings

Variable	Group A (n = 28)	Group B (n = 28)	p-value
Middle ear mucosa (gran/inflam/norm)	4 / 4 / 20	1 / 5 / 22	0.367
Rinne (negative/positive)	23 / 5	23 / 5	1.000
Ossicular chain (disrupted/intact)	2 / 26	3 / 25	0.639
Bone conduction (dB)	12.68 ± 4.59	12.14 ± 4.15	0.649
Air conduction (dB)	52.14 ± 9.82	52.46 ± 8.06	0.894
AB gap (dB)	39.46 ± 8.11	40.32 ± 6.44	0.663

Intraoperative and Early Postoperative Complications:

All procedures were performed via the post auricular approach using temporalis fascia grafts. The acicular chain was intact in 91.1% of cases. Intraoperative complications occurred in 3 patients from Group A and 1 patient from Group B; however, this difference was not statistically significant (p = 0.299). Early postoperative complications were minimal and statistically comparable between the two groups (Table 3).

Table 3. Intraoperative and Early Postoperative Complications

Variable	Group A (n = 28)	Group B (n = 28)	p-value
Intraoperative complications	3 (10.7%)	1 (3.6%)	0.299
Postoperative infection	0 (0%)	1 (3.6%)	
Hematoma	1 (3.6%)	0 (0%)	
None	27 (96.4%)	27 (96.4%)	0.368

Hearing Outcomes:

At 6 weeks postoperatively, both groups demonstrated improvement in hearing parameters. Although Group B exhibited greater gains, the differences did not reach statistical significance at this stage (Table 4).

Table 4. Hearing Outcomes at 6 Weeks

Variable	Group A (n = 28)	Group B (n = 28)	p-value
Air conduction (dB)	46.08 ± 10.65	41.43 ± 8.78	0.080
Bone conduction (dB)	12.68 ± 4.59	12.14 ± 4.15	0.649
AB gap (dB)	33.40 ± 9.09	29.29 ± 7.62	0.072

By 3 months, Group B showed statistically significant improvement in air conduction, air–bone gap, and AB gap closure, compared to Group A. The mean AB gap improvement was significantly higher in Group B (18.40 ± 4.91 dB) than in Group A (10.09 ± 5.55 dB, p < 0.001) (Table 5).

Table 5. Three Months Post-operative Outcomes

Variable	Group A (n = 28)	Group B (n = 28)	p-value
Air conduction (dB)	42.05 ± 11.72	34.06 ± 9.75	0.008*
Bone conduction (dB)	12.68 ± 4.59	12.14 ± 4.15	0.649
AB gap (dB)	29.38 ± 10.32	21.92 ± 8.89	0.005*
AB gap improvement (dB)	10.09 ± 5.55	18.40 ± 4.91	<0.001*
Graft uptake (Yes / No)	20 / 8 (71.4%)	27 / 1 (96.4%)	0.011*
Complications at 3 months (Infection / Retraction / None)	6 / 1 / 21	0 / 1 / 27	0.034*

Graft Uptake and Late Complications:

At 3 months, graft uptake was significantly higher in Group B (96.4%) compared to Group A (71.4%) with a p-value of 0.011, indicating better surgical success when cortical mastoidectomy was performed alongside tympanoplasty. Late complications were minimal and infrequent in both groups, though slightly more common in Group A.

Discussion:

Our findings are in agreement with several previous studies that reported improved graft uptake and hearing results with the addition of cortical mastoidectomy. Agrawal *et al.* reported a graft uptake rate of 95% in the combined group versus 80% in the tympanoplasty-alone group[9], which closely parallels our result of 96.4% in the mastoidectomy group. Similarly, Garg and Kakkar (2018) demonstrated that performing mastoidectomy alongside tympanic membrane repair reduces the likelihood of revision surgery[12]. Additionally, while Agrawal *et al.* noted a non-significant difference in hearing improvement, our study showed a statistically significant hearing gain, suggesting a more robust effect in our patient population.

Bajpai *et al.* (2023) also observed higher graft uptake in the mastoidectomy group (95.5%) compared to tympanoplasty alone (82.2%), along with significant AB gap closure in both groups1[9]. Similarly, Rajashekhar et al. (2024) found graft uptake rates of 96% with combined surgery and 94% with tympanoplasty alone, though the difference was smaller than in our study[20].

Contrastingly, other studies have reported more modest or non-significant differences. Aggarwal et al. (2019) found graft uptake rates of 87% with tympanoplasty alone and 90% with cortical mastoidectomy, with no statistical significance[13]. Naik et al. (2022) even reported a slightly lower graft uptake (75%) in the mastoidectomy group

compared to 85% in tympanoplasty alone[14]. Such variability may be attributed to differences in inclusion criteria, particularly regarding mastoid pneumatization and disease chronicity.

Baz (2020) and Sagesh *et al.* observed better graft uptake and AB-gap closure with cortical mastoidectomy, but their findings lacked statistical significance, possibly due to smaller sample sizes or differences in disease staging[15,16]. Likewise, in pediatric populations and cases with favorable middle ear conditions, studies have shown high graft success with tympanoplasty alone[17], suggesting that mastoidectomy may not offer additional benefit in well-ventilated or dry ears.

Interpretation of Differences:

The larger difference in graft uptake (~25%) observed in our study compared to many previous reports may be explained by our strict inclusion criteria, particularly the mandatory presence of mastoid sclerosis confirmed radiologically or intraoperative. Patients also had long-standing disease duration, and although ears were dry preoperatively, many had a history of recurrent discharge and varying middle ear mucosal states. These factors, along with possible Eustachian tube dysfunction, may limit middle ear ventilation, making mastoidectomy more beneficial in this subgroup[7,18].

Furthermore, our study standardized key variables including graft material (temporalis fascia), surgical technique, and postoperative care, minimizing procedural variability. Hearing assessment was conducted using pure-tone audiometry at defined intervals, and outcome evaluation was performed by a blinded examiner, increasing the internal validity of results.

However, certain limitations should be acknowledged:

- Short follow-up period (3 months), which may not capture long-term outcomes such as graft retraction, adhesive otitis, or delayed failures.
- Sample size was moderate; although powered to detect a difference in graft uptake, broader generalizability may require larger, multicenter studies.
- Although mastoid sclerosis was confirmed radiologically, Eustachian tube function and mucosal status, which are key prognostic factors, were only assessed clinically and not quantitatively.
- Some variability in perforation size and acicular integrity may have influenced individual outcomes.

Implications for Practice:

The findings of this study support the routine inclusion of cortical mastoidectomy in patients with CSOM and radiologic evidence of mastoid sclerosis, as it significantly improves both graft success and hearing outcomes. These results are consistent with the recent randomized controlled study by Gul (2025), which also reported better outcomes with cortical mastoidectomy[21]. In resource-constrained settings or in ears with favorable middle ear conditions, tympanoplasty alone may still be effective. However, in patients with poor mastoid ventilation, long-standing disease, or borderline middle ear mucosa, adjuvant mastoidectomy may enhance surgical success.

Conclusion:

This comparative randomized controlled study demonstrates that tympanoplasty combined with cortical mastoidectomy significantly improves both graft uptake rates and hearing outcomes in patients with sclerotic mastoid bone, as compared to tympanoplasty alone. The graft uptake success rate in the combined group was notably higher (96.4% vs. 71.4%), and mean air–bone gap closure was significantly greater, suggesting enhanced middle ear ventilation and disease clearance when mastoidectomy is performed. These findings support the incorporation of cortical mastoidectomy in select cases of chronic Suppurative otitis media, particularly where mastoid sclerosis or poor ventilation is evident. Further large-scale and long-term studies are warranted to validate these findings and assess sustainability of graft success over time.

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