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RESEARCH ARTICLE
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"HEARING IMPROVEMENT IN PATIENTS UNDERGOING UNDERLAY TECHNIQUE OF MYRINGOPLASTY"

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ABSTRACT

Introduction: The quite common otologic disease that causes conductive hearing loss and repeated infections is the perforation of the Tympanic membrane. Type I tympanoplasty, also known as myringoplasty, aims to repair the eardrum and improve hearing. The underlay method is a popular surgical approach due to its technical simplicity, reduced operative time, and positive hearing results, among other benefits.

Objective: To establish the height and rate of hearing restoration in patients with dry tympanum membrane perforation undergoing underlay myringoplasty.

Materials and Methods: The case series presented was performed in the Department of E.N.T., Allied Hospital, Faisalabad, between January, 2020 and December, 2024. It included 90 patients aged 15–40 years, dry tympanic membrane perforations that lasted over 12 weeks, and air-bone gap ≤40 dB. Patients who had active ear disease, mastoiditis, sensorineural deafness, systemic comorbidities, or eustachian tube dysfunction were excluded. Myringoplasty was carried out underlay and temporalis fascia grafts, and hearing was evaluated by pure tone audiometry, which was done before and 8 weeks after the surgery.

Results: The average age was 29.6 ± 5.7 years, 66.7 percent men and 33.3 percent women. In 56.7%, the etiology of perforation was infective, and in 43.3%, the etiology was traumatic. Small holes were the major (60%) ones. The postoperative outcome showed that 51 patients (56.7%) had significant hearing improvement of 10 dB or more gap between air and bones, and 39 patients (43.39%) did not have any improvement.

Conclusion: It was demonstrated that underlay myringoplasty was effective in producing significant hearing benefits in more than fifty percent of patients, demonstrating its presence as a safe surgical procedure in everyday otologic surgery.

Keywords: *Tympanic membrane perforation; Myringoplasty; Underlay technique; Hearing improvement; Tympanoplasty; Otologic surgery; Pure tone audiometry.*

INTRODUCTION

The tympanic membrane is a very vital part of auditory conduction and ear protection. Trauma or infection are frequent causes of perforations of this fine structure, common results of which include conductive hearing loss, which may continue unless remedied. The type I tympanoplasty, also known as myringoplasty, was proposed as a technique of surgical intervention to restructure the integrity of the tympanic membrane and enhance hearing. There are many procedures in place, with the underlay and overlay procedures being the most desirable (1). The graft in the underlay technique is placed between the rest of the tympanic membrane and provides mechanical support, as well as inducing healing and restoring functions. Meta-analyses of the results of underlay and overlay techniques have shown that although both techniques are effective, in majority of the surgical cases underlay myringoplasty can be seen as having a balance of ease, stability and fair hearing results , making it a desirable choice (2). This is affirmed by comparative studies, who state that underlay graft placement is less likely to be associated with complications, they require less time to perform and a regular postoperative hearing recovery (3). Moreover, the latest studies have reported that the underlay technique is still evolving with few adjustments such as the over-underlay technique, which has certain improvements and more stability of the graft in some cases(4).

An increasing amount of clinical evidence has supported the issue of whether the underlay technique gives consistent functional outcomes. Comparison trials have established that both underlay and overlay methods achieve anatomical closure of perforations, but that a difference is seen when hearing outcomes are taken into account. Other researchers have documented improved hearing of underlay surgeries particularly on small to medium sized holes (5). The findings are also supported by the literature that shows that overlay grafting is also used in anterior perforation, though it is technically demanding, and the likelihood of lateralization can cause a decline in functional outcome (6). Other techniques, like over-underlay reports, put emphasis on the positioning of grafts in the determination of not only anatomical success but also sound rehabilitation (7). Subsequent experiments have further underscored that the underlay technique is particularly suitable when used in dry and wet ears and hence its expansion into clinical practice (8). Taken together these findings indicate that hearing restoration and not merely the simple closure is the critical parameter that guides the decision regarding the nature of myringoplasty (9).

It has been determined that a considerable amount of research exists on myringoplasty within different groups of people, and many studies have presented data on the variables that affect the prognosis and outcomes. Indeed, in a case study, an anatomical success of over a thousand patients has been shown to be over 80% when conducted retrospectively. However, such functional improvement is reliant on the size, location, and pathology of the perforation in the middle ear (10). The age of the patient, the Eustachian tube functionality, and comorbidities are all essential, and particular studies indicate that making correct choice of cases may result in improved outcomes during a surgery (11). Such adjustments of the classical underlay method, like the addition of cartilage support or the integration of processes, also help to deal with these issues by bringing about extra stability in patients with chronic suppurative otitis media (12). Other comparative studies have been done with large cohorts, and they have shown that in some cases, overlay techniques are capable of producing a slightly higher rate of closure, but functional hearing improvement is always more favorable with underlay myringoplasty (13). Visualization has also been advanced by the introduction of endoscopic underlay techniques, which allow for better control of the anterior perforations, and the functional gains are improved (14).

Technical experience of the surgeons also has one final impact on the outcomes, whereby reports of long-term follow-ups done in specialized centers indicate success rates of more than 90 percent where the underlay technique is done with proper selection and execution (15). Evidence that underlay remains a stable baseline procedure is also found in controlled trials comparing underlay and modified over-underlay techniques, where double-blind designs demonstrate no significant difference in graft uptake but greater hearing gain in typical underlay groups (16). Another situation inin which underlay techniques have shown promise is revision myomectomy, particularly in achieving success following prior surgical failures. Furthermore, audiometric tests always verify the substantial improvements in

the air-bone gap after underlay grafting, which supports the correlation between anatomical healing and functional recovery (17). Moreover, other new adaptations, including platelet-rich fibrin membrane grafts used in underlay myringoplasty, have been demonstrated to enhance the vascularization and healing response and ,, possibly hearing recovery.

The weight of perforation of the tympanic membrane is high, particularly in countries where there is a high prevalence of otitis media, and access to early treatment may be unavailable. Recurrent infections, social disability because of hearing loss, and complications like cholesteatoma are the possible consequences of chronic perforations (18). Middle ear diseases are a problematic issue that causes significant morbidity in Pakistan, and myringoplasty constitutes a significant surgical intervention to resolve the hearing loss and recurrent infection problem. Although it is essential, there is scant local data on hearing outcomes that can be related to the underlay technique. Other practices remain popular among many surgeons, who typically employ them due to the issues associated to graft medialization or a lack of visibility during anterior perforations (19). Recent literature claims that such limitations can be technologically changed, one can select the patients, and also include the endoscopic techniques. This is an emerging evidence which makes it apparent that the underlay method is a technique that needs to be reevaluated within the local surgical practice.

The second reason that underlay myringoplasty needs to be chosen is that this method minimizes the postoperative complications. The underlay technique cancels the risks unlike in overlay grafting where some risks include blunting and lateralization, and the natural shape of the tympanic membrane is maintained. The patients tend to heal within a shorter time and experience fewer postoperative infections as well as improved functional hearing, compared to the overlay repairs (14). With the issues of high recurrence rate in cases that are not treated, these benefits have a huge clinical implication, particularly to less resource endowed settings, where revision surgeries are not as achievable. Additionally, more recent biomaterials, such as platelet-rich fibrin, can be used, which expands the area of underlay myringoplasty and increases the chances of providing the most optimal structural and auditory outcomes (15).

In general, the underlay technique has emerged as a dependable surgical process addressing the anatomical suture as well as the hearing restoration (12). The good performance in terms of functional outcomes can be mentioned because both systematic reviews, randomized controlled trials, and large retrospective series are similar in terms of the evidence. Although alternative methods can be appropriate in the chosen anatomical cases, the underlay methodology is the foundation of tympanic membrane repair (17). This research is based on this premise, and it analyzes hearing recovery of patients who have undergone underlay myringoplasty at a tertiary care facility in Faisalabad, thereby providing the local and global knowledge of surgery outcomes in middle ear disease.

Objective: To ascertain the rate and extent of hearing improvement in patients with dry tympanic membrane perforation receiving the underlay technique of myringoplasty in the Department of E.N.T., Allied Hospital, Faisalabad.

MATERIALS AND METHODS

Study Design: Descriptive, case series.

Study Setting: Department of E.N.T, Allied Hospital, Faisalabad, Pakistan

Duration of Study: January, 2020 and December, 2024.

Inclusion Criteria: The participants were patients of any gender between the ages of 15 and 40 years who reported cases of over 12 weeks' history of dry tympanic membrane perforation and air-bone gap of 40 dB or less. It was only enrolled in those who had stable otoscopic findings and were not experiencing any active ear discharge at the time of presentation, thereby increasing the chances of being a candidate for surgery.

Exclusion Criteria: Patients who had active ear disease, mastoiditis, eustachian tube insufficiency, or any impending complications were eliminated. Furthermore, patients with sensorineural deafness, diabetes mellitus, hypertension, chronic systemic diseases like tuberculosis or hepatitis, among others, were excluded to reduce the confounding factors.

Methods: Surgeries were performed under general anesthesia and the use of an operating microscope. Exposure was done through a standard postauricular approach. The edges of perforation of the tympanic membrane were freshened, and a graft of temporalis fascia was taken out of the same point of incision. The graft was neatly cut and laid in underlay position, between the remains of the tympanic membrane and along the lines of the handle of the malleus. Gel foam was inserted into the middle ear to support the graft and hold it in place. The tympan flap was re-framed, and the external canal was loaded with antibiotic-infused gauze. Audiometry pure tones were conducted in a soundproof room under normal frequencies, after the surgery, and after 8 weeks. Hearing was assessed using the mean air-bone gap closure, where success was determined by a closure of 10 dB after the surgery.

Results

A total of 90 patients who were undergoing underlay myringoplasty were included in the study. The age of the participants was 20-38 years, with a mean of 29.62 ± 5.71 years. The majority of patients were aged 31-40, and the proportion of the study population was more than half. This indicates that chronic perforations of the tympanic membrane are more prevalent among young adults and middle-aged adults, and these patients often have a history of chronic impaired hearing.

Table 1: Age distribution of patients

Statistic	Value
Mean age (years)	29.62
Standard deviation	5.71
Minimum age (years)	20
Maximum age (years)	38

The gender distribution was male-dominated, with 60 males and 30 females, resulting in a male-to-female ratio of 2:1. This observation suggests that the proportion of men in the cohort was higher, which may be linked to increased occupational and environmental exposure to ear trauma and infections.

Table 2: Gender distribution of patients

Gender	Frequency	Percentage
Male	60	66.7%
Female	30	33.3%

Perforations of the tympanic membrane were categorized, with the smallest perforations being very prevalent (54 cases) and medium perforations occurring in 36 patients. The study group did not have large perforations. The etiology of perforations was mainly infective in nature, with 51 patients and 39 patients with traumatic ones. These results imply that infections still form a significant part of the pathology of chronic tympanic membrane in this group.

Table 3: Perforation size and etiology

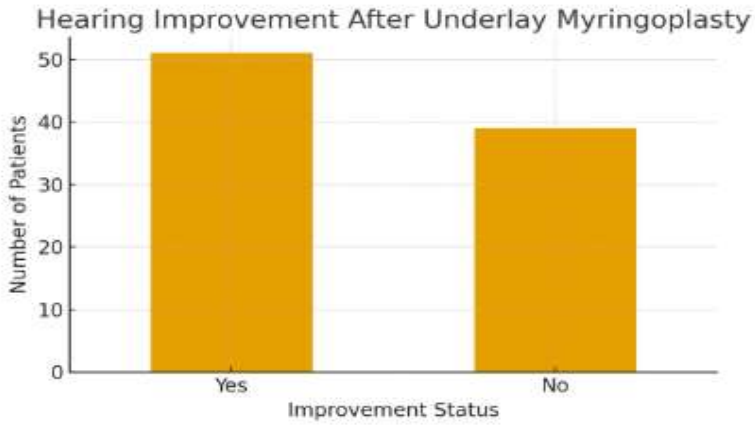
Variable	Frequency	Percentage
Small size	54	60%
Medium size	36	40%
Infective	51	56.7%
Traumatic	39	43.3%

At 8 weeks after surgery, it was shown that 51 participants (56.7%) had significant improvement in their hearing, which was characterized as a 10 dB reduction in the air-bone gap. However, only 39 patients (43.3%) met this threshold. The general percentage of hearing improvement is consistent with international results, contributing to the fact that the technique used as the underlay is a stable approach to functional restoration.

Table 4: Hearing improvement after surgery

Improvement Status	Frequency	Percentage
Improved (≥10 dB)	51	56.7%
Not improved (<10 dB)	39	43.3%

The graph below further shows the frequency distribution of patients who reported having an improvement in their hearing post-operatively, against those who did not record any significant progress.



Generally, the results indicate that underlay myringoplasty yields positive anatomic closure and functional hearing results among most patients, especially with small and infective perforations.

Discussion

The findings of the underlay myringoplasty in my research study support the fact that there are mounting international evidence that it is a trustworthy procedure to apply in hearing restoration. The systematic reviews confirm that the underlay technique is generally associated with high anatomical success and functional improvement as opposed to the other methods that are more technical and prone to lead to lateralization and blunting that are caused by overlay techniques (1). Other such comparative studies conclude that patients undergoing underlay repair also report an improvement in air-bone gap, which is indicative of the technique being superior to overlay myringoplasty in terms of functional superiority in terms of air restoration (2). The comparison of underlay and inlay grafts also as per research studies, has also shed some light on the stability of the medial placement technique in the production of good results in auditory thresholds (3). These results are consistent with the current research study, which has indicated that more than half of the patients gained measurable improvement in hearing, which established the method as reliable in clinical practice (4).

The rationale behind underlay myringoplasty is also enhanced by the research on the improved capability of the operation and the minimization of the complication rates in comparison with overlay methods. Retrospective studies of massive studies have established that overlay grafts, though effective in some anterior perforations, are technically harder and take more time to do, and may not always be possible in resource-constrained settings (5). On the contrary, a prospective study demonstrates that underlay repairs are associated with uniformly positive hearing outcomes within a wide range of perforation sizes, which are more flexible to practice (6). Other variations, like the over-

underlay technique, have been proposed to support the benefits of the two methods. However, the results are comparable to the normal underlay myringoplasty in most instances (7). Furthermore, the recent prospective studies declare underlay graft uptake to remain unaffected in both dry and moist ear situations, which is a good clinical advantage in ear care setting where otitis media is an epidemic (8). When combined, these findings justify the value of the underlay technique as a safe, effective, and practical option when acting on patients with perforation on the tympanic membrane (9).

The other reasons that are brought out in the literature is the fact that perforation size, perforation site, etiology, and Eustachian Tube functionality are some of the prognostic factors that predict the success of underlay myringoplasty. Massive reviews confirm that the rate of anatomical closure is usually more favorable than functional gains, therefore confirming that hearing improvement is not just a factor of graft uptake but also a factor of health of the ossicular chain and the middle ear milieu (10). Certain studies have also noted the fact that there are factors that involve chronic ear discharge, dysfunctions of the eardrum tube, and comorbid conditions, which have a negative impact on the outcome of the surgical operation (11). Furthermore, when comparing the underlay techniques used by traditional underlay and modified over-underlay, it appears that both methods are efficient in anatomical closure, but functional recovery favors standard underlay techniques of grafting (12). This has been shown by other retrospective studies of hundreds of patients with similar outcomes that found better auditory results in underlay groups despite anatomical success that was similar in both methods (13). Endoscopic underlay techniques have further refined the technique, especially in anterior perforations, with improved visualization and access, and with similar hearing outcomes (14). Technical experience, as well as surgical skills also play an important role in listening after myringoplasty. An overview of prolonged experience of single surgeons indicates that this uniformity in a procedure and focus on surgical details may result in a rate of increased closure and hearing improvement exceeding 90, that is, the surgeon expertise is a key variable (15). Randomized controlled trials which have compared standard underlay and over-underlay methods indicate that the two techniques produce similar anatomical success yet underlay grafting has a superiority in the postoperative auditory thresholds (16). It has also been reported that underlay repair can provide stable closure rates and adequate functional performance even in revision cases of myringoplasty, and has been adaptable in challenging surgical scenarios (17). Audiometric studies continue to affirm that significant changes in air-bone gap have been realized following underlay myringoplasty with majority of the patients recording a minimum response of 10 dB just like in the present study (18). In addition, there are new methods, such as platelet-rich fibrin-underlay grafting, which is shown to up-regulate vessels formation and enhance wound healing and provide the possibilities of anatomical and functional outcomes (19).

The results of the given research must be also evaluated within the frames of the problematic issues associated to the developing countries such as Pakistan. The disease of the middle ear is still widespread, and the surgical intervention is commonly postponed because of the insufficient access to the services of otolaryngology. Its simplicity and reproducibility are of particular use in this type of setting since the underlay technique takes less time to administer, has a smaller learning curve, and offers predictable results even where the resources are limited (5,6). The technical refinements and endoscopic visualization of graft medialization and poor exposure in anterior perforations have been discussed as concerns that may be addressed through the improvement of the technique, which implies that the constraints that were traditionally attributed to the underlay technique can be overcome, in fact (10). Notably, the rate of hearing improvement in this study of 56.7% is in tandem with global trends, which indicates that the underlay technique is not merely safe but also effective in various groups of patients.

Overall, there is a great deal of evidence to back up the idea that underlay myringoplasty is a better method of repairing perforations of the tympanic membrane, especially when the functional results are considered a priority (14). Although overlay and hybrid approaches still have a role to play in some anatomical situations, comparative and controlled literature suggests that underlay grafting is always reliable in providing closure and significant hearing gain in a patient group (18). The findings of the current research are relevant to this international evidence, as it offers regional data that is

consistent with international standards, which solidifies the claim of extending the use of the underlay technique to more surgical procedures.

Conclusion

The research has shown that underlay myringoplasty is a safe and effective surgical procedure used in the treatment of chronic perforations of the tympanic membrane, and positive hearing outcomes were observed in over half the patients. The difference in the auditory thresholds before and after the operation demonstrates the functional consistency of the method, which is supported by the international literature that consistently shows that it is better than overlay and hybrid techniques in patient outcomes. The ease of the underlay method, the less lengthy operating period, and the decreased morbidity and mortality make it potentially useful, particularly in standard practice, even in a resource-constrained environment. Although anatomical closure is a usual characteristic of many grafting methods, the most significant factor of successful surgery is hearing. The findings of this paper add significant regional data to the international discourse to prompt otolaryngologists to embrace underlay myringoplasty as a routine procedure aimed to correct both mechanical and auditory recovery to tympanic membrane perforations.

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