Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 1, 2021, Pages. 2297 - 2313
Received 15 December 2020; Accepted 05 January 2021.

PROSPECTIVE STUDY OF OVERLAY AND UNDERLAY TECHNIQUE IN MYRINGOPLASTY

K. Jayasudha[1], M.K. Rajasekar[2]
[1,2]Department of Otorhinolaryngology, SreeBalaji Medical College & Hospital, Chromepet, Chennai
*rajasekar.k@bharathuniv.ac.in

ABSTRACT

Underlay technique of myringoplasty showed results better than overlay myringoplasty in our study population. There was 88% success rate observed in the study population undergone underlay technique. The subjective hearing improvement co-relates well with the objective closure of AB gap on postoperative pure tone audiometry. On internal comparison of myringoplasty techniques (underlay myringoplastyvs overlay myringoplasty) the following conclusions were observed

Keywords:myringoplasty, perforation, temporalis fascia, Chronic otitis media

Introduction

Chronic suppurative otitis media is the most common otorhinolaryngology problems and one of the major health problems around the world. Chronic otitis media (COM) is defined as chronic inflammation of mucoperiosteal lining of part or whole of the middle ear cleft. It has been recognized since prehistoric times. It is classified into two types, mucosal and squamous, of which mucosal type is characterized by intermittent mucoid or mucopurulent discharge through a perforated tympanic membrane. It is the major public health problem in children and adults 1. Incidence of Chronic Otitis Media is higher in developing countries because of poor socioeconomic standards, poor nutrition. Prevalence of chronic suppurative otitis media in developing countries is around 72 cases per 1000 inhabitants and in the world is over 20 million. In India, prevalence of chronic suppurative otitis media is approximately 2%.

Tympanic membrane perforations can lead to recurrent ear infections and hearing loss, in India there is a general lack of awareness of the disease per say and also regarding the complications of the disease. Although the introduction of antibiotics has reduced the mortality in COM, still surgery remains the definitive treatment modality for closure of tympanic membrane perforation. Apart from this, people in our country are not aware of the functional benefits of myringoplasty/tympanoplastyand they are generally content to live with discharge and residual hearing loss 1. Spontaneous healing of chronic perforation of the tympanic membrane is uncommon and medical management is not effective in this regard. Hence surgery is necessary for closure of perforation.

From seventeenth to nineteenth century several attempts at closing tympanic membrane perforations were made using prosthetic materials like paper patch and cauterizing agents. Surgical repair of tympanic membrane was first attempted by Banzer (1640) with pig'sbladder 1. In1878 Berthold devised the term myringoplasty 2, 3 . In 1952, Wullstein formally announced 3, 4 a technique of closing perforation. That time he used split thickness skin graft 3, 4.After Wullstein 5 and Zollner 6introduced tympanoplasty in early 1950s, overlay graft was being used in all surgeries. The article "tympanoplasty as an operation to improve hearing in chronic otitis media and its results" by Wullstein had prepared the arena for the operation to be performed with a goal to improve hearing and protect the middle ear from the outside environment 5. Spilt thickness and full thickness skin graft were being used at that period of time, but graft eczema, desquamation, with poor long term results made surgeons search for alternate grafting

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 1, 2021, Pages. 2297 - 2313
Received 15 December 2020; Accepted 05 January 2021.

materials. Canal skin pedicle grafts had been used by Sooy in 1956 6. House and Sheehy 7, 8 and Plester 9 began using canal skin as free overlay graft independently of each other in 1958. Satisfactory techniques were created by House, Sheehy and Glasscock 10 in respect to the onlay placement of the tympanic membrane graft. They concluded that the high survival rate of dry fascia grafts was due to low metabolic rate as well as low viability.In 1960 underlay technique was described by Shea. When vein and fascia could be placed beneath tympanic membrane remnant the groundwork for underlay procedure was laid 11, 13.There are several factor mentioned in literature that may affect surgical results, including age, perforation size and site, the status of opposite ear, the type of graft , inactive status and technique used overlay or underlay. Myringoplasty is a surgical procedure to prevent recurrent discharge from the middle ear and to restore hearing mechanism in patients with otitis media, by closing the tympanic membrane perforation using different type of graft. The temporalis fascia or Conchalcartilage graft forms a scaffold for the growing epithelium to close the perforation.

The main objective of this study includes: determining the success of graft uptake rates and hearing gain in patients with chronic perforation of the tympanic membrane undergone overlay or underlay technique among the patients included in this study.

MATERIALS AND METHODS

The study design was Prospective conducted in 50 patients who attended E.N.T opd in SreeBalaji Medical College and Hospital for a period of 2 years and follow up them for a period of 6 months.

INCLUSION CRITERIA:

Both male and female patients between 20 to 50 years .

CSOM with Central perforation.

Inactive stage.

Conductive hearing loss.

Ossicular chain intact and mobile.

EXCLUSION CRITERIA:

Age less than 20 and more than 50 years.

Active and quiescent stage.

Traumatic perforation.

Mixed and sensorineural hearing loss.

Patients with adenoid enlargement 37.

MATERIALS:

Surgical technique adopted in our study is underlay and overlay myringoplasty. The equipment's used for this surgery listed below: 0 degree Hopkins endoscope, 4 millimeters wide angled 37, 38. CCD camera (storz, single chip). Rosen's, sickle knife and other middle ear micro instruments were used. Colour monitor which is facing the surgeon and light source cable. 38. Maico ma 52 clinical diagnostic two channel audiometer provided with sound proof room for audiological assessment.

METHODOLOGY

The patients who were selected for surgery were admitted in the ward, detail history and clinical examinations was done. Pre-operative and post operative hearing status to measure to assess the hearing improvement by comparing Air-Bone gap and the surgical outcome also measured by graft uptake. Diagnostic nasal endoscopy was done for all cases to rule out focal sepsis. Routine

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 1, 2021, Pages. 2297 - 2313
Received 15 December 2020; Accepted 05 January 2021.

investigations are taken for all patients for the purpose of anaesthetic fitness for general anaesthesia. All the patients undergone surgery by endoscopic method. Informed consent was obtained from each patient and one of his/her relative. About 25 patients with dry ear for more than 6 weeks were subjected to surgery undergone underlay myringoplasty were considered group A. Of these 23 patients with unilateral disease and 2 patients with bilateral disease were taken up for the study. For patients with bilateral disease, worse ear in terms of hearing was taken up for surgery. Another 25 patients with dry ear more than 6 weeks were subjected to overlay myringoplasty were considered as group B. Of these 22 patients with unilateral disease and 3 patients with bilateral disease were taken up for the study. For patients with bilateral disease, worse ear in terms of hearing was taken for surgery.
Graft material of choice in all cases was temporalis fascia and Conchal cartilage. 21,42following surgery mastoid dressing was done, that was changed on the post-operative day two. Sutures were removed on 7 th post-operative day from the graft harvested site. Patients were treated with I.V antibiotics for 2 - 3 days and oral antibiotics were continued for another one week. In the first month patients were followed up every week. Next two months they followed up every 15 days. Then once in 1 or 2 months till the end of the study.

Post operatively following parameters were noted:
Graft taken
Graft not taken
Graft lateralization
Atelectasis

Pure tone audiometry was done after 3 months and documented. Pre and post-operative air bone (A-B) gap calculated by taking the averages of bone conduction and air conduction at the frequencies of 500, 1000 and 2000 Hz.42. The graft uptake is measured for surgical outcome.
Myringoplasty:
Myringoplasty can be done under local or general anaesthesia. 37 But in this study all cases were done under general anaesthesia. Pre anaesthetic medication and local infiltration used were same for all cases. Skin preparation and sterility 38:
A small area of skin of the scalp over the temporal region must be shaved to harvest the fascia so that 2 to 3 cm of hairless skin is visible. This operating area painted with providine iodine solution and the same flushed into the external auditory canal and then sterile saline. Underlay myringoplasty 39: Under aseptic precautions, the four quadrants of the ear canal area are infiltrated with 2% lignocaine and 1:2,00,000 adrenaline. The margins of the perforation are freshened, and 2 radial incisions made along the tympanomastoid and tympanosquamous suture lines. The medial ends of these were joined using a medial circumferential incision by Rosen's knife. A postauricular incision is made about 3 mm behind the fold, and a self- retaining mastoid retractor (Mollison's) used to expose the temporalis fascia.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 1, 2021, Pages. 2297 - 2313
Received 15 December 2020; Accepted 05 January 2021.

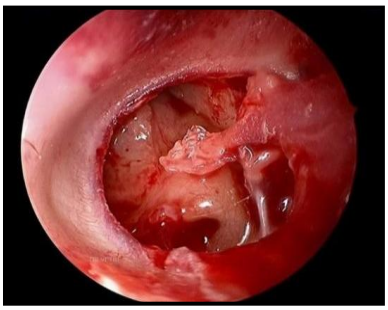


Fig 8: Margins freshened

By using Rosen's is used to elevate the temporalis fascia from the underlying muscle, and a large (roughly 2 cm × 3 cm) graft is harvested. The graft is spread on a Teflon block, any attached muscles teased off, and it is left to dry to parchment -like consistency.

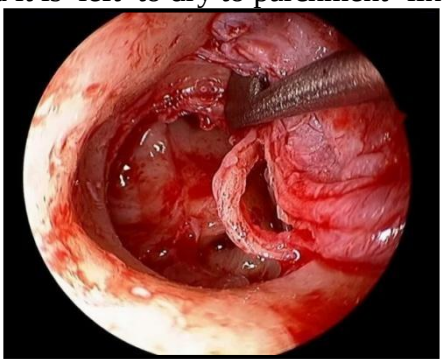


Fig 9: TM flap raised.

By using 0 degree endoscope Using microdissector and a small cotton ball, the tympanomeatal flap (with the posterior annulus) is elevated. The ossicular chain is inspected, and its mobility noted. The condition of the middle ear mucosa and Eustachian tube orifice (ETO) noted. The undersurface of the drum remnant or annulus is denuded of mucosa. Hemostasis achieved. The middle ear space is filled with gel foam, beginning anteriorly near the ETO and then the rest of the tympanic cavity. The graft is trimmed to size and placed into the ear.

A slit can be made for the handle of malleus and the graft tucked under the annulus, after carefully replacing the tympanomeatal flap.

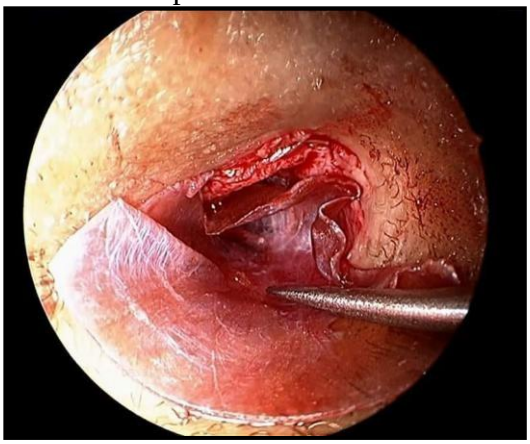


Fig:10: Temporalis graft inserted into middle ear.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 1, 2021, Pages. 2297 - 2313
Received 15 December 2020; Accepted 05 January 2021.

The vascular strip is replaced, and the rest of the canal packed with gel foam soaked with soframycin ointment. Post-auricular incision is sutured in layers, and a mastoid dressing applied. Patient is followed for 6 months and suture removal done by 7th day.

Fig:11. Graft insitu by underlay technique

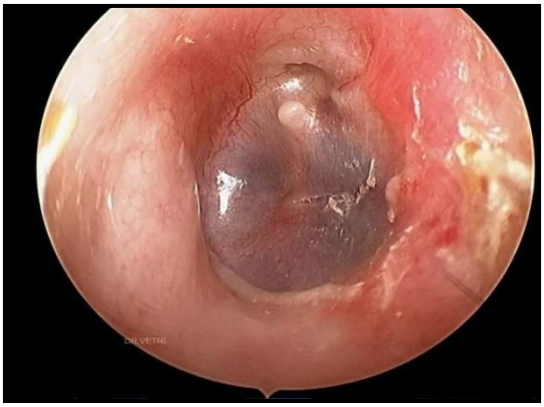


Fig12: Post operative temporalis graft uptake.

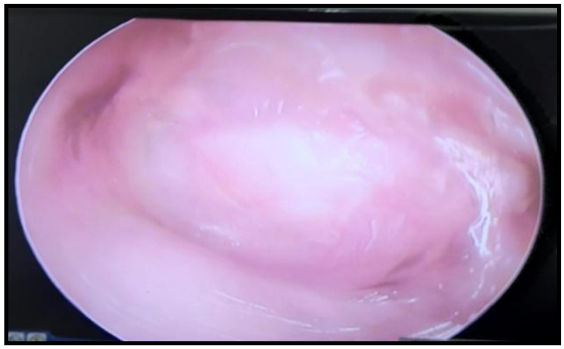


Fig 13: Post operativeConchal cartilage uptake.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 1, 2021, Pages. 2297 - 2313
Received 15 December 2020; Accepted 05 January 2021.

Overlay technique

Under aseptic precautions, the four quadrants of the ear canal and post auricular area are infiltrated with 2% lignocaine and 1:2, 00,000 adrenaline. By using 0 degree endoscope, the margins of the perforation are freshened.

Fig: 14. Margin freshens.

2 radial incisions by using Flags knife made along the tympanomastoid and tympano-squamous suture lines. The medial ends of these were joined using a medial circumferential incision by Rosen's knife. A post auricular incision is made about 3 mm behind the fold, and a self- retaining mastoid retractor (Mollison's) used to expose the temporalis fascia. Incision made on the temporalis fascia and it is used to elevate from the underlying muscle, and a large (roughly 2 cm × 3 cm) graft is harvested. The graft is spread on a Teflon block, any attached muscles teased off, and it is left to dry to parchment- like consistency. The retractors are removed.

Fig: 15. Incision made using Rosen's knife

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 1, 2021, Pages. 2297 - 2313
Received 15 December 2020; Accepted 05 January 2021.

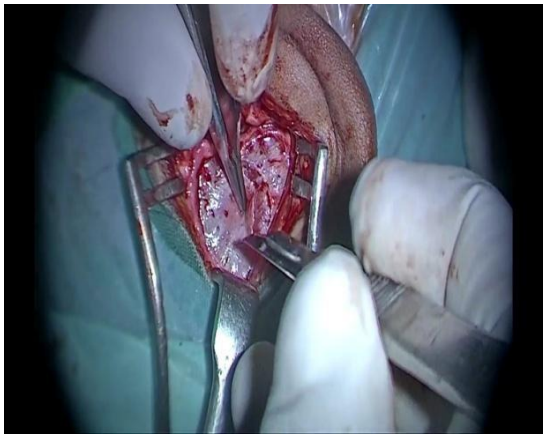


Fig: 16. Temporalis graft harvested.

A lateral circumferential incision is made, along the

anterior wall. Anterior skin wall is carefully elevated along the epithelial layer of the tympanic membrane remnant,taking care not to leave any residual epithelium over the tympanic membrane. The anterior canal wall skin is reoved and preserved.

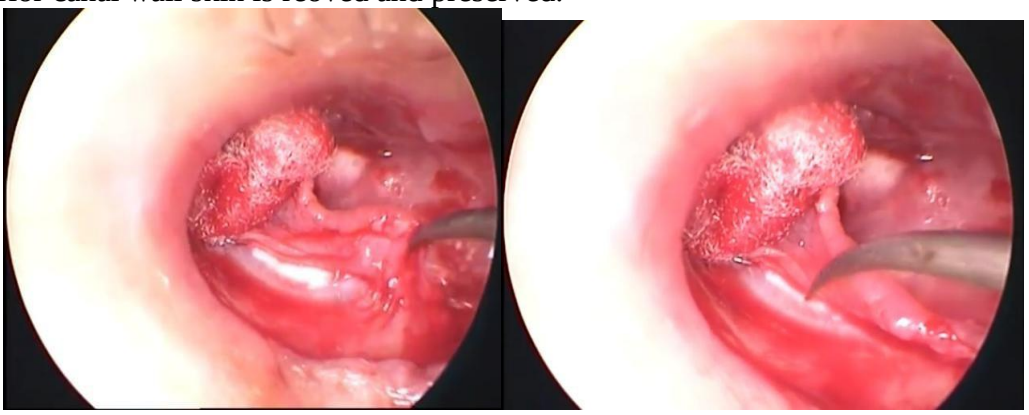


Fig17&18: Squamous part is separated from fibrous layer

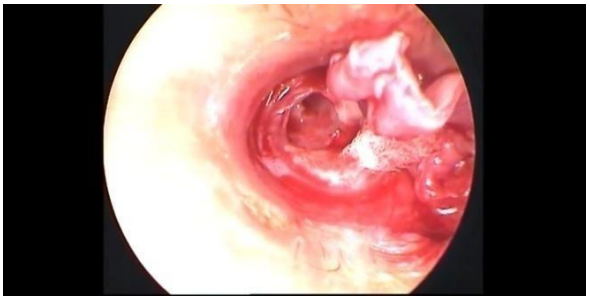


Fig 19: TM flap is raised.

The temporalis fascia graft is trimmed to size and preserved. The temporalis fascia graft is thencarefully positioned medial to the handle of malleus, the graft lifted and middle ear filled with gel foam, and final positioning of the graft done. Often, the double breasting technique was used. The anterior canal wall skin is reinserted and positioned so as to overlap the graft. External

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 1, 2021, Pages. 2297 - 2313
Received 15 December 2020; Accepted 05 January 2021.

auditory canal packed with gel foam and mastoid dressing applied. Patients were all put on antibiotic cover. Nasal steroid sprays were also routinely used. Pack and sutures were removed on postoperative day 7 and patient discharged on ear drops, oral antibiotics and antihistamines, and steroid nasal spray.

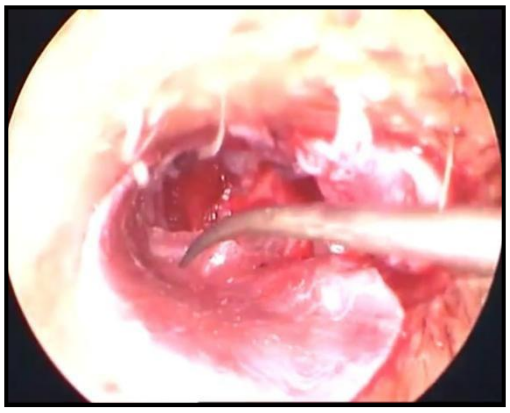


Fig: 20. Temporalis Graft.

Deep meatus filled with gel foam. Complete hemostasis achieved.

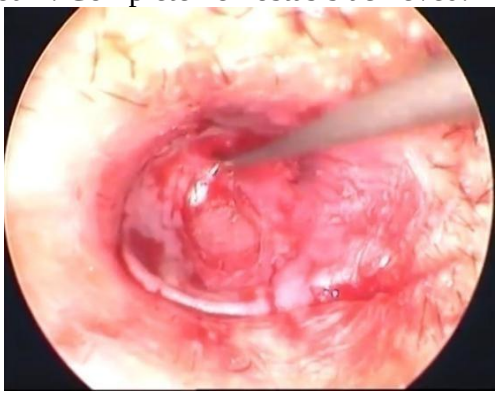
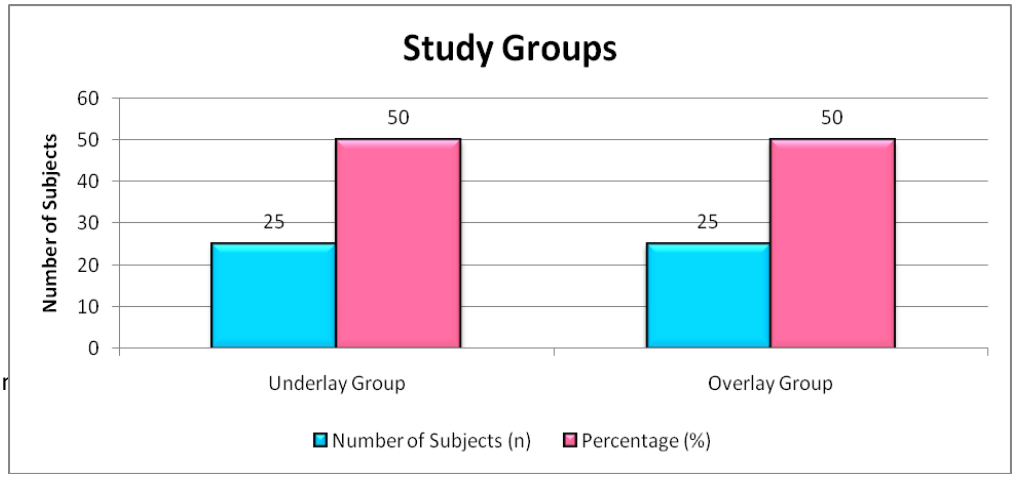


Fig: 21. Graft insitu

Ear care was explained. Patient is asked to review in ENT opdafter 1 week.

RESULTS

The present study was conducted on 50 patients in the department of ENT, SreeBalaji Medical College & Hospital, chennai. In our study 50 patients underwent CSOM, out of which 25 patients underwent overlay technique and 25 patient underwent underlay technique.



Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 1, 2021, Pages. 2297 - 2313
Received 15 December 2020; Accepted 05 January 2021.

Data Analysis

Descriptive statistics was done for all data and were reported in terms of mean values and percentages. Suitable statistical tests of comparison were done. Continuous variables were analyzed with the unpaired t test and ANOVA. Categorical variables were analysed with the Chi - Square Test and Fisher Exact Test. Statistical significance was taken as $P < 0.05$. The data was analysed using SPSS version 16 and Microsoft Excel 2007.

Description:

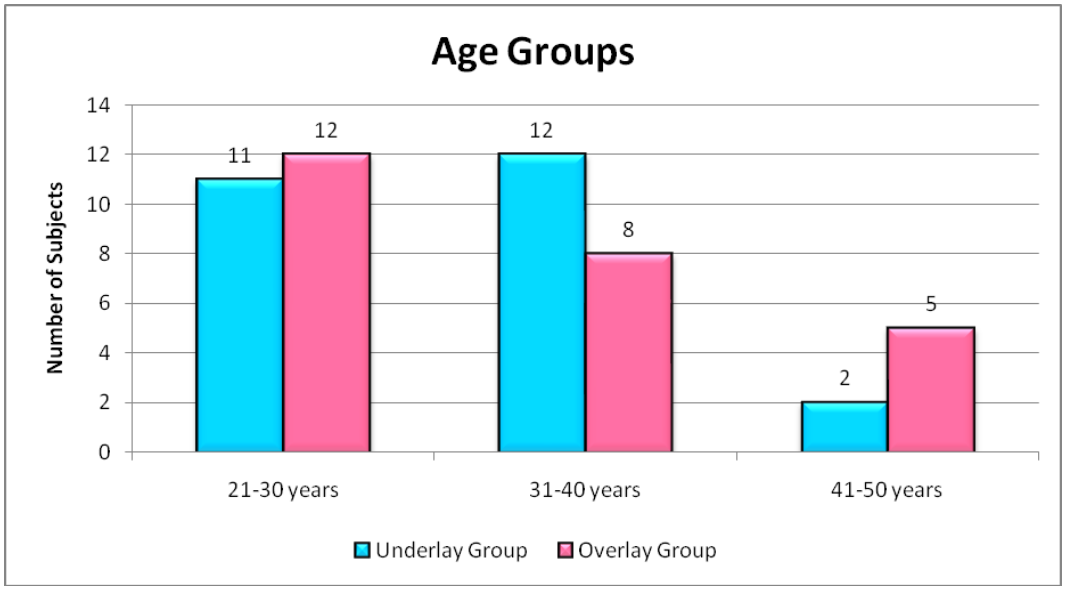
- The confidence level is estimated at 95% with a z value of 1.96

the confidence interval or margin of error is estimated at +/-7

- Assuming p% =3.3 and q%=96.7 n = p% x q% x

$[z/e\%]^2 n = 3.3 \times 96.7 \times [1.96/7]^2$ n= 25 per group.
Therefore 50 is the minimum sample size required (25 per group) for the study.
In my study I plan to recruit a minimum of 50 subjects (25 per intervention arm).

Age



Age Groups	Underlay Group	%	Overlay Group	%
21-30 years	11	44.00	12	48.00

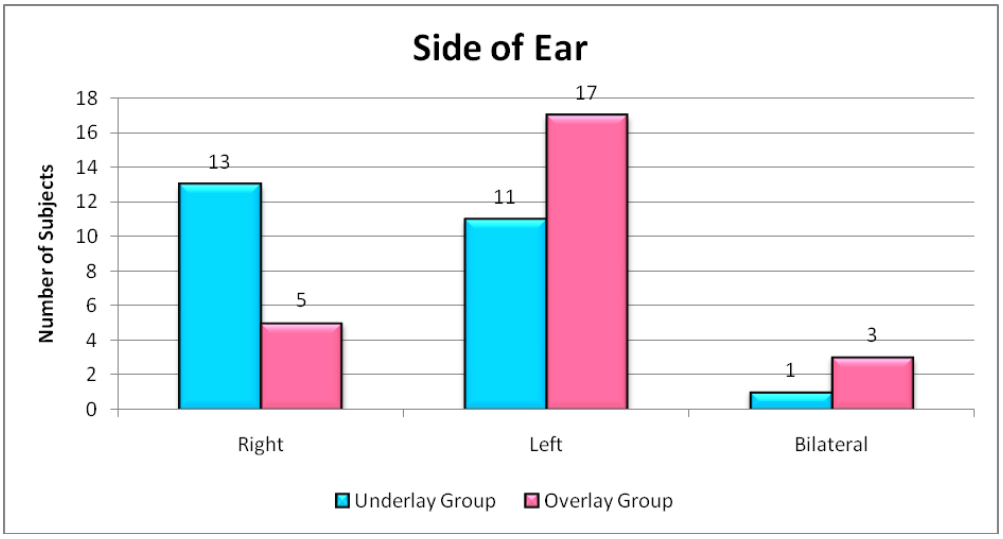
Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 1, 2021, Pages. 2297 - 2313
Received 15 December 2020; Accepted 05 January 2021.

31-40 years	12	48.00	8	32.00
41-50 years	2	8.00	5	20.00

Age Distribution	**Underlay Group**	**Overlay Group**
Mean	31.76	32.32
SD	6.20	7.45
P value Unpaired t Test		0.774

It is evident from the age distribution table that most of the underlay group subjects were in 31 - 40 years age group (48%) with a mean age of 31.76 years. In overlay group majority were in 21 - 30 years age group (48%) with a mean age of 32.32 years. (p= 0.774). The data subjected to unpaired t test reveals the existence of statistically non- significant association between age distribution and intervention groups (p > 0.05).

Side of Ear



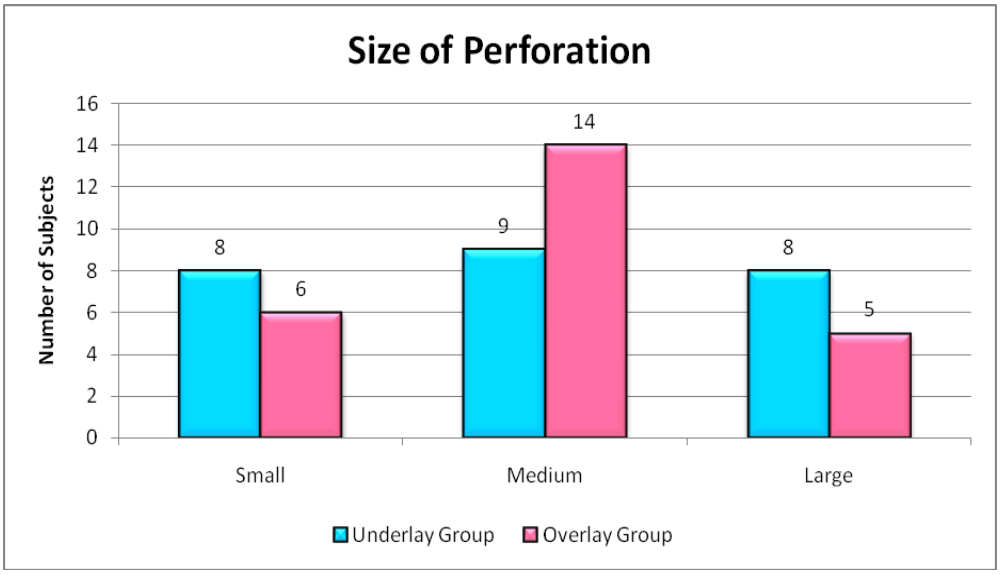
Side of Ear	**Underlay Group**	**%**	**Overlay Group**	**%**
Right	13	52.00	5	20.00
Left	11	44.00	17	68.00

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 1, 2021, Pages. 2297 - 2313
Received 15 December 2020; Accepted 05 January 2021.

Bilateral	1	4.00	3	12.00
P value Chi Squared Test	0.018			

It is evident from the side of ear perforation status table that most of the underlay group subjects had right side ear perforation (52%) followed by left side ear perforation (44%) and in overlay group majority had left side ear perforation (68%) followed by right side ear perforation (20%) (p= 0.018). The data subjected to chi squared test reveals the existence of statistically significant association between side of ear perforation status and intervention groups (p <0.05).

SIZE OF PERFORATION



Size of Perforation	**Underlay Group**	**%**	**Overlay Group**	**%**
Small	8	32.00	6	24.00
Medium	9	36.00	14	56.00
Large	8	32.00	5	20.00
P value Chi Squared Test	0.356			

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 1, 2021, Pages. 2297 - 2313
Received 15 December 2020; Accepted 05 January 2021.

DISCUSSION

The Prospective study was done to compare the overlay and underlay technique in myringoplasty. A comparative study was conducted in the Department of ENT, SreeBalaji Medical College and Hospital from July 2016 to July 2017 for 50 patients. Their hearing outcome and graft uptake were measured to assess the hearing and surgical outcome. In the total of 50 patients 25 patients underwent overlay technique and 25 patients underwent underlay technique.

AGE DISTRIBUTION

In our study of patients varies between 20years to 50years. It is evident that most of the underlay group subjects were in 31 -40 years age group (48%) with a mean age of 31.76 years. In overlay group majority were in 21 -30 years age group (48%) with a mean age of 32.32 years. (p= 0.774). This same view was echoed by ChirazMbarek that good chances of surgical outcome by restoring the hearing as age decreases.

SEX DISTRIBUTION

In the present study most of the underlay group subjects were males (56%) and in the overlay group majority were females (52%) (p=0.571).

SIDE OF EAR

In this present study most of the underlay group subjects had right side ear perforation (52%) followed by left side ear perforation (44%) and in overlay group majority had left side ear perforation (68%) followed by right side ear perforation (20%) (p= 0.018).

SIZE OF PERFORATION

In our study side of ear perforation status between the underlay group and overlay group was meaningfully significant. This is evident that medium sized perforations were most common in this study and the graft take rate in this group was 46% and small sized perforation was 28%. The graft taken rate of small perforation is highest 99.9% and medium sized was 86.95% and large perforation was 61.5% 46. The same view was echoed by Rupesh47closure rate is high in small perforation than large perforation. The site of perforation statistically affecting the outcome of the surgery was also reported by other 43, 44. The success rate of tympanoplasty depends upon the size of perforation i.e. this is less when perforation involves more than half of total circumference of the tympanic membrane. The anterior perforation of tympanic membrane has a success rate less than the perforation involving posterior half of tympanic membrane.

PERCENTAGE OF QUADRANT

In our study most of the underlay group subjects had 51-75% quadrant involvement (48%) and similarly in overlay group majority had 26 -50% quadrant involvement (56%) (p= 0.683).

Air-Bone Gap (dB) Underlay Group

The data subjected to ANOVA test reveals the existence of statistically significant association between preoperative air bone gap distribution and postoperative air bone gap distribution at 3 and 6 months with a p value of <0.001 (p > 0.05).

In our study the postoperative air bone gap distribution in underlay6months group between the preoperative ABG status and postoperative ABG status (3 and 6 months) was meaningfully significant. This is evident by the Decreased ABG in postoperative period at
compared to ABG in postoperative period at 3months

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 1, 2021, Pages. 2297 - 2313
Received 15 December 2020; Accepted 05 January 2021.

(mean difference of 1.12 dB, 6% lower).

Decreased ABG in postoperative period at 3months compared to ABG in preoperative period (mean difference of 14.48 dB, 44% lower).

Decreased ABG in postoperative period at 6 months compared to ABG in preoperative period (mean difference of 15.60 dB, 47% lower). The same view was echoed by previous author 50Singh et al have reported 93.3%success rate each technique and better hearing gain for patients underwent underlay myringoplasty. Postoperative graft uptake is better, graft laterization is less with decreased in air bone gap. Overlay Group The data subjected to ANOVA test reveals the existence of statistically significant association between preoperative air bone gap distribution and postoperative air bone gap distribution at 3 and 6 months with a p value of <0.001 ($p > 0.05$).

In our study the postoperative air bone gap distribution in overlay group between the preoperative ABG status and postoperative ABG status (3 and 6 months) was meaningfully significant. This is evident by that: Decreased ABG in postoperative period at 6 months compared to ABG in postoperative period at 3 months (mean difference of 0.20 dB, 1% lower). Decreased ABG in postoperative period at 3 months compared to ABG in preoperative period (mean difference of 12.60 dB, 38% lower). Decreased ABG in postoperative period at 6 months compared to ABG in preoperative period (mean difference of 12.80 dB, 39% lower). Underlay Group Vs Overlay Group – ABG

The decrease in ABG in postoperative period at 6 months compared to ABG in preoperative period was statistically significant ($p > 0.05$) and far more pronounced in underlay group (mean decrease difference of 2.80 dB, percentage decrease difference of 9%) compared to overlay group. The same view was echoed by Javid et al 46 also reported postoperative mean reduction in air bone gap in underlay technique to be better (21 db) than overlay technique. Even in literature review has shown that overlay technique is associated with more complications including bleeding, lateralization and thickening of the drum, squamous pearls and delayed healing. In this overlay ears developed atelactasis. Hearing results were significantly different between the overlay and underlay group. Closure of air bone gap within 0-20 dB in underlay group was 76%, while in over lay group it was 48%, which was in contrast to study of Rizer (Overlay 82%) 65.

GRAFT TYPE

In our study the graft type status between the underlay group and overlay group was meaningfully significant. This is evident by the increased incidence of temporalis fascia graft in overlay group compared to underlay group (percentage difference of 28 points, 28% higher). The graft used in underlay technique is 72% of temporalis fascia and 28% of conchal cartilage with 88.88% success in temporalis fascia and 85.71% success by using conchal cartilage. The same view was echoed by Mack E. Patterson 52 that temporalis muscle fascia has proven to be excellent material for tympanic membrane grafting since easily accessible as it is close to the operation site, easily to prepare, handle and increase in hearing outcome. Cartilage is a tough graft material with good revascularization and prevents negative middle ear pressure. Both graft material often fails as tympanic membrane reconstructions because of their low stability and tendency to atrophy over the years48.Nowadays, persisted tympanic membrane perforation is closed by a micro surgical procedure using different materials such as tragal perichondrium, with or without cartilage, temporalis fascia, septal cartilage, vein graft, fat, bone. Temporalis fascia is

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 1, 2021, Pages. 2297 - 2313
Received 15 December 2020; Accepted 05 January 2021.

the most commonly used as considered better graft material 50-52. According to this study the success rate with temporalis fascia as a graft material in underlay technique is near about 88% and in overlay technique is about 76%, however the Gibbs, Slung, Stars, Symith and Kerr reported the success rates of 65%, 86.7%, 90% and 91 %. So this shows that success rate is variable to the experience and skill of the surgeons.

Graft Uptake Status - 6 Months In this study the graft uptake at 6 months status table that most of the underlay group subjects had graft uptake (88%) and similarly in overlay group majority graft uptake (76%) (p= 0.464). We found that underlay technique wassignificantly better than overlay technique interns of drum healing (88% vs. 76%). This is in favour to both Doyle's and Glass-cocks results 14 .

The most significant findings in this study are high success rate with underlay technique and low incidence of complications associated with it. Endoscopic approach was used for adequate exposure. It is an ideal technique to repair perforation that are small and easily visualized in all quadrants, blunting and lateralization of the graft are avoided, the drum heals at the correct level relative to annulus and ossicles. The technique is quicker and easy to perform. The underlay tympanoplasty heals faster than overlay procedure because of lesser amount of surgical trauma and complication. The underlay technique is also technically less difficult and thus favours the occasional otologic surgeon.

CONCLUSION & SUMMARY

This study was conducted in the department of ENT, SreeBalaji Medical College & Hospital from July 2016 to July 2018 was to compare the hearing improvement and graft uptake between two techniques by Endoscopic myringoplasty in the study population.There was reduction in air-bone gap in 91.53% of study population in underlay technique. Underlay technique is easy and fewer complication than overlay technique with more graft lateralization and anterior blunting. The graft uptake was 88% better in underlay technique when compared to overlay technique from our observation. Based upon this study the success rate ofmyringoplasty depends upon selection of cases, technique of myringoplasty, hearing improvement and graft uptake. From our study we observed that underlay technique is better than overlay technique and the results have high clinical significance.

Funding: No funding sources

Ethical approval: The study was approved by the Institutional Ethics Committee

CONFLICT OF INTEREST

The authors declare no conflict of interest

ACKNOWLEDGMENTS

The encouragement and support from Bharath University, Chennai is gratefully acknowledged. For provided the laboratory facilities to carry out the research work.

REFERENCES

[1] Joshua S. Sckolnick, MD; Belinda Mantle, MD; Jia Li, MS; David H. Chi,MD. Paediatricmyringoplasty: Factors that affect success- A Retrospective study. Laryngoscope, 118: 723 -729, 2008.

[2] . Wullstien H. Theory and practice of tympanoplasty. The Laryngoscope 1956; 66: 1076 - 1093.

[3] Farr MR, De R, Irving RM. Cautery of the tympanic membrane:the lesser known history of myringoplasty. OtolNeurotol Feb; 33(2):270 -6 2012.

[4] Stross LA. Myringoplasty with use of fascia grafts. Arch Otolaryngol 1961; 49: 44 -45.

[5] Dennis SP. Endoscopic assisted middle ear surgery. In: Glasscock ME III, Gulya AJ, eds. Surgery of the Ear. 5th ed. Hamilton: Elsevier, 2003: 325 -34.

[6] Wullstein H. The restoration of the function of the middle ear in chronic otitis media. Ann OtolRhinolLaryngol. 1971;80(2):210–217.

[7] Zollner F. The principles of plastic surgery of the sound - conducting apparatus. J Laryngol Otol. 1955;69:637. doi: 10.1017/S0022215100051240.

[8] Sooy FA. A method of repairing a large marginal perforation. Ann OtoE. 1956;65:911.

[9] House WF. Myringoplasty. Arch Otolaryngol. 1960;71:399–404. doi: 10.1001/archotol.1960.03770030041009.

[10] Plester D. Myringoplasty methods. Arch Otolaryngol. 1963;78:310– 316.doi: 10.1001/archotol.1963.00750020320013.

[11] House WF, Sheehy JL. Myringoplasty: use of ear canal skin compared with other techniques. Arch Otolaryngol. 1961;73:407. doi: 10.1001/archotol.1961.00740020417009.

[12] Sheehy JL,Glasscock ME.;391. Tympanic membrane grafting with temporalis fascia. Arch Otolaryngol. 1967:86doi:10.1001/archotol.1967.00760050393008.

[13] Austin DF, Shea JJ., JrA new system of tympanoplasty using vein graft. Laryngoscope. 1961;71:596–611.

[14] Doyle JP, Schleuning AJ, Echevarria J. Tympanoplasty: should grafts be placed medial or lateral to the tympanic membrane? Laryngoscope. 1972;82:1425–1430. doi: 10.1288/00005537-197208000-00005.

[15] Glasscock ME. Tympanic membrane grafting with fascia: overlay vs underlay technique. Laryngoscope. 1973;83:754– 770.doi: 10.1288/00005537-197305000-00011.

[16] Sheehy JL, Anderson RG. Myringoplasty: a review of 472 cases. Ann Otol Rhinol Laryngol. 1980;89:331–334.

[17] Debora Bunzen 1, Alexandre Campos 1, Fabianasperandio 2, Silvio Caldas Neto 3 intraoperative findings influence in myringoplasty Anatomical result. International archives of otorhinolaryngology.2006 vol10 (4), 391.

[18] C.H.Raine, A.C.Swift. Antibiotic prophylaxis – a survey. The journal of Laryngology and Otology Feb 1985.vol 99.pp 183 - 185.

[19] Kamal G Effat. Results of inlay cartilage myringoplasty in terms of closure of central tympanic membrane perforations. Journal of Laryngology and Otology vol 119, issue 08, Aug 2005, pp 611 -613.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 1, 2021, Pages. 2297 - 2313
Received 15 December 2020; Accepted 05 January 2021.

[20] Sheehy JL, Anderson RG. Myringoplasty: a review of 472 Cases. Ann OtolRhinol Laryngol1980; 89:331 –334.

[21] Shea JJ.,Jr Vein graft closure of eardrum perforations. J Laryngol Otol. 1960:74;358-362. Doi:10.1017/ S002221510005670X.

[22] M.Karela. Sandeep Berry. A.Watkins.j.j.phillips. Myringoplasty: surgical outcomes and hearing improvement.is it worth performing to hearing? Eur Arch Otorhinolaryngol (2008) 265:1039 -1042.

[23] J.Acoust.Soc.Am. Early theories of Hearing Journal of the Acoustical society of America Volume 20, issue 4,pp.591- 591.(1948); 1 (page).

[24] M.McDonogh The middle ear transformer mechanism: man versus mouse. The journal of Laryngology and Otology. Vol 100, issue 01, jan1986, pp 15-20.

[25] Shrestha B L, Amatya R C M, Shrestha I, Ghosh I Microbiological profile of chronic suppurative otitis media. 89 Napalese Journal of ENT Head &Neck surgery. Vol 2 No2 Issue2 (july- Dec 2011) page 6-7.

[26] HasanYasan, OguzErdgan. The effects of tympanic membrane perforation on bone conduction hearing level.05/2011; 39(1):25 -7.

[27] Jack L.Pulec, Christian Dequine. Classification of chronic suppurative otitis media operative techniques in otolaryngology.vol 6,issue 1 pages 2 -4, march 1995.

[28] Tschiassny K. Tuning fork tests. A historical review. Ann OtolRhinolLaryngol. 1946; 55:433 -430.

[29] Carlos Antonio Rodrigues de Faria, Fabio Akira Suzuki. Pure tone audiometry with and without specific ear protectors.Rev Bras Otorhinolaryngol 2008; 74(3): 417 - 22.

[30] I Holtby, DP Forster, U Kumar. Pure tone audiometry and impedance screening of school entrant children by nurses: evaluation in a practical setting. J Epidemiology Community Health 1997; 51:6 711 -75 90.

[31] S Iurato, G Marioni, M Onofri Hearing results of ossiculoplasty in Austin- Kartushgroup A patients. Journal article 22(2): 140 -4 04/2001.

[32] M.W. Yung. Myringoplasty for subtotal perforation. Clinical otolaryngology and Allied sciences. June 1995.Volume 20, issue 3, pages 241-245.

[33] V.K.Mittal Assessment of eustachian tube functions in patients with ear drum perforation. Indian journal of otolaryngology march 1985, vol 37, issue 1, pp 23 -25.

[34] BalasubramnianThiagarajan, VenkatesanUlaganathan. Endoscope assisted myringoplasty. Otolaryngology online journal (2012) Volume 2 supplement 1. No 1.5 87

[35] M.Sakagami, R.Yuasa and Y Yuasa. Simple underlay myringoplasty. The journal of laryngology and otology. volume 121, issue 09, September 2007. Page 840 -844.

[36] Sheehy JL,GlasscockME.Tympanicmemebrane grafting with temporalis fascia. Arch Otolaryngol.1967; 86;57-68.

[37] Anthony WP, Harrison CW. Tympanic membrane perforation: effect on audiogram. Archives of Otolaryngology.1972 Jun 1;95(6):506 -10.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 1, 2021, Pages. 2297 - 2313
Received 15 December 2020; Accepted 05 January 2021.

[38] Black J H, Wormald P J. Myringoplasty effects on hearing and contributing factors. S Afr Med J 1995; 85: 41-3.

[39] Ross David Triolo, Stephen J O Leary. Hearing outcomes following myringoplasty for patients from developing countries with chronic otitis media. The internet journal of otorhinolaryngology. 2010 vol 11 number2.

[40] Mahesh SG et al. Int J Otorhinolaryngol Head Neck Surg. 2018 Mar;4(2):381 -386.

[41] International Journal of Otorhinolaryngology and Head and Neck Surgery | March-April 2018 | Vol 4. | Issue 2 Page 383.

[42] Lee p, Kelly G, Mills RP. Myringoplasty : does the size of perforation matter , clinical otolaryngology and allied sciences. 2002;27:331-4.

[43] Rupesh: Hearing evaluation after myringoplasty; Journal of Nobel Medical College Vol.2, No.1 Issue 3. 36 -42.

[44] Mackinnon D. Relationship of preoperative E ustachian tube function to myringoplasty. Acta Otolaryngology,5th ed. London: Butterworths, 1987:6-25.

[45] Prasnsuk S and Hinchelffe R. Tympanic membrane perforation: Descriptors and hearing levels in otitis media. Audiology 1982;21:43 -51.

[46] Singh M, Rai A, BandyopadhyayS,et al. Comparative study of the underlay and overlay techniques of myringoplasty in large and subtotal perforation of the tympanic membrane. J Laryngol Otol. 2003;117:444-448.

[47] Javaid M, Iqbal M, Hidayat U, Shah JI. Myringoplasty,onlay versus underlay technique. J Postgrad Med Inst 2002;16:17 -7.

[48] Islam MS, Isham MR, Bhuiyan MA, Rashid MS, Data PG. Pattern and degree of hearing loss in chronic supparativeototis media. Bangladesh journal of Otorhinolaryngology.2010;16(2):96 -105.