DOI: https://dx.doi.org/10.18203/issn.2454-5929.ijohns20204637

Original Research Article

Air bone closure and graft uptake, vis a vis tympanic reconstitution

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Received: 14 September 2020
Revised: 15 October 2020
Accepted: 16 October 2020

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ABSTRACT

Background: Tympanoplasty involves reconstitution of the tympano-ossicular system with commonly. fascia of the temporalis muscle, situated in its proximity. The fascia is grafted on the residual tympanic membrane by placing it either over it or below it, after creating a raw surface. The former is the overlay and latter, the underlay technique. In this study on restitution of the ear drum utilizing the overlay and underlay techniques, an exhaustive analysis of the two modalities has been done, taking into consideration various variables individually. The surgical outcome wrt to graft uptake and hearing gain has been compared in "depth" with extensive studies undertaken in India and abroad. The unbiased tabulated comparison of each aspect is unique and would guide future researchers to opt the ideal modality.
Methods: Tympanoplasty was undertaken in chronic safe suppurative otitis media with the underlay and overlay techniques in a study group of 40 patients in this prospective study. The patients were randomly divided into equal groups for either procedure.
Results: In the cohort of 40 subjects successful graft uptake was observed in 16 (80%) with overlay technique and 17 (85%) with underlay technique. Graft rejection was reported in 4 (20%) and 3 (15%) cases with overlay and underlay techniques respectively. Hearing improvement was 56.25% in 10-20 dB range in Overlay. Whereas, with underlay it was 47.05% in 10-2 dB.
Conclusions: Overlay technique is ideal for anterior and central perforations while underlay for subtotal and posterior perforations. In terms of hearing improvement, the fibrosis during graft uptake makes the results of either technique unpredictable.

Keywords: Perforation, Tympanoplasty, Overlay, Underlay

INTRODUCTION

Chronic suppurative otitis media is a persistent disease. Insidious in onset, often capable of causing severe deafness with irreversible sequelae Shenoi, 1987.[1] Tympanoplasty in adults is a simple operation with a high probability of success which can improve the quality of life of those operated upon. Podoshin and Fradis et al.[2]

Tympanoplasty requires, a tissue with low basal metabolic rate and a well vascularized bed on which it can be grafted. The residual tympanic membrane with a perforation can be de-epithelised on the lateral side towards the ear canal or on its under surface, the medial middle ear side. The graft is then approximated to this freshened raw area, either on the lateral side when it's called the overlay procedure. Approximation to the raw under surface of the residual drum with support on the tympanic sulcus cirumferentially or partially is the underlay. Merits and limitations of either techniques have been reported in global literature. We undertook a study at our institute utilizing both the techniques.

Aim and objectives

Aim and objectives were to compare the results of graft uptake in two different technique of tympanoplasty, comparison of hearing improvement in both techniques.

METHODS

In this prospective study, 40 patients were selected from the outpatient Otology clinics of Dayanand Medical College & Hospital, Ludhiana during a period of one and a half years (June 2008 to December 2009).

The subjects were randomly divided into two groups, according to the technique utilized a) group I: overlay tympanoplasty 20 patients b) group II; underlay tympanoplasty 20 patients.

Inclusion criteria

Inclusion criteria were, pars tensa perforation, dry ear, good cochlear reserve, mild to moderate conductive deafness, and no evidence of septic foci in nose, throat and external auditory canal.

Exclusion criteria

Exclusion criteria were, wet ear, septic foci, unsafe ear, patients below 16 and above 50 years, and poor eustachian tube functions.

Tympanoplasty by either technique was undertaken and the patients were followed up for a period of two years.

All statistical calculations were done using the Statistical Package of Social Sciences (SPSS) 17 version statistical program for Microsoft Windows (SPSS Inc. Released 2008. SPSS statistic for windows, version 17.0, Chicago). Ethical approval of the study was taken from the Institutional Ethics Committee.

RESULTS

Maximum number of patients were between the age group of 21-30 years (35%) in both the groups followed by 41-50 years (25%), less than 20 years (22.55) and 31-40 years (17.5%). No patient was taken up for surgery below 16 years of age in this study (Table 1).

In the present study 52.5% were females and 47.5% were males. The selection of the patients was random irrespective of sex. More female patients were seen to have been suffering from chronic suppurative otitis media which shows the ignorance and delay in taking up the treatment (Table 2).

Central perforation was observed in 19 (47.5%) of patients while anterior was observed in 10 (25%) patients, posterior perforation in 6 (15%) and subtotal in 5 (12.5%) of patients.

It is worth noting that overlay technique was employed maximum (35%) in anterior perforation thereby preventing anterior blunting and medialisation along the anterior quadrant, whereas in posterior and central perforation it was almost equal in both the groups (Table 3).

Table 1: Age distribution.

Age in years	Number of cases		Percentage		Total
	Underlay	Overlay	Underlay	Overlay	
<20	5	4	25	20	22.5
21-30	6	8	30	40	35
31-40	4	3	20	15	17.5
41-50	5	5	25	25	25
Total	20	20	100	100	100

Table 2: Sex distribution.

Sex	Number of cases		Percentage		Total
	Underlay	Overlay	Underlay	Overlay	
Male	12	7	60	35	47.5
Female	8	13	40	65	52.5
Total	20	20	100	100	100

Majority of patients 24 (60%) had mucopurulent discharge whereas 10 (25%) patients had mucoid discharge and only 6 (15%) had purulent discharge, at the time of first presentation. The culture sensitivity of the discharge in all the patients was done and in majority of the patient's staph, aureus was the organism found followed by E. coli, proteus and pseudomonas in almost equal proportions (Table 4).

Table 3: Site of perforation.

Quadrant involved	Number of cases		Percentage		Total
	Underlay	Overlay	Underlay	Overlay	
Anterior	3	7	15	35	25
Posterior	3	3	15	15	15
Central	11	8	55	40	47.25
Subtotal	3	2	15	10	12.5
Total	20	20	100	100	100

Table 4: Type of discharge.

Discharge	Number of cases		Percentage		Total
	Underlay	Overlay	Underlay	Overlay	
Mucoid	6	4	30	20	25
Mucopurulent	12	12	60	60	60
Purulent	2	4	10	20	15
Total	20	20	100	100	100

Table 5: Type of discharge V/S graft uptake.

Discharge	Number of cases		Graft uptaken		Success percentage		Total
	Underlay	Overlay	Underlay	Overlay	Underlay	Overlay	
Mucoid	6	4	5	4	83.3	100	90
Mucopurulent	12	12	10	10	83.3	83.3	83.3
Purulent	2	4	2	2	100	50	66.66
Total	20	20	17	16	85	80	82.5

Table 6: Over all graft uptake (n=40).

Status of graft uptake	Overall	Number of cases		Percentage	
		Underlay	Overlay	Underlay	Overlay
Successful Graft Uptake	82.5	17	16	85	80
Graft Rejected	17.5	3	4	15	20
Total	100	20	20	100	100

Comparison between graft uptake and type of discharge reported 90% uptake in patients with mucoid discharge, 88.3% uptake in those with mucopurulent and only 66.6% in purulent cases (Table 5).

Out of total 40 cases successful graft uptake was observed in 16 (80%) with overlay technique and 17 (85%) with underlay technique. Graft rejection was seen in 4 (20%) and 3 (15%) cases with overlay and underlay techniques respectively. The graft uptake with both the techniques of tympanoplasty was almost similar in our conditions (Table 6)

Out of 40 patients, 18 (45%) had healthy mucosa while 12 (30%) had hypertrophied mucosa, 7 (17.5%) had edematous and 3 (7.5%) had pale middle ear mucosa. Majority of patients in our study had healthy, middle ear mucosa showing the good status of the middle ear at the time of surgery. In patients with pale or edematous mucosa oral steroids were used for 2 weeks after operation covering the allergic tendencies of the patient (Table 7).

The relations of graft uptake with status of middle ear mucosa. 100% results were seen in healthy mucosa whereas in pale, edematous and hypertrophic mucosa the results were not very satisfactory, i.e. 66.6%, 85.7%, 58.8% respectively (Table 8) The hearing improvement in 33 successful cases. In 51.5% patients 10-20 dB AB closure could be achieved. Whereas in only 6.06% AB closure was more than 20dB possibly because of the lateralisation of the graft (Table 9).

Total graft rejection was seen in 3 (15%) patients with underlay technique and 4(20%) with overlay technique technique. Graft lateralisation was seen in 2 (10%) with overlay technique. Anterior Blunting was seen in 2 (10%) patients with overlay technique. Hearing Loss was seen in 1 (5%) patients with underlay technique (Table 10).

Table 7: Status of middle ear mucosa.

Status	Number of cases		Percentage		
	Underlay	Overlay	Underlay	Overlay	Total
Healthy	11	7	55	35	45
Pale	1	2	5	10	7.5
Edematous	2	5	10	25	17.5
Hypertrophied	6	6	30	30	30
Total	20	20	100	100	100

Table 8: Status of middle ear mucosa v/s results.

Status	Number of cases		Graft uptaken		Percentage		
	Underlay	Overlay	Underlay	Overlay	Underlay	Overlay	Total
Healthy	11	7	11	7	100	100	100
Pale	1	2	1	1	100	50	66.66
Edematous	2	5	2	4	100	80	85.71
Hypertrophied	6	6	3	4	50	66.66	58.83
Total	20	20	17	16	85	80	82.5

Table 9: AB gap closure in 33 successful graft uptakepatients.

Duration	Number of cases		Percentage	
	Underlay	Overlay	Underlay	Overlay
<10 dB	8	6	47.05	37.5
10-20 dB	8	9	47.05	56.25
>20 dB	1	1	5.82	6.25

Table 10: Complications encountered post operatively.

Complications	Type of procedure		Percentage	
	Underlay	Overlay	Underlay	Overlay
Anterior Blunting	-	2	-	10
Lateralisation	-	2	-	10
Graft Rejection	3	4	15	20
S/N Hearing Loss	1	0	5	0

DISCUSSION

The present study of 40 subjects, in context to overall graft uptake and air bone gap shift, recorded 82,5% (33 cases) uptake and a 10-20 closure in 51.51% (17 cases).

Part A

In the Overlay group 80% (16 pts) and in the Underlay 85% (17 pts) had a successful graft uptake.

The results of our series with respect to graft uptake, are similar to those obtained by Wang and Lin, who reported 82,1% and 85% in overlay and underlay respectively.

The review of literature wrt graft uptake and a comparison with other studies is tabulated as below (Table 11).[3-13]

Table 11: Studies on surgical graft ptake with either technique.

S. no.	Study	Overlay	Underlay
1.	Wang and Lin	82.17%	85%
2.	Doyle et al-131 cases	77%	83%
3.	Glasscock-554 cases	91%	96%
4.	Rizer	95.6%	88.8%
5.	Pecker et al-1065 cases	91%	93%
6.	B Sergi et al-115 cases	91.5%	94.2%
7.	Singh et al-60 cases	93.3%	93.3%
8.	Kalsotra Pet al	89.18%	91.43%
9.	Fadi et al	66.7%	85.4%
10.	Brown et al	11%	44%
11.	Mahesh S.G.	96.6%	90%
12.	Lemke and Hormann	62 %	68%

Table 12: Studies on surgical graft uptake with overlay technique.

S. no.	Study	Overlay
1.	Sheehy &Anderson- 472 cases	97%
2.	Gupta et al	86.6%
3.	Ferraro et al	96%
4	Landa aranzabal and rodriguez	80%

Studies on surgical graft uptake with overlay technique (Table 12). Studies on surgical graft uptake with underlay technique.[14-17]

Studies on surgical graft uptake with underlay technique (Table 13).[18-21]

Table 13: Studies on surgical graft uptake with underlay technique.

S. no.	Study	Underlay
1.	Yung 240 cases	92.5%
2.	Gibbs 365 cases	89.5%
3.	Ashtaq et al 105 cases	73%
4.	Khan and Khan 94 cases	77.5%

Part B

In our series the results of improvement in hearing were different with different techniques. Hearing improvement was 56.25% in 10-20 dB range in overlay. Whereas, with underlay it was 47.05% in 10-2-dB.

The hearing improvement in the present study in the range of less than 20 dB in 93% is in accordance with the results by Feilen and Federspil who achieved 84% results.

The review of available literature wrt hearing gain/ air–bone closure to 10-20 db, and a comparison with other studies is tabulated as below:

Studies on hearing gain/Ab closure to 10-20 Db with either technique (Table 14).[7-10,13] Studies on hearing gain/Ab closure to 10-20 dB with overlay technique (Table 15).[14,22-24]

Table 14: Studies on hearing gain/Ab closure to 10-20 Db with either technique.

S. no	Study	Overlay	Underlay
1.	B Sergei et al	74%	75.7%
2.	Mahesh SG et al	90%	86.7%
3.	Pecker et al	93.3%	93.3%
4.	Singh M et al	57%	92.89%
5.	Kalsotra P et al	81.08%	85.7%

Table 15: Studies on hearing gain/Ab closure to 10-20 Db with overlay technique.

S. no	Study	Overlay
1.	Black & Wormald et al	77.9%
2.	Perkin et al	87%
3.	Sheehy & Anderson	80%
4.	Seifi et al	84%

Thus, in the present study it is observed that both the overlay and underlay techniques of tympanoplasty have their own merits and demerits. The results depend upon the selection of cases in which the procedure is being employed. We observed that in overlay technique results were better with anterior and central perforations. Whereas results with underlay technique were significantly better in subtotal and posterior perforations.

However, type of discharge, age, sex, status of mucosa didn't make much difference as far as graft uptake was concerned. Anterior blunting was seen in 10 % and graft lateralisation too in 10%.

Sheehy and Anderson 1980db showed successful closure of perforation observed in over 97% of cases with Overlay technique using post-auricular approach.[14] Blunting of the anterior sulcus and lateral healing of the graft were very uncommon. However, in our setup all the cases were taken up with per-meatal approach.

Strauss and Kress showed results of both techniques do not differ significantly.

Smyth and Koch Friedmann et al observed inferior results with anterior perforation in underlay technique.[26,27]

The results of present study in terms of graft uptake in various sites of perforation are comparable to those of Wyne et al, Landa, Aranzabal M and Vartianon E. The probable factors for failure might be inadequate anterior tucking, anterior blunting, inadequate margins or complexity of Eustachian tube functions.[17,28]

Landa Aranzabal and Rodriguez overall showed 80% uptake showing statistically better results with the overlay method, particularly in large perforations and poorer results in young patients.[17] The presence of sensorineural hearing loss in one patient 2,5% is in accordance with the Sheehy and Anderson study who had 3% results.[14]

CONCLUSION

Overlay technique is ideal for anterior and central perforations while underlay for subtotal and posterior perforations. In terms of hearing improvement, the fibrosis during graft uptake makes the results of either technique.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Munjal M, Mathur N, Chopra P, Munjal S, Chopra H, Garg A, et al. Air bone closure and graft uptake, vis a vis tympanic reconstitution. Int J Otorhinolaryngol Head Neck Surg 2020;6:2094-9.