

Comparative Study between Interlay Grafting and Underlay Grafting in Tympanoplasty

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Abstract:

Background and Aim: Tympanoplasty using the underlay method is a widely used technique for repairing a perforated tympanic membrane. This procedure is typically performed with the assistance of a microscope. In this study, we will be examining and comparing the outcomes of two frequently utilized techniques for type I tympanoplasty: underlay and interlay. Our focus will be on patients with chronic otitis media and mucosal disease, specifically those with large central perforations. We will be evaluating the success of graft uptake as well as any improvements in hearing that may result from these procedures.

Material and Methods: This study is a 12-month randomized prospective study involving 160 patients with chronic otitis media inactive mucosal type and large central perforation. The study took place in the E.N.T department at a Tertiary Care Teaching Institute in India. A total of 80 patients were included in each group, specifically the underlay group (Group 1) and the interlay group (Group 2). The results were evaluated based on the rate of graft take up and improvement in hearing. The patients were regularly followed up, specifically at the end of the 1st week, four weeks, eight weeks, and 12 weeks. During each follow-up appointment, otomicroscopy was performed to assess the success of the graft and identify any potential complications.

Results: In group 1, 55% of the patients were males and the remaining 45% were females. In group 2, 60% of the patients were males and the remaining 40% were females. In the present study, the graft uptake rate was observed to be 95% and 89% in the interlay and underlay techniques, respectively. After 12 weeks post-surgery, the Interlay tympanoplasty procedure showed the greatest reduction in the mean air bone gap.

Conclusion: The Interlay technique has proven to be highly successful in Type I tympanoplasty, achieving excellent results in terms of graft uptake and closure of the air-bone gap.

Keywords: Ear Discharge, Hearing, Interlay Technique, Tympanoplasty.

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Introduction

Ear discharge and decreased hearing are frequently reported by patients seeking treatment from an otorhinolaryngologist. Perforation of the tympanic membrane typically occurs as a result of long-term middle ear infection. Additional factors can include injury or causes related to medical treatment. Most of these perforations will heal on their own, but the ones that don't can cause ongoing ear discharge and hearing loss, requiring tympanoplasty. [1]

Tympanoplasty is a surgical procedure that is often performed using the underlay technique to repair a perforated tympanic membrane. Many otologists have been using a variety of techniques, such as overlay, interlay, overlay-underlay, and the sandwich method, for a long time. In interlay

tympanoplasty, the graft is positioned between the fibrous layer and the mucosal layer of the remaining tympanic membrane. On the other hand, the underlay method involves placing the graft beneath the mucosal layer. [2]

There are numerous surgical techniques of tympanoplasty described in literature. Some of the most commonly used techniques include underlay interlay, overlay, sandwich, and double breasting techniques. [3-8] among these techniques, underlay, interlay, and overlay are the most commonly used. Every technique has its own set of pros and cons. According to the available literature, the success rate of tympanoplasty can range from 75 to 98%, depending on factors such as graft take

up rates and hearing improvement. The outcome of these results relies heavily on the expertise of the surgeon performing the procedure and the specific surgical approach used. In underlay type I tympanoplasty, the graft is positioned beneath all three layers. There is a possibility of graft medialization and the risk of residual epithelium and anterior blunting in the underlay technique. The underlay technique is known for its simplicity and efficiency, resulting in a high success rate for graft uptake. [9,10]

The Interlay technique offers numerous advantages compared to the underlay technique. The graft is placed between the mucosal and fibrous layers, allowing them to grow and eventually close the perforation. Therefore, this particular mucosal and fibrous layer plane is considered the most optimal plane for preserving the graft. It effectively prevents the graft from shifting to either side, thanks to the support provided by the outer fibrous and inner mucosal layers. Additionally, it helps to prevent any decrease in the middle ear space, while also reducing operating and healing times. Residual epithelium and anterior blunting are unlikely to occur. The interlay technique boasts an impressive graft take up rate of over 90%. [11,12]

There is a growing movement towards minimally invasive intervention in the field of otology, and endoscopes are playing a significant role in ear surgeries. It provides a comprehensive and detailed view of the structures within the middle ear, allowing for the use of smaller incisions. In recent times, there has been a growing preference among otologists for endoscopes over microscopes.

In this study, we will analyze and compare the outcomes of two widely used techniques for type I tympanoplasty: underlay and interlay. Our focus will be on chronic otitis media with mucosal disease in large central perforation. Specifically, we will examine the success rate of graft uptake and the extent of hearing improvement achieved with each technique.

Material and Methods

This study is a 12-month randomized prospective study involving 160 patients with chronic otitis media inactive mucosal type and large central perforation. The patients were admitted to the E.N.T department at a Tertiary Care Teaching Institute in India. The study was conducted after obtaining ethical clearance from the Ethical committee.

Inclusion criteria

The study included cases of chronic otitis media with inactive mucosal disease, characterized by a large central perforation and pure conductive hearing loss. The ear remained dry for a minimum

of 6 weeks. Participants of various ages, ranging from 10 to 60 years old, were included in the study.

Exclusion criteria

Excluded from the study were patients with various conditions such as active mucosal disease, squamous disease, ossicular discontinuity/necrosis, tympanosclerosis, sensorineural and mixed hearing loss, as well as those below 10 years and above 60 years of age. Additionally, patients with diabetes mellitus, hypertension, other systemic diseases, active focus of infection in throat, nose, and oral cavity, and recurrent disease were also excluded.

Patients and their attendants received detailed information and counseling about the disease process, surgical procedure, expected outcomes, potential complications, and alternative treatments. Consent was obtained from both the patient and the attendant after providing them with all the necessary information.

A total of 80 patients were randomly assigned to each group: the underlay group (Group 1) and the interlay group (Group 2). The results were evaluated based on the rate of graft take up and improvement in hearing.

These cases underwent a comprehensive evaluation, including a detailed medical history, thorough examination of the ear, nose, and throat, and routine laboratory tests. All cases underwent a thorough ear examination, which included a microscopic examination, tuning fork tests, pure tone audiometry, and radiological tests. All patients and attendants provided informed consent for the study.

Prior to surgery, all patients underwent a pure tone audiogram to assess their hearing abilities. The audiogram measured four frequencies (0.5, 1, 2, and 4 Khz) for both air and bone conduction. The procedures were conducted with the use of general anesthesia, utilizing the postaural approach and employing a temporalis fascia graft. In all of these cases, a posterior meatotomy was performed, followed by the freshening of the margins.

The underlay technique was performed on a group of 80 patients who were experiencing dry ear conditions. The surgery was performed using the traditional approach, utilizing a temporalis fascia graft. Following the procedure, an ossicular mobility graft was carefully positioned beneath the remaining portion of the eardrum. This was done by lifting the tympanomeatal flap and working alongside the annulus.

The Interlay technique was performed on a sample of 80 patients chosen at random. The tympanomeatal flap was carefully lifted all around until it reached the fibrous annulus, while ensuring that the superior region, where the head of the

malleus is located, was preserved. During the procedure, the fibrous annulus was carefully removed from the bony sulcus surrounding it. This allowed the fibrous and squamous layers to be lifted off the remaining tympanic membrane, while preserving the mucosal layer. The mobility of the ossicles was examined and verified.

The temporalis fascia graft was harvested and allowed to dry in the room air. The graft was positioned securely, with the malleus handle serving as a stable anchor and the bony canal walls providing additional support. The remaining mucosal layer below helped to further stabilize the graft. The tympanomeatal flap was repositioned. The graft was soaked with blood and antibiotic solution, and gelfoams were used to cover it. Additionally, a medicated ointment pack was placed in the external auditory canal for a week.

The patients were regularly followed up, specifically at the end of the 1st week, four weeks, eight weeks, and 12 weeks. During each follow-up appointment, oto-microscopy was performed to assess the success of the graft and identify any potential complications. A pure tone audiogram was performed three months after the operation. The hearing results were evaluated by comparing the pre-operative and postoperative pure tone averages, as well as the closure of the air-bone gap.

Statistical analysis

The data was compiled and entered into a spreadsheet computer program (Microsoft Excel 2007) and then exported to the data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). Quantitative variables were reported using measures such as means and standard deviations or median and interquartile range, depending on their

distribution. The presentation of qualitative variables was in the form of counts and percentages. Confidence level and level of significance were set at 95% and 5% respectively for all tests.

Results

For this study, a total of 160 cases were enrolled. To ensure fairness, 80 patients were randomly selected for the underlay technique, while the other 80 were chosen for the interlay technique. These two groups, labeled as group 1 and group 2, respectively, formed the basis of the study. The age of the patients varied between 12 and 65 years. In 90 (56.25%) patients, the left ear underwent surgery, while the remaining 70 (43.75%) cases involved surgery on the right ear.

Group 1 had 44 (55%) male patients and 36 (45%) female patients, while Group 2 had 48 (60%) male patients and 32 (40%) female patients. This indicates a slight male preponderance, although it was not statistically significant.

The preoperative mean air bone gap in groups 1 and 2 was 26.5 ± 8.45 dB and 25.6 ± 8.20 dB, respectively. After the operation, the mean air bone gap decreased to 17.2 ± 8.88 dB and 13.1 ± 5.89 dB in groups 1 and 2, respectively. A noticeable decrease in the air bone gap was observed in both groups. The reduction in mean was highest in group 2. The reduction in air bone gap showed a highly significant intergroup difference, as indicated by statistical analysis ($p < 0.01$). During the study, there were 10 cases (6.25%) where graft failure occurred, leading to a residual perforation. The success rates in the Underlay and Interlay groups were 89% and 95% respectively.

Table 1: Age Distribution of Study Subjects

Age (Years)	Underlay (Group 1)		Interlay (Group 2)		Total	
	N	Percentage (%)	N	Percentage (%)	N	Percentage (%)
10-20	7	8.75	8	13.3	15	25
21-30	31	38.75	35	58.3	66	41.25
31-40	22	27.5	20	33.3	42	26.25
41-50	14	17.5	15	25	29	18.12
51-60	6	7.5	2	2.5	8	5
Total	80	100	80	100	160	100

Table 2: Preoperative air-bone gap of the patients

Pre-operative air-bone gap (dB)	Underlay (Group 1)		Interlay (Group 2)		Total	
	N	Percentage (%)	N	Percentage (%)	N	Percentage (%)
10-20	20	25	24	30	50	31.25
21-30	32	40	35	43.75	67	41.8
31-40	22	27.5	17	21.25	39	24.37
> 40	6	7.5	4	5	10	6.25
Total	80	100	80	100	160	100

Table 3: Post-operative air-bone gap of the patients

Postoperative air-bone gap (dB)	Underlay (Group 1)		Interlay (Group 2)		Total	
	N	Percentage (%)	N	Percentage (%)	N	Percentage (%)
<10	30	37.5	40	50	70	43.75
11-20	23	28.75	26	32.5	49	51.8
21-30	16	20	10	12.5	26	16.25
31-40	8	5	3	3.75	11	6.87
> 40	3	3.75	1	1.66	4	2.5
Total	80	100	80	100	160	100

Discussion

There is ongoing discussion about the best approach to tympanoplasty, with different surgeons having their own preferences and skill levels. Regardless of the chosen method of reconstruction, it is important to achieve a healed membrane that closely resembles the original, with a well-functioning and effective vibrating area. In recent years, endoscopic ear surgery has shown promising results. There are several advantages to consider when comparing it to microscopes, such as improved appearance, reduced invasiveness, decreased postoperative discomfort and recovery time, as well as increased patient satisfaction.

Our study found that the Underlay technique graft was rejected in 8 patients. The preoperative mean air bone gap measured 26.5 dB, which decreased to 17.2 dB after the surgery. After 12 weeks, there was a mean hearing gain of 8.80 dB following the surgery. Three patients experienced graft rejection in the interlay technique. The preoperative mean air bone gap was initially measured at 25.6 dB, but it was later reduced to 13.2 dB. After 12 weeks, there was a mean hearing gain of 12.1 dB following the surgery. There were no complications observed during either of the two procedures.

The success rates for the Underlay and Interlay techniques were 89% and 95%, respectively. In a recent study conducted by Patil BC et al, they examined 100 cases that underwent surgery using the interlay method. The results showed an impressive graft success rate of 96%, leading the researchers to conclude that interlay tympanoplasty is a reliable and efficient technique for placing grafts in cases of large central perforation. [13] A study conducted by Jain et al examined 500 cases of chronic suppurative otitis media (CSOM) that were treated using the interlay method. They found a graft uptake rate of 96.6%, which is similar to the findings of our own study. An interlay technique is often recommended as a highly effective method for reconstructing the tympanic membrane. [14]

In this study, the Interlay technique demonstrated a significantly better outcome in terms of resolving the air-bone gap compared to the underlay group. According to the study, the Interlay method resulted in improved graft take and a reduced postoperative air bone gap, leading to a better

overall outcome. The preoperative mean air bone gap in groups 1 and 2 was 26.5 ± 8.45 dB and 25.6 ± 8.20 dB, respectively. After the surgery, the mean air bone gap decreased to 17.2 ± 8.88 dB in group 1 and 13.1 ± 5.89 dB in group 2. In their study, Raj et al found that the endoscopic group had a graft uptake rate of 90%, while the microscopic group had a rate of 85%. The results of endoscopic myringoplasty were similar to those of conventional myringoplasty performed under an operating microscope. There was no notable difference in the improvement of the A-B gap between the two groups. [15] In a study conducted by Sergi et al using the underlay technique, the average post-operative ABG was found to be 9.9 dB. A total of 56% of participants successfully achieved complete ABG closure. [16] In a study conducted by Takahashi M et al, they reported on 51 cases. The average postoperative AB gap ranged from 4.0 to 18.1 dB, and a significant majority of the cases had a postoperative AB gap within 20 dB. [17]

According to numerous studies, the interlay technique showed superior graft uptake and hearing gain compared to the underlay technique. According to a study conducted by Jain et al, the graft uptake rate was found to be 96.6% using the interlay technique. Additionally, 95.4% of the patients reported an improvement in their hearing. [14] According to Kawatra et al, the Interlay technique has shown superior results in terms of graft uptake and hearing improvement when compared to the underlay technique. [8] Komune et al found a graft uptake rate of 94.2%. [5]

It is evident that numerous studies, including the current study, have shown highly promising success rates for the Interlay technique, typically exceeding 90%. In the interlay technique, the graft is supported medially by the mucosal layer and laterally by the fibrosquamous layer. This positioning ensures that the fibrous annulus is placed back close to the bony sulcus, resulting in none of the cases in the present study experiencing blunting, lateralization, epithelial cyst formation, or medialization. This finding aligns with the studies conducted by Jain et al [14] and Patil et al [13] independently.

Conclusion

The Interlay technique in Type I tympanoplasty has been found to be highly successful in terms of both graft uptake and ABG closure. The complications related to this method are relatively minimal compared to other techniques. Based on the findings, it appears that interlay may be a more effective method than underlay type I tympanoplasty for treating chronic otitis media with large central perforation of mucosal variety.

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