ABSTRACT: Tympanic membrane perforation may be traumatic in origin or due to CSOM which may not heal spontaneously. Over the years various modalities of treatment have evolved for the treatment of this. Primary aim of the treatment is to control and eliminate the foci of infection. The closure of tympanic membrane perforation with different graft materials restores the vibratory area of the membrane, gives round window protection, reduces susceptibility of the middle ear mucosa to infection and improves hearing. Two basic techniques have come up in which the graft is placed either over the drum remnant or under the drum remnant and the techniques are called overlay and underlay respectively. The present study is an attempt to compare the results of both techniques in a tertiary care hospital. Tympanic membrane perforation may be traumatic in origin or due to CSOM which may not heal spontaneously. Over the years various modalities of treatment have evolved for the treatment of this. Primary aim of the treatment is to control and eliminate the foci of infection. The closure of tympanic membrane perforation with different graft materials restores the vibratory area of the membrane, gives round window protection, reduces susceptibility of the middle ear mucosa to infection and improves hearing. Two basic techniques have come up in which the graft is placed either over the drum remnant or under the drum remnant and the techniques are called overlay and underlay respectively. The present study is an attempt to compare the results of both techniques in a tertiary care hospital.

KEYWORDS: Underlay technique, Overlay technique, Myringoplasty.

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ORIGINAL ARTICLE

ONE YEAR PROSPECTIVE STUDY TO COMPARE UNDERLAY AND OVERLAY TECHNIQUES OF MYRINGOPLASTY
K. M. Thomas Rony¹, Anil Markose², Asha Annie Abraham³, Jacob C. E⁴, Sajeev George M⁵

HOW TO CITE THIS ARTICLE:
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and radiological findings. William Wilde's incision and homologous temporalis fascia graft was used in everyone.

**SURGICAL TECHNIQUE:**

**Underlay Technique:** Tympanic membrane perforation visualised, through posterior meatotomy through the microscope. The margins of tympanic membrane perforation were freshened and under surface were abraded. The canal incision is designed to create a laterally based vascular strip. The horizontal incision was taken first approximately 2 to 5 mm lateral to the annulus from the 12 o’clock to the 6 o’clock position, followed by vertical incisions. The superior limb follows the tympanosquamous suture line and the inferior limb follows the tympanomastoid suture line. The tympanomeatal flap along with the annulus was elevated. The temporalis fascia graft is shaped to the proper size needed for closure of perforation and is tucked into position under the anterior tympanic membrane remnant and onto the posterior canal wall. Care is taken to obtain the maximum amount of circumferential overlap of the graft with the tympanic membrane. Franklin M. Rizer(1997)\(^2\) recommends at least 5 mm of overlap. The annulus is placed back into position posteriorly and the vascular strip is carefully moved into its anatomic place. Gelfoam is placed over the drum remnant, graft and vascular strip. External auditory canal is filled with bacitracin ointment impregnated ribbon gauze.

**Overlay technique:** The initial steps in exposing the tympanic membrane through post auricular incision for the overlay are similar to that of underlay technique. Once the vascular strip has been elevated the remainder of the bony canal skin and periosteum is elevated medially towards the annulus. Dissection is continued onto the tympanic membrane between the squamous and fibrous layer. Dissection is started anterio superiorly using cup forceps to get into the plain more easily. A proper size graft required for the closure of perforation is then placed over the tympanic membrane remnant. The canal skin is then replaced and the vascular strip is laid back down. Remaining procedure is similar to the underlay technique.

Patients were put on Ciprofloxacin 500 mg tablet twice daily for one week along with analgesics, antihistamines, 0.1% xylometazoline nasal drops and multivitamins. The condition of the graft was appreciable from the 2nd week onwards and pure tone audiometry was done at 6th week post-operatively. Auditory gain was calculated by taking the difference of pre-operative and post-operative pure tone averages in Speech frequency (0.5, 1 and 2 kHz). Outcomes were measured for healing, post-operative hearing and the incidence of complications.

**OBSERVATION:** The results of 15 cases each of underlay technique and overlay technique of myringoplasties were assessed for patients’ statistics, surgical results, anatomical results and functional results. All of them were in age group of 16 and 50, the average age of underlay group was 26.5 years and that of overlay group was 25 years.
In underlay group 5 patients, 6 patients and 2 patients each were in the age group of 10-20, 21-30, 31-40 & 41-50 respectively. Among the patients who underwent underlay technique, 5, 7 & 3 patients were in the age group of 10 to 20, 21 to 30 and 31 to 40 years.

In our study 17 cases (56.7%) belonged to the low socio economic group and 13 cases (43.3%) belonged to the middle class income group. None of the patients were in the high-income group. All the 30 (100%) patients in the study had ear discharge and some degree of hearing impairment. Three patients (20%) from the underlay group and 1 patient (6.7%) from the overlay group had tinnitus. No patient in the study presented with symptoms of otalgia, vertigo and facial palsy.

Oto- microscopic findings

All the patients included in the study had central perforations.

| Size of perforation      | Underlay group | Overlay group | Total | Percentage |
|--------------------------|----------------|---------------|-------|------------|
|                          | NO. | %    | NO.   |           |
| Small central            | 6   | 40   | 4     | 60         | 10         | 33.3       |
| Medium sized central     | 9   | 60   | 11    | 40         | 20         | 66.7       |
| total                    | 15  | 15   | 15    | 30         | 100        |

In this study 20 (66.7%) patients, i.e. 9 of the underlay group (60%) and 11 of the overlay group (40%) had moderate sized central perforations. Ten (33.3%) patients, i.e. 6 (40%) of the underlay group 14 (60%) of the overlay group had small central perforations. No one had large or subtotal perforations. Pre-operative x-rays (schuller's view) showed sclerotic mastoids in one patient of underlay group and two patients of overlay group. Nine (60%)patients of the underlay group and 7 (46.7%) patients of the overlay group had diploeic mastoids. Five (33.3%) patients in the underlay group and 6 (40%) patients in the overlay group had cellular mastoids.
Pre-operative pure tone audiometry: Pre-operative pure tone audiometry was done for all the patients and average hearing loss in the speech frequencies (0.5, 1.0 and 2.0 kHz) were calculated which showed conductive hearing loss in everyone. Only the ear, which was operated upon, is considered in the calculation.

| Average Conductive loss in dB | Underlay group | Overlay group | Total |
|------------------------------|----------------|---------------|-------|
|                              | NO  | %  | NO  | %  | NO  | %  |
| Less than 20                 | 4   | 26.7 | 1   | 6.7 | 5   | 16.7 |
| 21 - 30                      | 4   | 26.7 | 5   | 33.3 | 9   | 30   |
| 31 - 40                      | 5   | 33.3 | 7   | 46.7 | 12  | 40   |
| 41 - 50                      | 2   | 13.3 | 2   | 13.3 | 4   | 13.3 |

Five (16.7%) patients had an average hearing loss of up to 20 dB, i.e. 4 (26.7%) patients in the underlay group and 1 (6.7%) patient in the overlay group. 9 (30%) patients, i.e. including 4 (26.7%) of the underlay group and 5 (33.3%) of the overlay group had a loss of 21 to 30 dB. 12 (40%) patients were in the range of 31 to 40 dB consisting of 5 (33.3%) the underlay group and 7 (46.7%) of the overlay group. 4 (13.3%) patients consisting of 2 (13.3%) from underlay group and 2 (13.3%) from overlay group had hearing loss in the range of 41 to 50 dB.

Post-Operative Pure Tone Average in dB [6 weeks]: Post-operative audiometric evaluation was done at 6th week in all patients.

| Average Conductive loss in dB | Underlay group | Overlay group | Total |
|-------------------------------|----------------|---------------|-------|
|                               | NO. | %  | NO. | %  | NO. |
| Less than 20                  | 7   | 46.7 | 7   | 46.7 | 14  | 46.7 |
| 21 - 30                       | 6   | 40  | 7   | 46.7 | 13  | 43.3 |
| 31 - 40                       | 2   | 13.3 | 1   | 6.6  | 3   | 10   |

Results showed that 14 patients (46.7%) had residual average conductive hearing loss of up to 20 dB, i.e. 7 patients (46.7%) in the underlay group and 7 patients (43.3%) in the overlay group. 13 patients (43.3%) had residual average conductive hearing loss of 20 to 30 dB, i.e. 6 patients (40%) in the underlay group and 7 patients (46.7%) in the overlay group. 3 patients (10%) were in the range of 30 to 40 dB residual average conductive hearing loss, i.e. 2 patients (13.3%) from the underlay group and 1 patient (6.6%) from the overlay group.

In this study 28 patients (93.3%) had conductive hearing improvement, 14 patients each from both the groups. Two patients did not show any improvement in conductive hearing after the
surgery, one with underlay technique and the other with overlay technique. Average conductive hearing improvement with underlay technique was 8.3 dB (range 0 to 17 dB) and with overlay technique it was 10.4 dB (range 0 to 21 dB). Average conductive pure tone difference between the pre and post-operative air conduction threshold showed that 21 patients (70%) had an improvement of 0 to 10 dB, i.e. 11 patients (73.3%) in the underlay group and 10 patients (66.7%) in the overlay group. 7 patients (23.3%) were in the range of 11 to 20 dB, i.e. 4 patients (26.7%) in the underlay group and 3 patients (20%) in the overlay group. 2 patients (13.3%) of the overlay group showed improvement of 21 to 30 dB.

28 patients (93.3%) showed good take up of the graft. One patient (6.7%) of the underlay group had graft medialization and 1 patient (6.7%) of the overlay group showed graft lateralization. Only one patient (3.3%) had a complication in form of post aural wound infection, which subsided with medical line of treatment.

| Range in dB | Underlay group | Overlay group | Total |
|------------|----------------|---------------|-------|
|            | NO. | %   | NO. | %   | NO. | %   |
| 0-10       | 11  | 73.3| 10  | 66.7| 21  | 70  |
| 11-20      | 4   | 26.7| 3   | 20  | 7   | 23.3|
| 21-30      | 0   | 0   | 2   | 13.3| 2   | 6.7 |

**DISCUSSION:** The present study was conducted in patients of chronic suppurative otitis media (CSOM) with central perforations, attending the Otorhinolaryngology department of MOSC Medical College during April 2011 and March 2012. The results of 15 cases of myringoplasty with underlay technique and 15 cases of overlay technique were assessed. In a study conducted by Chopra et al (2001), the patients were in the age up of 16 to 50 years which is similar to our patients’ age group. Graft success rate in children increases as the age increases.

There is a close relationship of chronic otitis media and low socio-economic group. High incidence is due to poor general health, malnutrition and overcrowding. In a study conducted by Tiwari et al (1991), 70% of the patients belonged to the low socio-economic group. In our study 56.7% belonged to the low socio-economic group and 43.3% belonged to the middle class income. The principal symptoms of CSOM are otorrhea, hearing loss along with tinnitus, earache, giddiness and facial weakness. The characteristics of otorrhea many a times indicate type of CSOM. The discharge tends to be profuse, mucopurulent, seldom malodorous, and intermittent and is precipitated by upper respiratory tract infection in tub tympanic cases of CSOM. In atticoantral variety, the discharge is foul smelling, scatty, purulent or with flakes and continuous which is not precipitated by any condition. Hearing loss is purely conductive in tubotympanic cases while it may be conductive or mixed in atticoantral type. The development of headache, vertigo or facial palsy is an evidence of complications. In a prospective audit study of 1070 myringoplasties, done by Kotecha B et al (1999), 69.6% of perforations were due to infective causes, 3.2% were traumatic, 10.4% were iatrogenic and 16.8% were unknown or not recorded. All the 30 (100%) patients in our study presented with ear discharge either active or inactive and some degree of hearing impairment. 3 cases (20%) in the underlay group and 1 case (6.7%) in the overlay group had tinnitus. Important aspect of a successful myringoplasty is the period in which the ear remained dry. All the cases in this...
study were operated after the ear was dry for a minimum of 2 weeks.

In a prospective audit study of 1070 myringoplasties by Kotecha et al (1999), size of the tympanic membrane perforations was classified as those less than 50% and those more than 50% of the tympanic membrane. In the same study, it was noted that graft uptake is better for perforations involving less than 50% of the tympanic membrane. Take up rate was 84.7% (710/1018 cases) and 76.5% (8/1018 cases) respectively for perforations of less than 50% and those of more than 50%. All the patients included in our study, had central perforations in pars tensa and they were classified according to the number of quadrants it occupied. Small perforations were limited to one quadrant only, while moderate perforations involved 2 quadrants including kidney shaped perforations. Large perforations were those classified as occupying 3 quadrants and subtotal perforations were those occupying all 4 quadrants, bounded by the annulus. In our study 20 (66.7%) of the patients, i.e. 9 of the underlay group (60%) and 11 of the overlay group (40%) had moderate sized central perforations. 10 of the patients (33.3%) that is 6 (40%) of the underlay group and 4 (60%) of the overlay group had small central perforations. None of the patients in this study had large or subtotal perforations, as it was excluded from the study.

Pre-operative x-rays (schuller's view of both mastoids) of all patients were taken. In this study one case of the underlay (6.7%) had sclerotic mastoids while two cases of the overlay group (13.3%) had the same. 9 cases of the underlay group (60%) and 7 cases of the overlay group (46.7%) had diploeic mastoids. 5 patients in underlay group (33.3) and 6 patients in the overlay group (40%) had a cellular mastoids. None of the x-rays showed cavitations in the mastoids or evidence of coalescent mastoiditis.

Pure tone audiometry in the speech frequencies (0.5, 1.0 and 2.0 kHz) showed conductive hearing loss in all the patients. Only the ear, which was operated upon, is considered in the calculation. In the present study 5 patients (16.7%) had an average hearing loss of up to 20 dB, 4 (26.7%) in the underlay group and 1 (6.7%) in the overlay group. Nine patients (30%) including 4 (26.7%) of the underlay and 5 (33.3%) of the overlay had a loss of 21 to 30 dB. 12 (40%) patients were in the range of 31 to 40 dB consisting of 5 (33.3%) from underlay group and 7 (46.7%) from overlay group. Four (13.3%) patients consisting of 2 (13.3%) from underlay group and 2 (13.3%) from overlay group had hearing loss in the range of 41 to 50 dB. The average conductive hearing loss in the underlay group was 29.1 dB (range 12 dB to 45 dB) while that of overlay group was 31.6 dB (range 17 dB to 43 dB).

Homologous temporalis fascia is an excellent graft material for closure of perforation of tympanic membrane (John Mathai et al, 1999). Surgical intervention is the main stay of treatment in the closure of the tympanic membrane perforations for all cases of CSOM. Franklin M. Rizer (1997) retrospectively reviewed 551 cases in which the underlay technique was used and 158 cases using the overlay technique. After reviewing the advantages and disadvantages of both the techniques he concluded that the underlay technique was ideal for small sized perforations while overlay technique is ideal for perforations situated in the anterior quadrant. Chopra H, Munjal M, Mathur N (2001) conducted a study to assess the graft uptake results in patients undergoing different techniques of myringoplasty, where a total of forty patients were studied. In the present study myringoplasty was done in all 30 cases under general anaesthesia. Underlay technique and overlay technique were used in 15 cases each. No additional procedure was required in any of the cases.

In a study by Quraishi et. Al. 23 patients (72%) in the study group had a post-operative
improvement in their hearing, with an average of 14 dB (range 5 to 31 dB). Their control group with 15 patients (47%) had an average hearing improvement of 11 dB (range 3 to 30 dB). In the present study post-operative audiometric evaluation was done at 6th week. Results showed that 14 patients (46.7%) had residual average conductive hearing loss of up to 20 dB, 7 (46.7%) in the underlay group and 7 (43.3%) in the overlay group. Post-operatively, 13 patients (43.3%) had residual average conductive hearing loss of 20 to 30 dB, 6 (40%) in the underlay group and 7 (46.7%) in the overlay group. Three patients (10%) were in the range of 30 to 40 dB, 2 patients (13.3%) from the underlay group and 1 patient (6.7%) from the overlay group.

In a study by Chopra H, Munjal M, Mathur N (2001)\(^1\), 56.25% had hearing improvement of 10 to 20 dB air-bone gap closure, 37.5% less than 10 dB air-bone gap closure and 6.25% showed more than 20 dB air-bone gap closure. In another study by John Mathai et al\(^3\), there was definite improvement of hearing in all the cases (in the range of 20 dB to 30 dB). In a study by Fraklin M. Rizer\(^2\), myringoplasty resulted in closure or over closure of the air-bone gap less than 10 dB in 83.9% and to more than 10 dB 16.1% of patients. Quraishi et al\(^4\) 1995 showed that 72% of patients had post-operative hearing improvement. In the present study 28 patients (93.3%) had hearing improvement, 14 cases of (93.3%) underlay group and 14 cases of 93.3% overlay group. Average hearing improvement with underlay technique was 8.3 dB (range 0 to 17 dB) and 10.4 dB (range 0 to 21 dB) with overlay technique (using the 'Z' test P value is determined and P value is > 0.05).

In a study by Sharp J.F. et al\(^7\), in 1992 there was a mean auditory threshold gain of 8.5 dB. They reported a gain of 5 to 11.9 dB in 95 the cases. In a study by, Chopra H, Munjal M, Mathur N (2001)\(^1\), 51.51% cases showed a post-operative hearing improvement of 10 to 20 dB, 42.36% showed less than 10 dB improvement and 6.06% cases had more than 20 dB hearing improvement. In present study, pure tone average difference between the pre and post-operative air conduction threshold showed that 21 patients (70%) had an improvement in the range of 0 to 10 dB, 11 (73.3%) cases the underlay group and 10 (66.7%) cases in the overlay group. 7 cases (23.3%) were in the range of 11 to 20 dB, 4 (26.7%) in the underlay group and 3 (20%) in the overlay group. 2 cases (13.3%) of the overlay group showed improvement of 21 to 30 dB.

Quraishi et al\(^4\) 1995 stated the graft success rate was 84% for the cases receiving temporalis fascia. Fraklin M. Rizer (1997)\(^2\) showed a successful healing rate of 90.3% in his myringoplasties irrespective of the technique. Using overlay technique he achieved successful grafting in 95.6% of the cases. He had 88.8% success rate with underlay technique of myringoplasty. In the present study condition of graft was examined from 3rd week onwards, post-operatively. Minimum follow up period was of 6 weeks. 28 cases (93.3%) showed good healing, 14 (93.3%) cases of the underlay group and 14 (93.3%) cases of the overlay group. Graft was medialised in one case (6.7%) of the underlay group. One (6.7%) case of graft lateralization (using the 'Z' test P value is determined and P value is > 0.05).

Of the 30 patients operated, all the patients had dry ears at the time of surgery. One case, with small central perforation, showed graft medialization with underlay technique. Improper tucking of the graft on the anterior canal wall might have caused the medialization. A patient with a medium sized central perforation after overlay technique of myringoplasty showed lateralization at 6th week post-operatively. This can be attributed for placing the graft lateral to the handle of malleus. Proper placing of the graft medial to the handle of malleus will avoid the lateralization. None of the cases developed blunting in our series.
Franklin M Rizer in 1997 reported that 8% of the cases developed complications following underlay technique of myringoplasty. He reported complications like infection, worsening of hearing, tympanic cholesteatoma and atelectatic drums in underlay technique. He reported 8.9% complication rate for overlay technique of myringoplasty, which includes infection, worsened hearing, perforation and lateralized drum. John et al in 1999 reported a complication rate of 5% in patients undergoing myringoplasty with temporalis fascia. In the present study, only one (3.3%) case of underlay technique had a complication of post aural wound infection, which subsided with medical line of treatment. None of the patients had complications like granulation tissue formation, pinna haematoma, facial nerve palsy, extradural abscess or loss of taste sensation.

CONCLUSION: Hearing results with both underlay and overlay techniques of myringoplasty were similar. Success rate in our study was 93.3% with underlay technique and 93.3% with overlay technique. No statistically significant difference was noted. Post-operatively, the tympanic membrane with both techniques had similar properties, with respect to appearance and mobility. Age, sex and side of involvement had no bearing on the result. Radiological findings of x-ray mastoids did not affect the outcome. When all factors are aligned, excellent results can be expected from myringoplasty at any age with either an underlay or an overlay technique.

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