

Long-term Persistence of Tympanic Membrane Perforation following Myringotomy: A Three-Year Follow-up Study

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Abstract

Background: Myringotomy is a common otologic procedure performed to relieve middle ear effusion and improve ventilation. The tympanic membrane incision typically heals spontaneously; however, persistent perforation may occur, leading to recurrent infections, hearing impairment, and a potential need for surgical repair. Long-term data on this complication in resource-limited outpatient settings remain limited.

Objective: To determine the rate and associated factors of long-term persistence of tympanic membrane perforation three years after myringotomy.

Methods: This follow-up study was conducted in the private chamber of a registered physician in Bangladesh from January 2019 to December 2024. A total of 120 patients who underwent myringotomy were included using purposive sampling. Otoscopic and audiological evaluations were performed periodically, and membrane status at three years was the primary outcome. Data were analyzed using SPSS version 23.0.

Results: The mean age was 24.6 ± 12.3 years; 58.3% were male. Persistent tympanic membrane perforation at three years was observed in 14 patients (11.7%). Higher persistence was significantly associated with recurrent otitis media (OR = 3.21, $p=0.01$), large initial incision size (OR = 2.87, $p=0.02$), and postoperative infection (OR = 3.54, $p=0.004$). Most persistent perforations were central (71.4%). Patients with persistent defects had significantly greater mean conductive hearing loss (28.5 ± 6.2 dB vs 16.1 ± 5.4 dB, $p<0.001$).

Conclusion: Although most myringotomy incisions heal, a notable minority develop long-term perforation. Careful surgical technique and infection control may reduce the risk.

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Introduction

Myringotomy is a fundamental otologic procedure involving a small incision in the tympanic membrane to alleviate middle ear effusion, reduce middle ear pressure, and improve hearing outcomes. In clinical practice, it is commonly performed either alone or in conjunction with tympanostomy tube insertion to manage otitis media with effusion (OME), recurrent acute otitis media, or Eustachian tube dysfunction.^{1,2} The primary goal of the procedure is to establish ventilation of the middle ear, facilitating fluid drainage and reducing the risk of chronic inflammation and conductive hearing loss. Without tube placement, the incision usually heals spontaneously within days to weeks; with tube insertion, the eardrum incision remains patent until the tube extrudes naturally or is removed.^{3,4} Tympanostomy tubes are categorized based on design and intended duration within the tympanic membrane. Short-term tubes are meant to remain for approximately 6–12 months, whereas long-term tubes are shaped to persist longer.⁴ Although most tympanic membrane perforations resulting from myringotomy or tube extrusion heal spontaneously after tube loss, a subset may remain unclosed for extended periods, leading to persistent perforation. Persistent tympanic membrane perforation can predispose individuals to recurrent infections, conductive hearing loss, chronic otorrhea and may necessitate further surgical intervention such as myringoplasty or tympanoplasty.^{5,6} Prior research has noted that the incidence of persistent perforation varies widely, influenced by factors such as tube type, duration of tube retention, and patient characteristics.⁷ Persistent perforations following ventilation tube removal have been reported at rates ranging from approximately 6% to 20% in pediatric populations, with higher rates typically observed in ears that had long-term tube placement compared with short-term tubes. Other studies have identified

patient and tympanic membrane characteristics, including larger perforation size, tympanosclerosis, and history of multiple tube placements, as potential predictors of delayed or incomplete healing.⁸ Additionally, comorbid conditions such as previous head and neck radiotherapy have been associated with an increased risk of persistent perforations in adult cohorts undergoing myringotomy or tube placement.^{9,10} These findings highlight the multifactorial nature of tympanic membrane healing and the need for tailored follow-up strategies. Despite evidence from pediatric and specialized adult populations, there remains a paucity of long-term outcomes focused specifically on the natural history of tympanic membrane perforations beyond standard follow-up periods in outpatient clinical settings. Most existing studies primarily address closure rates in relation to short-term tube extrusion or surgical removal at 6–12 months; fewer studies evaluate outcomes extending to three years post-procedure.^{11,12} Such extended follow-up is particularly important in settings where access to regular specialist care may be limited and where patients may present late with unresolved perforations. Understanding the long-term persistence of tympanic membrane perforations after myringotomy is clinically relevant for both prognostication and management. Persistent perforations have implications for quality of life, hearing rehabilitation, and the potential need for secondary surgical closure procedures. Furthermore, identifying factors associated with persistence may inform clinician decision-making regarding initial tube selection, postoperative care, and targeted follow-up, particularly in resource-limited contexts such as outpatient private practices. In light of these considerations, the present study investigates the incidence and clinical correlates of persistent tympanic membrane perforations three years following

myringotomy in a cohort from a private physician's chamber in Bangladesh. By extending the follow-up period to three years, this study aims to fill an important gap in long-term data on tympanic membrane healing trajectories in everyday clinical practice.

Methods

This follow-up study was conducted in the private chamber of a registered physician in Bangladesh from January 2019 to December 2024. A total of 120 patients who previously underwent myringotomy for middle ear conditions were enrolled using purposive sampling. Patients were followed to evaluate long-term tympanic membrane healing status.

Inclusion criteria: This follow-up study was conducted in the private chamber of a registered physician in Bangladesh from January 2019 to December 2024. A total of 120 patients who previously underwent myringotomy for middle ear conditions were enrolled using purposive sampling. Patients were followed to evaluate long-term tympanic membrane healing status.

Exclusion criteria: Patients with a history of traumatic tympanic membrane perforation, prior tympanoplasty, cholesteatoma, congenital ear anomalies, or incomplete follow-up records were excluded. Those with systemic conditions affecting wound healing, such as uncontrolled diabetes, were also excluded.

Study procedure: Data were collected from clinical records and follow-up examinations. Otoscopic evaluation assessed membrane integrity, site and size of perforation, and middle ear status. Pure tone audiometry determined hearing levels. Clinical variables, including infection history, incision characteristics, and postoperative complications, were recorded.

Data analysis: Data were analyzed using SPSS version 23.0. Descriptive statistics summarized demographic and clinical variables. Associations between risk factors and persistent perforation were evaluated using chi-square and logistic regression tests. A p-value < 0.05 was considered statistically significant.

Results

A total of 120 patients completed the three-year follow-up. The majority belonged to the 11–30 year age group (41.7%), followed by 31–50 years (33.3%). Males constituted 58.3% of the cohort. The most common indication for myringotomy was otitis media with effusion (46.7%), followed by recurrent acute otitis media (30.0%) and Eustachian tube dysfunction (23.3%). At three years, persistent tympanic membrane perforation was identified in 14 patients, giving an overall persistence rate of 11.7%, while 88.3% showed complete healing. Among persistent cases, central perforations were most frequent (71.4%), with small-to-moderate-sized defects predominating. Recurrent otitis media after the procedure was significantly associated with persistence. Perforation occurred in 23.5% of patients with recurrent infection compared to 7.7% without recurrence ($p = 0.012$). Similarly, a larger initial incision size was linked with higher persistence (20.5% vs 6.3%, $p = 0.018$). Postoperative ear infection showed a strong association, with 26.7% persistence compared to 6.5% among those without infection ($p = 0.004$). Hearing outcomes differed notably. Patients with persistent perforation demonstrated higher mean conductive hearing loss (28.5 ± 6.2 dB) compared to healed patients (16.1 ± 5.4 dB), and this difference was statistically significant ($p < 0.001$). Logistic regression analysis revealed postoperative infection (OR 3.54, $p = 0.004$), recurrent otitis media (OR 3.21, $p = 0.010$), and large incision size (OR 2.87, $p =$

0.018) as independent predictors of persistent perforation. Age and sex were not significantly associated ($p > 0.05$).

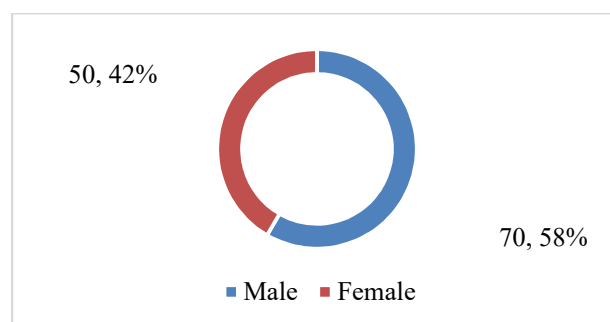


Figure 1: Gender distribution of cases

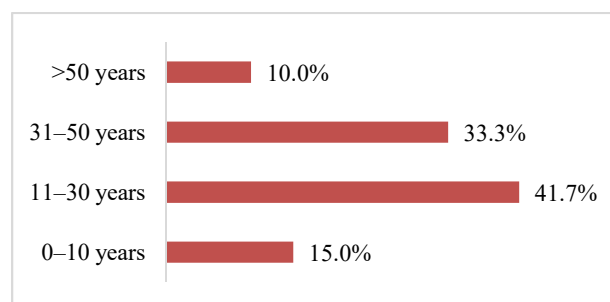


Figure 2: Age distribution

Table I: Clinical indications for myringotomy

Indication	n	%
Otitis media with effusion	56	46.7%
Recurrent acute otitis media	36	30.0%
Eustachian tube dysfunction	28	23.3%

Table II: Tympanic membrane status at three years

Status	n	%
Healed membrane	106	88.3%
Persistent perforation	14	11.7%

Table III: Association of recurrent otitis media with persistent perforation

Recurrent infection	%	p-value
Yes (n=34)	23.5%	0.012
No (n=86)	7.7%	

Chi-square test

Table IV: Incision size and postoperative infection as risk factors

Risk factor	%	p-value
Large incision	20.5%	0.018
Small incision	6.3%	
Postoperative infection	26.7%	0.004
No infection	6.5%	

Chi-square test

Table V: Hearing loss comparison

Group	HL (dB)	p-value
Persistent perforation	28.5 ± 6.2	<0.001
Healed membrane	16.1 ± 5.4	

HL: Hearing loss

Discussions

The present study demonstrated that 11.7% of patients had persistent tympanic membrane perforation three years after myringotomy, while the majority (88.3%) showed complete healing. This finding aligns with earlier reports indicating that although most myringotomy incisions close spontaneously, a small but clinically significant proportion remains unhealed.^{13,14} The observed persistence rate falls within the range documented in previous otologic studies evaluating post-procedural tympanic membrane healing, particularly where infection or prolonged inflammation is involved.¹⁵ Age and sex were not significantly associated with persistent perforation in this cohort, which is consistent with several studies suggesting that demographic factors play a limited role compared to local middle ear pathology.¹⁶ Instead, disease-related variables appeared more influential. Recurrent otitis media showed a significant association with perforation persistence ($p = 0.012$). Repeated inflammatory episodes may impair epithelial migration and fibrous layer regeneration of the tympanic membrane, leading to delayed closure.¹⁴ Chronic mucosal edema and infection can also interfere with

normal reparative mechanisms, thereby prolonging membrane defects. Incision characteristics were another important factor. Larger initial incisions were associated with higher persistence rates ($p = 0.018$). Larger defects require more extensive epithelial and fibrous tissue regeneration, increasing the likelihood of incomplete closure.¹⁷ Similar findings have been reported in studies evaluating surgical perforations and post-tube extrusion defects, where perforation size correlated directly with non-healing outcomes.^{17,18} This underscores the importance of careful surgical technique and limiting incision size whenever clinically feasible. Postoperative ear infection emerged as the strongest predictor in this study ($p = 0.004$; OR 3.54). Infection may disrupt early healing by damaging the epithelial margin and sustaining inflammatory processes that prevent membrane regeneration.^{15,18} Previous investigations have likewise identified postoperative otorrhea and middle ear infection as major risk factors for chronic perforation.¹⁸ Effective postoperative care, including infection control and patient education, therefore plays a vital role in reducing long-term complications. Audiological assessment further highlighted the clinical impact of persistent perforation. Patients with non-healed membranes exhibited significantly higher mean conductive hearing loss than those with healed membranes ($p < 0.001$). This is expected because tympanic membrane integrity is essential for efficient sound transmission, and persistent defects reduce vibratory surface area and middle ear impedance matching.¹⁹ Similar degrees of conductive loss have been documented in patients with chronic perforations, emphasizing the functional consequences beyond structural abnormality.²⁰ The three-year follow-up period provides valuable long-term insight, as many earlier studies focused primarily on short-term healing within months

after the procedure.^{15,17} Extended observation helps identify patients whose perforations fail to close naturally and who may benefit from surgical repair. In resource-limited outpatient settings, delayed presentation is common; thus, understanding long-term healing patterns is particularly relevant.²⁰ Overall, the study confirms that while myringotomy is generally safe, persistent tympanic membrane perforation remains a notable complication, particularly in the presence of infection and larger incisions. Targeted preventive strategies, meticulous operative technique, and close follow-up for high-risk patients could minimize this outcome.

Limitations

This study was limited by its single-center design, purposive sampling technique, relatively small sample size, and reliance on outpatient follow-up records, which may limit generalizability and introduce potential selection and information bias.

Conclusion

Most tympanic membrane incisions following myringotomy healed spontaneously within three years; however, a meaningful minority developed persistent perforation associated mainly with postoperative infection, recurrent otitis media, and larger incision size. Persistent defects were linked with greater conductive hearing loss, emphasizing clinical impact. Careful surgical technique, infection prevention, and structured follow-up of high-risk patients are essential to reduce long-term complications and improve functional outcomes.

Recommendation

Clinicians should employ meticulous surgical technique, minimize incision size, and ensure effective postoperative infection control. Regular follow-up is recommended, especially for patients with recurrent otitis

media or large incisions, to identify persistent perforations early and consider timely surgical repair.

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