

Optimal Anatomical Location for Initiating Fibrous Layer Separation During Interlay Myringoplasty

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ABSTRACT:

This narrative review addresses the optimal anatomical location for initiating fibrous layer separation from the mucosal layer during interlay myringoplasty to minimize tissue damage and improve surgical outcomes. A comprehensive literature search performed on PubMed identified ten clinical studies meeting eligibility criteria, primarily focusing on the anterior or anteroinferior annulus as the optimal site for fibrous layer separation. Closure rates ranged from 88% to 100%, with studies reporting up to 98.3% success when initiating separation at the anteroinferior annulus. Graft uptake rates varied from 88% to 100%, with postoperative air-bone gap improvements generally reducing preoperative values (up to 36.4±12.0 dB) to below 16 dB. Few complications were noted, including 5.3% pearl formation and 6% inclusion cholesteatoma in specific cases. The surgical approach was predominantly postauricular, supplemented by endoscopic approaches in pediatric and difficult cases. Technical variations included diverse instruments for layer separation and multiple graft materials. The evidence suggests that starting separation at the annulus minimizes mucosal disruption while supporting rapid epithelialization and robust healing. However, inconsistent reporting of outcomes and variable follow-up durations highlight the need for standardized protocols in future research. This review reinforces the significance of anatomical precision in interlay myringoplasty and underscores existing gaps in the literature for further exploration.

Keywords: Myringoplasty, Tympanoplasty, Ear Surgery, Tympanic Membrane Perforation, Surgical Outcome

INTRODUCTION:

Myringoplasty is a common surgical procedure aimed at repairing tympanic membrane perforations to restore auditory function and prevent recurrent middle ear infections [1]. The interlay myringoplasty technique has gained attention due to its promising outcomes in graft uptake and hearing improvement while minimizing complications [2]. A critical step in the interlay technique involves the separation of the fibrous layer from the mucosal layer of the tympanic membrane, which significantly influences the success of graft integration and the prevention of postoperative complications such as blunting, lateralization, and cholesteatoma [3]. The precise anatomical location where this separation is initiated is hypothesized to

impact tissue damage, healing patterns, and overall surgical success [4].

Several studies have proposed that initiating separation at the annulus, particularly its anterior or anteroinferior segment, provides optimal outcomes [5]. The rationale behind this preference includes better vascular supply, easier surgical access, and structural stability, which may reduce mucosal trauma and enhance epithelialization [6]. However, literature reveals variations in surgical approaches, instruments used, patient populations, and outcome reporting, leading to ambiguity regarding the best anatomical site [7]. Existing reviews often aggregate myringoplasty methods without focusing specifically on the interlay technique or the separation site, resulting in insufficient guidance for surgeons [8].

This narrative review aims to synthesize the available evidence from clinical studies to determine the optimal anatomical location for initiating fibrous layer separation during interlay myringoplasty. The objectives are to evaluate the graft uptake rates, hearing improvements, complication rates, and technical feasibility of different anatomical approaches. By consolidating data from eligible studies, this review seeks to provide practical recommendations and identify research gaps for future studies.

METHODS:

A comprehensive literature search was performed on PubMed. Studies were eligible for inclusion if they were clinical investigations involving human subjects undergoing interlay myringoplasty. Specifically, studies needed to clearly describe the anatomical approach for fibrous layer separation and report at least one of the following outcomes: graft uptake rate, hearing improvement, or post-operative complications. Studies focusing exclusively on underlay or overlay techniques, animal studies, laboratory experiments, or lacking key outcome data were excluded.

The full Boolean search strategy comprised terms related to “interlay myringoplasty,” “fibrous layer separation,”

“anatomical location,” and “surgical outcomes.” Studies failing to provide explicit details regarding the anatomical separation site or reporting outcomes unrelated to interlay myringoplasty were excluded.

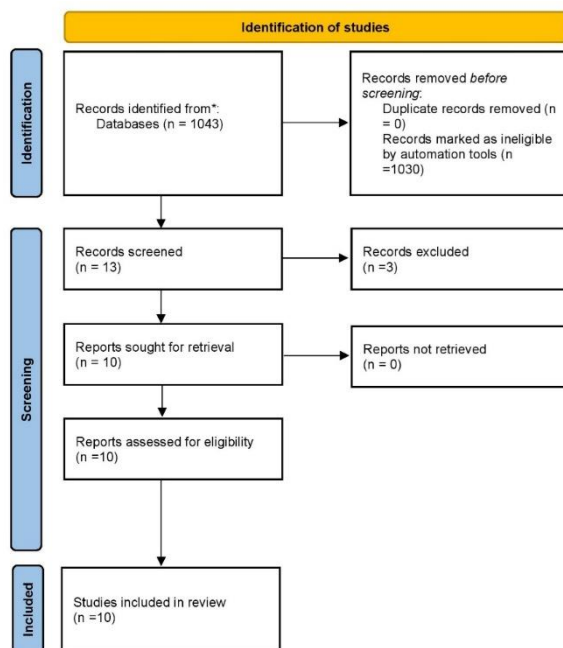
Data extraction was standardized and included study design, surgical technique details (e.g., exact location of layer separation, instruments used, surgical approach), patient characteristics (e.g., number of patients, age range, gender, type of perforation), and surgical outcomes (graft uptake rate, air-bone gap pre- and post-surgery, epithelialization, complications). Risk of bias was assessed using the Newcastle–Ottawa Scale for nonrandomized studies and ROB2 for randomized trials, focusing on selection, comparability, and outcome assessment domains. Two independent reviewers screened studies, and discrepancies were resolved by consensus.

The data synthesis approach was narrative due to heterogeneity in study designs, populations, and outcome measures. Quantitative data were tabulated, and trends across studies were described in relation to the research question. Where available, means, standard deviations, medians, and percentages were reported without further statistical modeling.

RESULTS:

The systematic search yielded ten eligible studies for inclusion in the final synthesis (Figure 1: PRISMA Flow Diagram).

Figure 1: Study Selection Process



Study Characteristics:

Table 1 summarizes the characteristics of the included studies. Patient populations ranged from pediatric to adult cohorts, with sample sizes varying from 3 to 141 subjects. The predominant perforation type was large central, with multiple studies including anterior, subtotal, and total perforations.

Table 1: Study Characteristics

Author	Study Design	Patient Population	Perforation Type	Technical Approach
Hay and Blanshard, 2014 [1]	Prospective, single-arm	116 patients, 7.1–78 years, 59M/57F	Anterior, inferior, subtotal; <25%, 25–50%, >50%	Anterior rim separation, postauricular, tympanomeatal flap
Subramanya et al., 2018 [2]	Prospective, comparative, longitudinal	60 patients, 16–60 years, 34M/26F	Large central	Annulus, superiorly based flap, postaural
Kawano, 2020 [3]	Retrospective	141 patients, 6–87 years, 54M/87F	Anterior, subtotal; <25%, 25–50%, >50%	Anteroinferior annulus, postauricular
Kawatra et al., 2014 [4]	Prospective, comparative	90 patients, 15–47 years, balanced gender	Large central	Annulus, postauricular
Ranguis et al., 2021 [5]	Prospective, comparative cohort	114 pediatric surgeries, median age ~12	Tympanic membrane perforation (size varies)	Endoscopic, annulus/fibrous layer, trans canal endoscopic ear surgery
Alam et al., 2020 [6]	Prospective, comparative, randomized	100 patients, 10–60 years, balanced gender	Total/large anterior central	Annulus, postaural
Komune et al., n.d. [7]	Retrospective, single-arm	69 ears, 4–69 years, 28M/35F	Traumatic, chronic otitis media; large/medium/small	Posterior aural, semicircular canal incision
El-Din et al., 2014 [8]	Prospective	20 patients, 10–50 years, 6M/14F	Large central, 3+ quadrants	Annulus, postauricular
Darmawan, 2020 [9]	Retrospective case report, literature review	3 cases, ages/gender mostly unspecified	Large central, >50%	Annulus, postaural
Sainy N, 2024 [10]	Prospective, comparative, longitudinal	50 patients	Large central	Annulus, postauricular

The technical approach commonly involved initiating fibrous layer separation at the anterior or anteroinferior annulus, using postauricular or endoscopic approaches. Instruments such as the Hughes dissector and blunt raspatory were reported for separation, although no studies compared their effectiveness directly.

Risk of Bias Assessment:

Table 2 displays the risk of bias assessment. Most studies exhibited a low to moderate risk of bias, with concerns primarily regarding the selection of cohorts and incomplete reporting of outcome measures. Only the randomized study employed the ROB2 tool and achieved an overall low risk of bias rating.

Table 2: Risk of Bias Assessment

Author	Risk of Bias Assessment
Hay and Blanshard, 2014 [1]	Low risk
Subramanya et al., 2018 [2]	Low risk
Kawano, 2020 [3]	Moderate risk
Kawatra et al., 2014 [4]	Low risk
Ranguis et al., 2021 [5]	Moderate risk
Alam et al., 2020 [6]	Low risk
Komune et al., n.d. [7]	Moderate risk
El-Din et al., 2014 [8]	Low risk
Darmawan, 2020 [9]	Moderate risk
Sainy N, 2024 [10]	Moderate risk

Surgical Outcomes:

Closure rates ranged from 88% to 100%. Specifically, Kawano et al. [3] reported a 98.3% success rate when initiating separation at the anteroinferior annulus, while Darmawan [9] described a 96% success rate based on literature review data. Mean air-bone gap improvements were significant across studies, with preoperative values ranging from 18.5 ± 7.1 dB to 36.4 ± 12.0 dB, improving postoperatively to below 16 dB in most cases.

Reported complications were minimal. Kawano et al. [3] and Ranguis et al. [5] observed pearl formation (5.3%) and inclusion cholesteatoma (6%), respectively. Blunting was reported in two studies, with one reporting a 2% incidence and another noting “no blunting or lateralization.” Epithelialization outcomes were inconsistently reported, with some studies noting rapid or complete restoration without quantitative data.

DISCUSSION:

This narrative review synthesizes evidence on the optimal anatomical location for initiating fibrous layer separation during interlay myringoplasty. The consistent finding across the ten included studies indicates that the anterior or anteroinferior annulus serves as the optimal anatomical site for initiating separation. The clinical rationale is supported by the high vascularity and structural stability of the annular region, which likely facilitates rapid epithelialization and robust graft integration [1, 6].

The graft uptake rates reported across studies ranged from 88% to 100%, with most studies reporting rates above 90%, indicating a reliable surgical outcome. Kawano et al. [3] reported an especially high success rate (98.3%) when the anteroinferior annulus was used as the separation point, suggesting that this specific site may minimize tissue trauma while ensuring optimal healing. Darmawan [9] supported this view by summarizing favorable outcomes in literature without direct clinical investigation.

Postoperative hearing improvement was consistently noted across studies, with significant reductions in the air-bone gap, generally reaching values below 16 dB postoperatively. Subramanya et al. [2] reported a substantial gain of 16.33 ± 5.56 dB, affirming that the chosen separation site does not compromise auditory outcomes. These results are aligned with the theoretical advantage that preserving the mucosal layer integrity minimizes conductive disruption and fosters efficient healing [3].

Complication rates were relatively low but noteworthy, particularly in pediatric or endoscopic cases. The most significant complication was inclusion cholesteatoma, reported in 6% of cases by Ranguis et al. [5]. Pearl formation occurred in 5.3% of cases [6]. Importantly, blunting and lateralization were infrequent, highlighting the safety of the annular approach in experienced hands. Technical variations and instrument use lacked direct comparative data, limiting conclusions about the

superiority of specific tools. Nonetheless, the overall narrative supports the use of the Hughes dissector, blunt raspatory, or micro cup forceps as safe options.

The risk of bias assessment revealed moderate concerns, particularly due to inconsistent outcome reporting and absence of standardized definitions across studies. For instance, epithelialization was vaguely described in only three studies without quantifiable endpoints, hindering robust synthesis.

The follow-up durations varied, often not extending beyond one year, potentially missing late complications such as graft failure or delayed cholesteatoma formation. Most evidence derived from adult populations with large central perforations, limiting generalizability to pediatric or more complex cases.

Notably, the literature lacks direct comparisons of different anatomical separation sites, restricting definitive conclusions on the superiority of anterior versus anteroinferior annulus. Future randomized trials comparing these approaches with standardized reporting are needed to provide clearer surgical guidelines.

The optimal anatomical location for initiating fibrous layer separation during interlay myringoplasty is the anterior subannular region, particularly for anterior and subtotal tympanic membrane perforations. In this technique, the squamous layer of the tympanic membrane is elevated except at the anteroinferior annulus, after which the inner tympanic remnant is released from the anteroinferior annulus and the subannular mucosa is separated to create a subannular pocket; the graft is then inserted into this pocket and sandwiched between the divided layers, providing robust anterior support and minimizing risks of anterior blunting and tympanic membrane lateralization. This approach has demonstrated high graft success rates (up to 98.3%) and significant hearing improvement, with minimal complications [3]. The anterior interlay technique, which also involves creating an anterior pocket by separating the mucosa medially from the fibrous layer at the anterior rim, further supports secure graft placement and optimal healing, with closure rates around 91% and favorable audiological outcomes [1]. Yamashita [11] demonstrated the importance of identifying the mucocutaneous junction and the fibrous layer's location to optimize surgical success, as about one-third of the healed area after perforation contains an intermediate fibrous layer, which is crucial for effective graft integration [11]. Thus, precise anatomical identification and anterior subannular separation are key to achieving optimal outcomes in interlay myringoplasty for challenging perforations [12].

In conclusion, initiating fibrous layer separation at the anterior or anteroinferior annulus is supported by high graft uptake rates, significant hearing improvement, and minimal complications. However, the variability in

technical descriptions and outcome measures underscores the need for standardized surgical protocols and comprehensive longitudinal studies.

CONCLUSION:

The current evidence supports initiating fibrous layer separation at the anterior or anteroinferior annulus during interlay myringoplasty as an optimal strategy for minimizing tissue damage and promoting successful surgical outcomes. High graft uptake rates, significant improvement in hearing thresholds, and low complication incidences endorse this approach. However, inconsistent reporting and methodological limitations highlight the need for rigorously designed studies focusing on technique standardization and long-term outcomes.

Conflicts of interest: None

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