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Comparative Results of Trans-Tympanic Pop-In Myringoplasty.

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ABSTRACT

The trans-tympanic pop-in technique is an alternate technique that allows temporalis fascia graft placement medial to tympanic membrane remnant through the perforation without the need for tympano-meatal flap elevation. Objective of the study was to compare trans-tympanic pop-in myringoplasty results with the conventional tympano-meatal flap method of underlay myringoplasty by trans-canal & post-aural approaches. This prospective study comprises of a cohort of 122 patients who underwent myringoplasty between January 2012 and December 2014 in Manipal Teaching Hospital, Pokhara; a tertiary referral center. They were divided into 3 groups according to the technique of surgery. Group A: Post-aural approach for tympano-meatal flap elevation. Group B: Trans-canal approach for tympano-meatal flap elevation. Group C: Trans-canal, trans-tympanic pop-in technique. Results in the 3 groups were assessed by comparing the mean operative time taken, status of tympanic membrane graft and change in the pre-operative to post-operative average air bone gap. The mean operative time taken for Group A, Group B and Group C were 106.4 minutes, 72.1 minutes and 45.5 minutes respectively. 6 months after the surgery, 82.2% patients had an intact tympanic membrane graft in group A, 80% patients in group B and 81.1% patients in group C. A successful hearing outcome with an average air-bone gap of $\leq$10 dB was seen in 77.8 % patients in group A, 75% patients in group B and 78.4% patients in group C. 3 patients in group A and 1 patient in group B complained of reduced taste sensation on the side of operation. Trans-tympanic pop-in myringoplasty gives similar hearing & graft uptake results when compared with tympano-meatal flap method of underlay myringoplasty done by trans-canal or post-aural approach. However it is easier and takes less time to perform when compared to these two approaches, thus being more cost-effective. It also has no potential risk of injury to chorda tympani nerve like these two approaches.

Keywords: trans-tympanic, pop-in, myringoplasty

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BACKGROUND

The underlay technique of myringoplasty by elevation of tympano-meatal flap described by Austin and Shea Jr.[1] in 1961 is the most widely accepted technique. The trans-tympanic pop-in technique is an alternate technique that allows temporalis fascia graft placement medial to tympanic membrane remnant through the perforation without the need for tympano-meatal flap elevation. Pop-in technique is easier to learn and takes lesser time as there is no need for tympanomeatal flap elevation, thus making it cost-effective. It also has no risk of injury to chorda tympani nerve. This potentially makes it a suitable teaching method in selected cases of myringoplasty for postgraduate trainees.

MATERIAL AND METHODS

This study comprises of 122 patients who underwent myringoplasty at Manipal Teaching Hospital, Pokhara between January 2012 and December 2014. The study was performed after approval from the institutional review board at our hospital and taking written, informed consent from all the patients.

Inclusion criteria for the study

- Patient suffering from unilateral chronic suppurative otitis media, tubo-tympanic (mucosal) type with no ear discharge for at least 3 months.
- Presence of medium size perforation of tympanic membrane with at least 2 mm membrane remnant all around for anchoring the graft.
- Wide external auditory canal with visible access to entire tympanic membrane.
- Conductive hearing loss of $\leq$ 40 dB.
- Underwent myringoplasty by trans-tympanic pop-in method or the underlay tympano-meatal flap method by either trans-canal or post-aural approach.
- Minimum follow up period of 6 months after the surgery.
- Patient aged between 12-45 years to remove age bias.

Exclusion criteria for the study

- Small perforation (< 25 %) of tympanic membrane as these patients were chosen for fat plug myringoplasty.
- Subtotal perforation or large perforation with < 2 mm tympanic membrane remnant as these patients was chosen for cartilage-supported myringoplasty in another study.
- Sensorineural & mixed hearing loss in operated ear before surgery.
- Use of cartilage support during myringoplasty.
- Revision myringoplasty or previous ear surgery in operated ear to remove the bias of revision surgery on the results.
- Presence of migrated squamous epithelium or cholesteatoma in middle ear.
- Active focus of infection in nose, paranasal sinuses or throat not responding to treatment.
- Patients with any congenital anomalies like cleft lip or cleft palate.

Originally 133 patients were enrolled for this study. The patients were randomly divided into 3 groups. Group A: Post-aural approach for tympano-meatal flap elevation. Group B: Trans-canal approach for tympano-meatal flap elevation. Group C: Trans-canal, trans-tympanic pop-in technique. However 11 patients were excluded later as they did not come for follow-up. Thus, 122 patients were left in the study with 45 in group A, 40 in group B and 37 in group C.

Surgical technique

All surgeries were done under general anesthesia. In all patients, tympanic membrane perforation margin was freshened with a sickle knife and its undersurface was scored with a circular knife. Myringosclerotic plaques if present, were removed carefully before the start of myringoplasty. Patients in group A underwent elevation of tympano-meatal flap and fibrous annulus by a post-aural incision. Patients in group B underwent elevation of tympano-meatal flap and fibrous annulus by a permeatal incision. After putting gelfoam pieces in middle ear,

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underlay myringoplasty was performed in both groups with temporalis fascia graft and the tympano-meatal flap was repositioned. Packing of external auditory canal was done and a mastoid dressing applied. The surgical technique for pop-in myringoplasty is shown in figure 1. The perforation margin was freshened (figure 1b) and medicated gelfoam pieces were packed in the middle ear cavity till they caused a slight bulge in the tympanic membrane remnant (figure 1c). Temporalis fascia graft was inserted through the tympanic membrane perforation and evenly spread out with 2 micro-elevators till 2 mm beyond the perforation margin (figure 1d). Gelfoam pieces were then placed lateral to the graft (figure 1e). Further packing of external auditory canal was not necessary. External auditory canal was closed with a sterile cotton ball plug and a small external dressing applied.

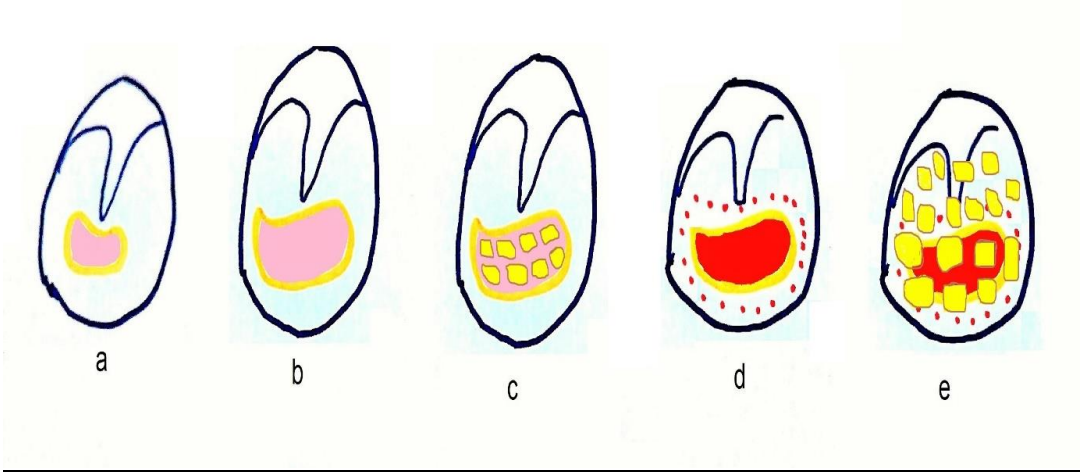

Figure 1: a. Medium size central perforation, b. Perforation margin freshened, c. Middle ear packed with medicated gelfoam pieces, d. Temporalis fascia graft inserted through the perforation, e. Medicated gelfoam pieces placed lateral to the graft.

After hospital discharge, the patients were reviewed in the OPD at 1 week, 2 weeks, 4 weeks, 3 months and 6 months. During these visits, assessment was done by otoscopic examination. The hearing assessment was performed at the 6-month visit. Results in the 3 groups were assessed at 6 months by comparing the mean operative time taken, status of tympanic membrane graft and post-operative average air-bone gap. Average air-bone gap was calculated during pure tone audiometry by the difference in the mean thresholds of air conduction and bone conduction at 500, 1000 and 2000 Hz. An intact tympanic membrane graft and $\leq$ 10 dB average air-bone gap were considered as successful outcome. All results were analyzed using Statistical Package for Social Sciences (SPSS) version 16.0. Statistical significance was set at a 2-sided p value <0.05.

RESULTS

Of the 122 patients in this study, 62 were males and 60 were females. The mean age was 23.6 years (sample standard deviation 7.97). The mean follow-up was 12.47 months for group A, 11.75 months for group B and 12.0 months for group C. The mean operative time taken for the three groups is described in table 1. Group A (post-aural underlay) patients averaged 106.4 minutes, Group B (trans-canal underlay) patients 72.1 minutes, while Group C (trans-tympanic pop-in) patients 45.5 minutes. Pop-in technique was much faster compared to the other 2 techniques and this finding was statistically significant (P value < 0.0001).

The results of closure of tympanic membrane perforation at 6 months after surgery are shown in table 2. 82.2% patients had an intact tympanic membrane graft in group A, 80% patients in group B and 81.1% patients in group C. The success rate in 3 groups were similar though this finding was not statistically significant (P value = 0.96). The overall perforation closure in 122 patients was 81.1%. Out of the 23 cases of graft perforation, 18 were smaller residual perforations while 5 cases were graft rejections. 8 cases of residual perforation responded to 20% silver nitrate chemical cautery while 4 cases were successfully treated with fat graft myringoplasty. 11 cases refused further surgical management.

The mean gain in average air-bone gap after surgery is shown in table 3 with the values in groups A, B and C being 15.5 dB, 16.1 dB and 16.9 dB respectively. The gain in 3 groups were similar though this finding was not statistically significant (P = 0.40). A successful hearing outcome with an average air-bone gap of $\leq$ 10 dB was seen

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in 77.8% patients in group A, 75% patients in group B and 78.4% patients in group C as shown in table 4. The hearing results in 3 groups were again similar though this finding was not statistically significant (P value = 0.93). The overall successful hearing result in 122 patients was 77%. There was no case of mixed hearing loss, sensorineural hearing loss or dead ear as a result of surgery.

3 patients (6.66%) in group A and 1 patient (2.5%) in group B complained of reduced taste sensation on the side of operation. This was due to transection or stretching of the chorda tympani nerve during elevation of tympano-meatal flap. These symptoms got reduced within 6 months of the surgery. No such symptom was reported in Group C as the pop-in method has no potential risk of injury to chorda tympani nerve.

Table 1: Mean operative time

	Sample size	Mean operative time (minutes)	Sample standard deviation
Post-aural Underlay	45	106.4	3.09
Trans-canal Underlay	40	72.1	4.02
Trans-tympanic Pop-in	37	45.5	2.94
P value by one way analysis of variance (ANOVA) < 0.0001			

Table 2: Tympanic membrane graft status at 6 months

Tympanic membrane graft status at 6 months	Post-aural Underlay		Trans-canal Underlay		Trans-tympanic Pop-in	
	Number of cases	%	Number of cases	%	Number of cases	%
Intact	37	82.22	32	80	30	81.1
Perforated	8	17.78	8	20	7	18.9
Total	45	100	40	100	37	100
P value by Pearson Chi-square test = 0.966						

Table 3: Mean gain in average air-bone gap after surgery

	Sample size	Mean gain in average air-bone gap (dB)	Sample standard deviation
Post-aural Underlay	45	15.53	4.05
Trans-canal Underlay	40	16.13	5.26
Trans-tympanic Pop-in	37	16.91	4.38
P value by one way analysis of variance (ANOVA) = 0.401			

Table 4: Post-operative average air-bone gap categories at 6 months

Average air-bone gap category	Post-aural Underlay		Trans-canal Underlay		Trans-tympanic Pop-in	
	Number of cases	%	Number of cases	%	Number of cases	%
≤10 dB	35	77.8	30	75	29	78.4
11-30 dB	10	22.2	10	25	8	21.6
Total	45	100	40	100	37	100
P value by Pearson Chi-square test = 0.93						

DISCUSSION

This study compares the results trans-tympanic pop-in myringoplasty with those of underlay myringoplasty by trans-canal and post-aural approaches. In this study post-aural underlay cases averaged 106.4 operative minutes, trans-canal underlay patients 72.1 minutes, while trans-tympanic pop-in patients 45.5 minutes. Alzoubi et al[2] compared the results of 29 trans-tympanic myringoplasty with 32 cases of transcanal tympano-meatal flap myringoplasty. Mean operative time for the 2 groups were 49.8 minutes and 58.6 minutes respectively.

In this study the tympanic membrane perforation closure at 6 months after surgery in the trans-tympanic pop-in method was 81.1%. Alzoubi et al[2] reported perforation closure rates of 72% and 78% for trans-tympanic

myringoplasty and transcanal tympano-meatal flap myringoplasty respectively. El-Guindy [3] reported a 91% success rate with trans-tympanic myringoplasty in adults using a rigid endoscope and perichondrium as the graft material. Naganuma et al [4] reported a 78% success rate in adults using homologous temporalis fascia as the graft material by the trasnstympanic method, the procedures being done under local anaesthesia. Srinivasan et al [5] described trans-tympanic 'push through' technique using temporalis fascia in 40 children with the rate for perforation closure as 77.5% at 6 months. They reported no significant relationship between the site of perforation and successful outcome. Singh GB et al [6] reported 25 cases of trans-tympanic myringoplasty with a success rate of 84% in terms of perforation closure. They also opined that surface area of perforation did not influence the result, however anterior perforations showed poor graft uptake rates. Sharma DK et al [7] reported 90 cases of myringoplasty with the success rate associated with permeatal, endaural and post-aural approaches as 73.33%, 83.33% and 86.66% respectively. However they used both onlay and underlay techniques. Albert et al [8] reported 6 cases of office based trans-tympanic myringoplasty using cyanoacrylate adhesive delivered in an insulin syringe with successful perforation closure in 5 cases.

A successful hearing outcome with an average air-bone gap of $\leq$ 10 dB was seen in 78.4% patients of pop-in myringoplasty in this study. Alzoubi et al [2] reported that hearing results were better in trans-tympanic technique compared to tympano-meatal flap technique especially at 1 kHz. Audiometric analysis of Srinivasan et al [5] series reveals that 66% of patients achieved 20 dB or better hearing thresholds for air conduction postoperatively. Singh GB et al[6] reported a success rate of 71.5% in terms of hearing improvement.

CONCLUSIONS

Trans-tympanic pop-in myringoplasty gives similar hearing & graft uptake results when compared with tympano-meatal flap method of underlay myringoplasty done by trans-canal or post-aural approach. However it is easier and takes less time to perform when compared to these two approaches, thus being more cost-effective. It also has no potential risk of injury to chorda tympani nerve like these two approaches.

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