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ORIGINAL ARTICLE

A Comparative Study Between Anterior Tunnel and Anterior Release Techniques in the Management of Anterior Tympanic Membrane Perforation

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Abstract

Introduction: **When the perforation in the tympanic membrane is anteriorly located with a thin anterior rim, stabilizing the graft using the traditional underlay tympanoplasty approach may be challenging. It was attempted to solve this issue using tympanoplasty with anterior tunneling or anterior releasing.**

Aim and objectives: **This study aims to compare the efficiency of the anterior tunnel and anterior release techniques in the management of anterior tympanic membrane perforation.**

Patients and methods: **A 1-year prospective single-blinded study with 3-months follow-up was conducted on 60 patients divided into two groups: tympanoplasty with tunneling (group A) and release (group B) tympanoplasty for comparison in regards to before and after surgery anatomical correction and physiological enhancements.**

Results: **The average air bone gap in (group B) decreased from 22.2 dB to 10.6 dB, with an average drop of 11.6 dB. Similarly, the average change in (group A) of 9.6 dB from 18.6 dB to 9.3 dB. Air bone gap improved in both groups, with the release group improving slightly more compared with the anterior tunnel group (group A) 3-month graft uptake rate has been reported to be 93.3%, whereas (group B) was 96.6% ($P = 0.7$).**

Conclusion: **For anteriorly located perforations with a thin anterior rim, the tympanoplasty technique (type-I) may be combined with anterior tunneling or anterior release. Our research showed that the outcomes of both procedures were nearly the same, with good graft uptake in the release group. Hearing enhancement outcomes in both approaches were equivalent, with the release technique producing a good result.**

Keywords: Anterior release, Anterior tunnel, Anterior tympanic membrane perforation

1. Introduction

Tympanoplasty for closing anterior perforations of the tympanic membrane is considered challenging. The reasons for poor surgical outcomes include a reduced vascular supply, limited anterior margin, and poor visualization.

Underlay tympanoplasty might not succeed, whether the perforation is in the TM's anterior half or whether it is subtotal or total in nature since the anterior edge of the graft breaks away from and does not succeed in adhering to the TM's anterior remnant. Inadequate blood supply and poor exposure, major side effects such as severe lateralization, blunting, and the formation of cholesteatomas can occur.[1]

As a solution, the purpose of this study is to establish the effectiveness of two various methods used for tympanoplasty: anterior tympanic membrane perforation with an anterior tunnel or anterior release techniques, because the anterior graft is securely supported and provides sufficient vascular supply anteriorly. Stabilizing the graft may be hard with the traditional underlay tympanoplasty methods.[2]

2. Patients and method

In this comparative prospective study, 60 patients suffering from anterior tympanic membrane

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perforations were treated with tympanoplasty at Al-Azhar University Hospitals (Sayed Galal and Al-Hussein) using the following techniques: anterior tunnel and anterior release.

Those patients had been randomly assigned to two groups: group A being operated on using the anterior tunnel technique. Group B being operated on using anterior release technique.

All patients underwent thorough history-taking, general and ENT examinations, and investigations, which included hearing evaluation (Pure tone audiometry), which was done in the ENT department (audiology unit) to assess hearing acuity and recording of the air bone gap (ABG). Full laboratory tests were performed, ECG and chest X-ray.

2.1. Inclusion criteria

The ages ranged from 18 to 60. Both men and women were included in the sample. Patients with a perforated anterior TM. Dry tympanic membrane perforation without treatment for at least 6 weeks and has conductive hearing loss with an ABG of less than 30 dB.

2.2. Exclusion criteria

Posterior tympanic membrane perforation. Active ear infection or otorrhea. Vertigo, tinnitus, cholesteatoma, granulation, ossicular chain diseases. Hearing loss that is mixed or sensorineural. Previous ear surgery. Any deformation or congenital abnormality of the external ear.

2.3. Surgical technique

The post auricular approach was used in all of the patients, Temporalis fascia is the commonest graft because it is abundant availability and ease of harvest, A rim of tissue is removed from the edges of an anterior perforation.

Group A (anterior tunnel Technique): the tympanomeatal flap and tympanic annulus are subsequently lifted to enter the middle ear region. The anterior canal skin is injected with a tiny amount of 1% lidocaine and 1 : 100 000 epinephrine, just laterally to the annulus's anterior aspect.

Approximately one to 2 mm lateral to the annulus, a tiny horizontal cut of around 3 mm is made in the anterior superior part of the deep meatus. An appropriate tunnel is then made with the aid of a round knife by medially raising a tiny cuff of the deep meatal skin and the annulus along the anterior bony wall.

A distinctive tab is left anteriorly on the temporalis fascia graft, which is going to be pulled from the middle ear via a skin incision in the anterior canal (below the anterior tympanic annulus). Before middle ear was packing with gel foam is placed. A fascia graft is adjusted via the TM perforation so that the anterior tab is directly parallel to the skin tunnel in the anterior canal before the tympanomeatal flap is repositioned back to its original location.

After that, the external auditory canal is packed using dry gel foam, which is subsequently followed by gel foam soaked in a fluoroquinolone antibiotic solution.

Group B (Anterior Release Technique): the tympanomeatal flap is raised to reveal the middle ear cavity in the 6 to 12 o'clock position. This flap is lifted superiorly to just over the malleus's short process. The malleus' manubrium has been denuded. It mobilizes the anterior fibrous annulus from its bony sulcus.

The sub-annular pocket under the anterior annulus is created by elevating the anterior external auditory canal's skin in a medial to lateral way.

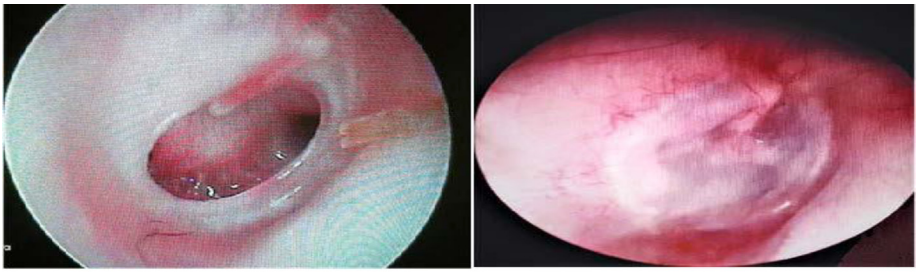
The dried areolar tissue graft has been cut to the proper dimension after hemostasis has been achieved. To allow for insertion medially to the malleus handle, a slit is created in the graft's superior aspect. Then tucked under the annulus/drum remnant anteriorly and inferiorly. With the fibrous annulus covering the fascia graft, the anterior canal skin is placed back in its original location. To help maintain the graft, saline-soaked Gelfoam is put into the middle ear and squeeze-dried with gauze. The flaps in the superior and inferior canals have been replaced in their original locations. To avoid postoperative epithelial 'pearl' formation, it is important to ensure that all skin margins are everted. The annulus has been packed against the bone sulcus tympanic in the anterior region using Gelfoam.

2.4. Postoperative follow-up

Every patient received a call for regular follow-up. Inspection of the tympanic membrane for healing of the graft by endoscopic examination is done weekly for a month, then monthly for 3 months. An audiological evaluation has also been performed three months following surgery. The wanted data was collected in the case sheet of every patient Figs. 1 and 2.

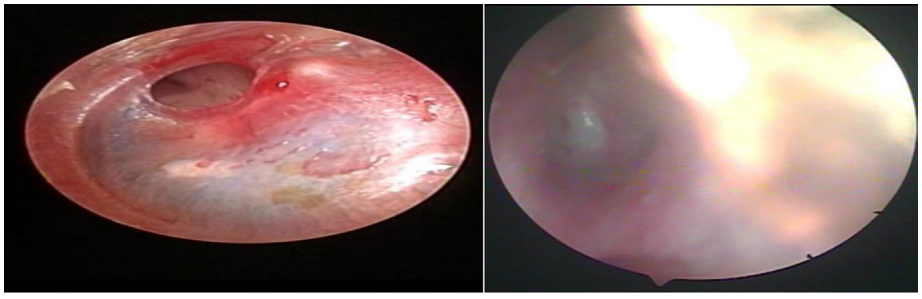
2.5. Statistical analysis

SPSS version 23 was used for data processing, checking, entering, and analysis. The outcomes of



(A) (B)

Fig. 1. (a) Preoperative endoscopic view of the right ear showing large sized central tympanic membrane perforation that underwent the anterior tunnel technique of tympanoplasty type I (ANT tympanic membrane perforation). (b) Endoscopic view of the same patient 3 months postoperative showing well taken tympanic membrane graft.



(A) (B)

Fig. 2. (a) Preoperative endoscopic view of the left ear showing small sized central tympanic membrane perforation that underwent the anterior release technique of tympanoplasty type I (ANT tympanic membrane perforation). (b) Endoscopic view of the same patient 3 months postoperative showing well taken tympanic membrane graft.

the current investigation were analyzed using the following statistical techniques.

For quantitative variables, the data have been represented as mean +standard deviation (SD), and for qualitative ones as numbers and percentages.

3. Results

A total of 60 patients responded to tympanoplasty through anterior tunnel technique (group A) and anterior release (group B) technique as a surgical management for symptomatic anterior tympanic membrane perforation.

The mean age of the patients in group A who underwent the Anterior Tunnel procedure was 30.3 ± 3.7 years. There were 19 female patients and 11 male patients. The mean age of the Ant Release procedure patients in group B was 29.5 ± 4.3 years. According to Table 1, there were 18 female patients and 12 male patients. The majority of the study participants (68%) were under the age of 25 Table 1.

Age and sex differences between the two groups were not statistically significant Tables 2–4.

Table 1. Comparison of socio-demographic characteristics between the two groups studied.

Variable	Group A (30) mean ± SD (Range) median	Group B (30) mean ± SD (Range) median	*t*- test	*P*-value
Age (y)	30.3 ± 3.7 (18–46) 30	29.5 ± 4.3 (22–48) 27	0.8	0.7
Variable	Group A No (30) %	Group B No (30) %		
Sex				
Male	19 (63%)	18 (60%)	0.7	0.9
Female	11 (37%)	12 (40%)		

P-value greater than 0.05: Nonsignificant (NS); *P* value less than 0.05: Significant(S); *P* value less than 0.01 Highly significant (HS).

Table 2. Comparison between the two studied groups regarding the affected side.

The affected side	Ant Tunnel No (30) %	Ant Release No (30) %	χ^2	*P*-value
Right sided	17 (57) %	11 (37) %	2.47	0.3
Left sided	12 (40) %	17 (57) %		
Bilateral	1 (3) %	2 (6) %		

P-value greater than 0.05: Non-significant (NS); *P* value less than 0.05: Significant(S); *P* value less than 0.01 Highly significant (HS).

Table 3. Comparing the preoperative air bone gap between the two studied groups.

The preoperative air bone gap	Ant tunnel No (30) %	Ant release No (30) %	χ^2	*P*-value
15	17 (57) %	17 (57) %		
20	11 (37) %	11 (37) %		
25	2 (6) %	1 (3) %	1.33	0.4
30	0 0%	1 (3) %		

P value greater than 0.05: Nonsignificant (NS); *P* value less than 0.05: Significant(S); *P* value less than 0.01 Highly significant (HS).

Table 4. Comparing the postoperative air bone gap between the two studied groups.

The postoperative air bone gap (dB)	Anterior tunnel No (30) %	Anterior release No (30) %	χ^2	*P*-value
5	17 (57) %	18 (60) %		
10	8 (27) %	8 (28) %	1.28	0.4
15	3 (10) %	2 (6.5) %		

P-value greater than 0.05: Nonsignificant (NS); *P* value less than 0.05: Significant(S); *P* value less than 0.01 Highly significant (HS). Statistically no significant difference.

Table 5. Comparing the hearing gain between the two studied groups.

The hearing gain (dB)	Anterior Tunnel No (30) %	Anterior Release No (30) %	χ^2	*P*-value
0–5	5 (16.7) %	3 (10) %		
6–10	16 (53.3) %	15 (50) %		
11–15	7 (23.3) %	8 (26.7) %	3.64	0.058
16–20	2 (6.7) %	4 (13.3) %		

P value greater than 0.05: Non significant (NS); *P* value less than 0.05: Significant(S); *P* value less than 0.01 Highly significant (HS).

Table 6. Comparing graft uptake (the rate of success) three months after surgery across the two groups studied.

Graft uptake	Anterior Tunnel No (30) %	Anterior Release No (30) %	χ^2	*P*-value
Succeeded	28 (93.3) %	29 (96.6) %	FET	0.7
Residual perforation	2 (6.7) %	1 (3.4) %		

P value greater than 0.05: Nonsignificant (NS); *P* value less than 0.05: Significant(S); *P* value less than 0.01 Highly significant (HS).

ABG improved in both groups, with the anterior release group improving slightly more than the anterior tunnel group Table 5.

The anterior release group showed slightly better enhancement than the anterior tunnel group Table 6.

There was slightly statistically significant difference in graft uptake 3 months after surgery among the two groups, with slightly better results for anterior release.

4. Discussion

Underlay tympanoplasty using anterior tunneling differs from traditional procedures using anterior tucking in that the modified fascial graft is tucked via an anteriorly formed tunnel through the antero-superior part of the deep meatus close to the drum annulus, giving extra support, while in traditional underlay tympanoplasty using anterior tucking, the anterior portion of the fascia is blindly inserted below the anterior drum remnant, purportedly above the deep meatal bone canal, using gel foam supporting below medially.[3]

The anterior release technique involves elevating the whole tympanic membrane off the malleus and subsequently rolling remnant of the drum (when maintained) and annulus anteriorly and laterally to create a sub-annular pocket. Skin of the canal wall is lifted laterally to the bony annulus. Our graft is positioned medially to the fibrous annulus and remaining tympanic membrane, similar to the underlay. The graft is slipped beneath the malleus long process and tucked under the annulus/drum remnant anteriorly and inferiorly.

Circumferential sub annular grafting of[4] involves elevating the annulus over the sulcus tympanicus in the anterior portion, which closely resembles our anterior release group. After that, the graft is placed between the anterior canal wall and the anterior annulus.

In terms of age composition, both groups have been similar. In the anterior tunnel group, operations were more frequently conducted on the right side (57%), in comparison to the anterior release group, where they were more frequently conducted on the left (57%). Concerning the affected ear, there is not a statistically significant difference among the two groups.

In the present research, the graft has been well taken in 28 (93.3%) cases, but it has been refused because of a residual perforation in 2 (6.7%) cases who were in the anterior tunnel group. In 29 (96.6%) cases, the graft was well taken; however, in 1 (3.4%) case (in the anterior release group), it was refused with a residual perforation. But this difference among the two groups was statistically insignificant (*P* value 0.7), indicating that the anterior release approach resulted in better graft uptake.

In Mokhtarinejad and colleagues study: 25 cases circumferential sub annular grafting (and 25 cases anterior tunneling of underlay tympanoplasty), they found graft healing rate in 97% in circumferential sub annular similar to anterior release technique and 100% in anterior tunnel patients.[4]

Mishra and colleagues: revealed graft taken in 97% by doing STT technique, result was similar to anterior release which was comparable with our study with 96.6%.[5]

Hosamani and colleagues study: cases with anterior tunneling technique showed 95.45% graft uptake in subtotal and anterior perforations, this was also comparable with our study with 93.3%.[6]

Our study revealed that; The preoperative ABG was 18.7 ± 4.6 (15–20) dB and the postoperative gap 9.3 ± 4.7 (5–15) dB in the anterior tunnel technique. The preoperative ABG was 22.6 ± 3.6 (15–25) dB and the postoperative gap 10.6 ± 4.7 dB (5–15) dB in the anterior release technique. The difference was no significant difference pre operatively ($P < 0.4$).

In terms of after-surgery ABG closure at the conclusion of the third month, both groups improved, (57% of the anterior tunnel group patients had ABG of 5 dB) in the anterior tunneling group as compared with anterior release (60% of the anterior release group patients had ABG of 5 dB). This difference was, however, show slightly statistically significant ($P = 0.4$). In the postoperative ABG between the two groups.

The anterior tunnel the results was agree with of Caye-Thomasen et al., a study of 26 cases, which showed that the mean preoperative ABG average to be 20.1 dB, the mean postoperative ABG average of 11.5 dB and thus the mean hearing gain of 8.6 dB.[7]

Singh and colleagues, study 58 adult patients with subtotal or anterior perforations underwent circumferential sub annular tympanoplasty (mimic anterior release). The mean preoperative pure tone was 33.05 dB; the mean postoperative pure tone was 18.12 dB, and the mean ABG closure was 14.69 dB.[8]

Consequently, patients in the anterior release group had better postoperative ABG closure and hearing gain in comparison to patients in the anterior tunnel group.

The number of cases that participated in every group, the average follow-up length, the kinds of grafts utilized, as well as the cumulative experiences of the ear surgeons, may all play a role in the variation in surgical success outcomes among the studies.

Graft success has been characterized as an intact graft without medialization, lateralization, perforation, retraction, or significant blunting.

4.1. Conclusion

Following the underlay approach, anterior tympanic membrane perforations are more likely to fail because of graft lateralization, medialization, and anterior blunting.

According to our findings, both the anterior tunnel approach and the anterior release group have better graft uptake and hearing enhancement in comparison to a basic underlay. A deeper understanding could have been provided by a bigger specimen size and a longer time period; however, that is left for the future.

The overall outcome is anterior release is better than in the anterior tunnel technique.

Conflicts of interest

There are no conflicts of interest.

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