

Comparative Study On Success Rate Following Tympanoplasty With Or Without Canaloplasty

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ABSTRACT

Background: Chronic otitis media is a highly prevalent disease in developing as well as developed countries, causing hearing disabilities to the patients and causing huge problems to the patients in their daily routine lives. The patients are routinely advised for tympanoplasties in the specialized centers. Canaloplasties are routinely performed in such patients to get wide exposure while doing tympanoplasties. The present study seeks to determine the impact of canaloplasty on the outcome of the tympanoplasty.

Material and methods: The study was conducted in Department of Otorhinolaryngology in which 60 patients were included. These patients were randomly divided into two groups. Group A patients underwent type I tympanoplasty with canaloplasty while group B patients underwent type I tympanoplasty alone. Patients in both the groups were followed up with pure tone audiometry and otoscopy at 6 weeks and 12 weeks postoperatively. Hearing was compared in both the groups in terms of air bone gap closure. Air bone gap closure at 12 weeks was considered final. Final analysis was done using SPSS version 21.0.

Results: The patients were randomly divided into two groups. Group A patients underwent type 1 tympanoplasty with canaloplasty, and group B comprises of case I graft tympanoplasty alone. Graft uptake was better in group A with a success rate of 94.3% as compared to group B which had a success rate of 88.57%. Air bone gap closure was better in group A as compared to group B (15.76 dB $\pm$ 6.75 v/s 14.87 dB $\pm$ 5.99) at 12 weeks postoperatively.

Conclusion: Tympanoplasty with canaloplasty showed advantageous outcome over tympanoplasty alone and thus should be considered with limited exposures. However, the surgical procedures should be formulated based on the patient and surgical Expertise.

Keywords: Medial graft tympanoplasty, Air bone gap, Canaloplasty, Graft uptake

1. INTRODUCTION

The World Health Organization has estimated that approximately 65 to 330 million people have chronic otitis media (COM) worldwide with 50% having hearing impairment and approximately 28,000 deaths per annum due to complications [1]. COM usually starts with episodes of acute otitis media (AOM) or otitis media with effusion in childhood which results in long-term changes of the tympanic membrane [2]. There is degeneration in the outer and inner fibrous layers of the lamina propria and in the submucosal layer of the tympanic membrane (TM). Such changes reduce the elastic properties of the tympanic membrane making it susceptible to chronic perforations or retraction. Traumatic tympanic perforation can occur from penetrating trauma, blast injuries, and iatrogenic causes [3]. Patients with TM perforations present with ear discharge and hearing loss. As the perforation size increases, transformer ratio diminishes leading to larger cancelling effect of sound. Hearing loss almost reaches 40–45 decibel (dB) with total perforation and intact ossicular chain [4]. Wullstein introduced the term “Tympanoplasty” in 1953 [5]. An ideal tympanoplasty aims to restore sound protection for the round window by creating a closed air containing the middle ear and rebuilds the sound pressure transformation mechanism for the oval window [6]. The ear canal plays an important role in modulating the sound that is incident upon the tympanic membrane. A resonance-induced amplification of 20 dB sound pressure occurs in the normal ear canal at frequencies of 2800–3000 Hz

owing to the length and diameter of the canal [7]. Thus, canaloplasty should be done till the canal becomes an inverted truncated cone. The secret of the success of the procedure is in the preservation of the canal skin, and to do so, the canal is widened in parts [8]. Thus, the primary objective of the study is to determine the hearing outcome of the patients undergoing tympanoplasty with canaloplasty and without canaloplasty with the secondary objective of comparing the graft uptake in the two groups, keeping the confounding factors to as minimal as possible.

2. MATERIALS AND METHODOLOGY

The present study was conducted in Department of Otorhinolaryngology. The study is a prospective study comparing the outcome of hearing in type I tympanoplasty with or without canaloplasty. Patients of age 18–50 years with inactive chronic mucosal otitis media having pure conductive hearing loss (air bone gap of less than or equal to 40 dB) were included in the study. Patients with history of previous ear surgery were excluded. These patients were randomly divided into two groups. Group A patients underwent type I tympanoplasty with canaloplasty, while group B patients underwent type I tympanoplasty alone. After taking consent, the patients were subjected to detailed history and examination. Preoperative audiometric evaluation was done and Air bone gap calculated. The patients were then subjected to type I tympanoplasty.

The graft placement was done medial to the handle of malleus in the study. In cases where the canal is narrow or has bony overhangs, Canaloplasty is done. (Fig. 1).



Fig. 1 Pre canaloplasty image showing superior bony overhangs (Right ear)

In patients who underwent canaloplasty, the external auditory canal was widened with cutting and diamond burrs removing any canal wall bulge or hump

Drilling was done along with suction and irrigation (Fig. 2).



Fig. 2 Drilling along with suction and irrigation being done during canaloplasty (right ear)

In case of anterior canal bulge, the canal skin was elevated from lateral to medial till the bony cartilaginous junction 3 mm is lateral to the tympanic annulus, and then using burrs, the anterior canal bulge was reduced without exposing the temporomandibular joint. The shape of the EAC appears as an inverted cone at the end of canaloplasty (Fig. 3).

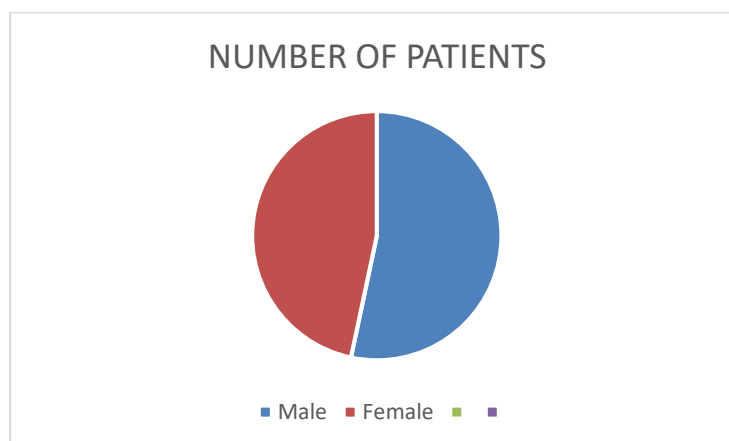


The aim of the canaloplasty was to expose and visualize the entire tympanic annulus in one view of the microscope. Patients in both the groups were followed up with pure tone audiometry and otoscopy at 6 weeks and 12 weeks postoperatively. Hearing was compared in both the groups in terms of air bone gap closure. Air bone gap closure at 12 weeks was considered final. Final analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.

3. RESULTS

A total of 60 patients were included in the current study out of which 30 patients each were included in the group A and group B. Out of 60 patients, 28 were females, and 32 were males.

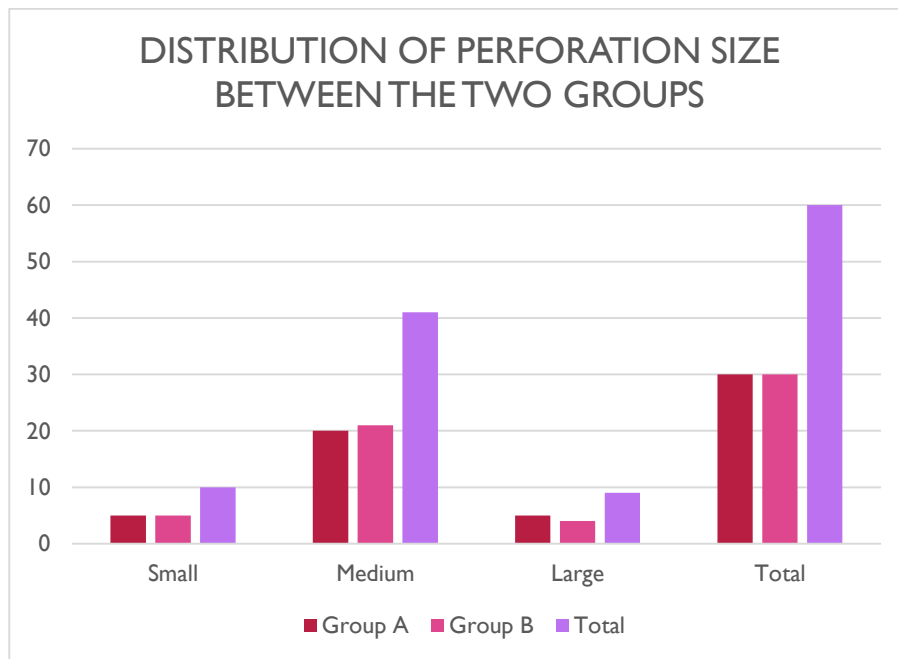
GENDER	NUMBER OF PATIENTS	PERCENTAGE (%)
Male	32	53.33%
Female	28	46.67%
Total	60	100.0%



The mean age of the patients in group A was 24.57 ± 5.05 , while in group B, it was 28.03 ± 6.71 . Chi-square test was done, and the p value was insignificant (0.106). The chi-square value for the distribution of perforation size between the two groups showed p value of 0.951 as seen in Table 1.

Table 1

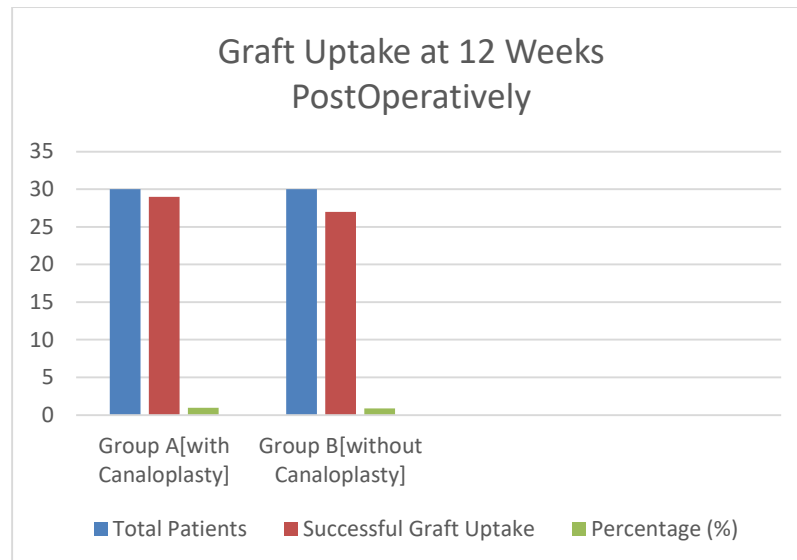
	Group A	Group B	Total	P value
Small	5(20%)	5(20%)	10 (20%)	0.951
Medium	20 (60%)	21 (62.86%)	41 (61.43%)	
Large	5 (20%)	4 (17.14%)	9 (18.57%)	
Total	30	30	60	



Postoperatively, at 12 weeks, in group A, 29 patients (94.3%) showed successful graft uptake, while in group B, 27 patients (88.57%) showed successful graft uptake. The p value for the difference between two groups came out to be 0.356 using Fischer exact test suggesting no significant differences between the two groups as in Table 2.

Table 2

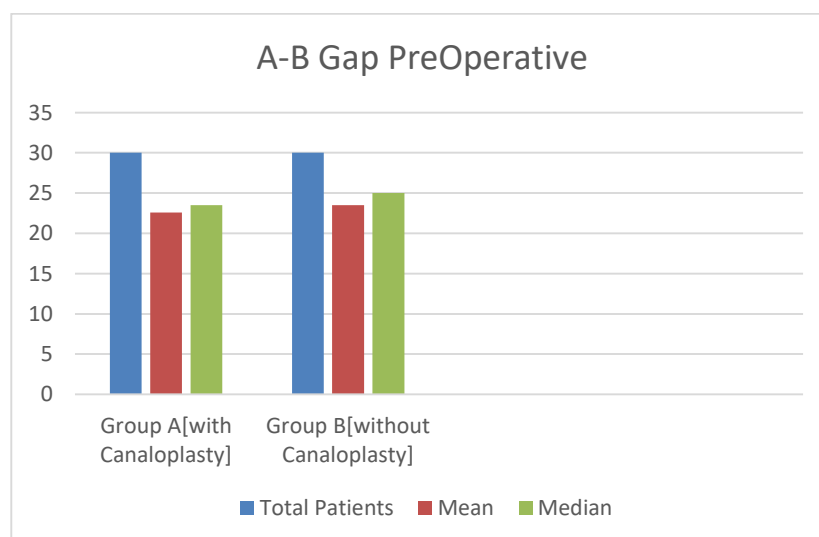
GROUP	Total Patients	Successful Graft Uptake	Percentage (%)	Statistical Significance (p value)	Test performed
Group A[with canaloplasty]	30	29	94.3%		
Group B[without canaloplasty]	30	27	88.57%		
Comparision				P = 0.356	Fisher exact test



Preoperative air bone gap in group A was $22.57 \text{ dB} \pm 7.75$. However, air bone gap in group B was $23.49 \text{ dB} \pm 5.94$. The p value for the difference in air bone gap distribution among the two groups preoperatively was 0.506. The p value was calculated using Mann-Whitney test suggesting no significant between the two groups (Table 3).

Table 3

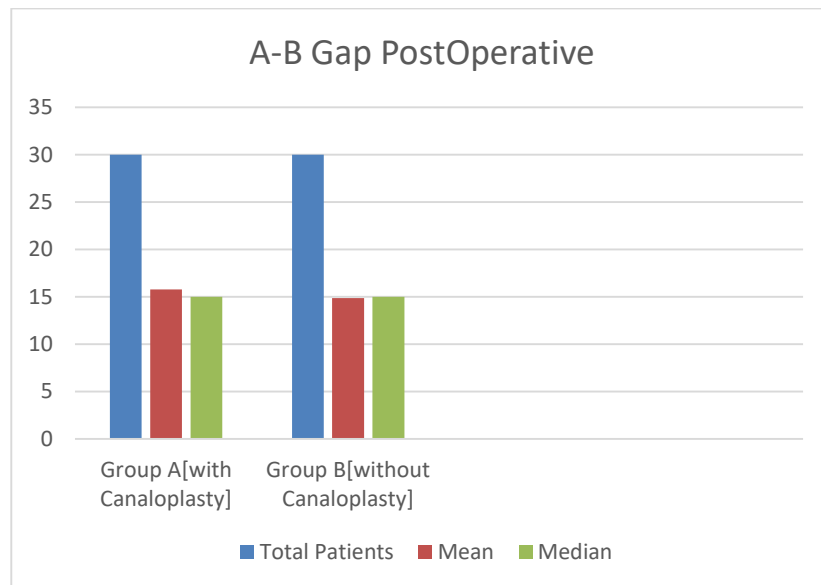
Pre op AB gap (dB)	With canaloplasty Group A (n=30)	Without canaloplasty Group B (n=30)	Total	p value	Test performed
Mean + Standard deviation	22.57 + 7.75	23.49 + 5.94	23.03 + 6.87	0.506	Mann-Whitney test : 569
Median (IQR)	22.5 (16.5-30)	25 (20-28)	24.75 (20-28)		
Range	7-35	10-35	7-35		



Postoperative air bone gap closure in group A was $15.76 \text{ dB} \pm 6.75$ at 12 weeks. However, air bone gap closure in group B was $14.87 \text{ dB} \pm 5.99$ at 12 weeks. The p value for the difference in air bone gap distribution among the two groups at 12 weeks postoperatively was 0.506. The p value was calculated using Mann-Whitney test suggesting no significant between the two groups (Table 4).

Table 4

	With canaloplasty Group A (n=30)	Without canaloplasty Group B (n=30)	Total	p value	Test performed
Mean + Stdev	15.76 + 6.75	14.87 + 5.17	15.31 + 5.99	0.506	Mann-Whitney test; 569
Median (IQR)	15 (10-20)	15 (10-20)	15 (10-20)	0.506	
Range	5-28	5 -25	5-28		



4. DISCUSSION

Tympanoplasty is the surgical procedure in which disease from the middle ear is eradicated followed by the reconstruction of hearing mechanism with or without tympanic membrane grafting [5]. Canaloplasty is a surgical procedure that aims to widen the external auditory canal [8]. Canaloplasty leads to better surgical visualization and hence improved graft uptake. Since the ear canal also plays an important role in modulating sound, thus the study was conducted to determine the additional improvement in hearing on combining canaloplasty with type I tympanoplasty. In the present study, the confounding factors such as gender and age distribution along with the type of perforation and preoperative air bone gap did not show any significant statistical difference among the two groups. There are very few studies which compared outcomes of tympanoplasty with or without canaloplasty when the graft is placed medial to the handle of malleus. After 12 weeks postoperatively, the success of graft uptake in group A was better than group B in the current study at 94.3% in group A compared to 88.57% in group B. This corroborates with the earlier studies done by Morrison et al. at the University of Alabama, who reported 91.6% graft uptake in patients with tympanoplasty with canaloplasty as compared to 69% in patients with tympanoplasty alone when the graft was placed medially. However, the success rate of graft uptake was higher in the patients with tympanoplasty with and without canaloplasty, but the p value was not significant in the present study, while it was significant in the study conducted by Morrison et al. [9]. Hearing outcomes at 12 weeks postoperatively showed air bone gap closure of $15.76 \text{ dB} \pm 6.75$ in patients with tympanoplasty along with canaloplasty, while the air bone gap closure of $14.87 \text{ dB} \pm 5.99$ was seen in patients who underwent tympanoplasty alone. However, in the study conducted by Morrison et al., the air bone gap of $8.7 \text{ dB} \pm 6.3$ was seen in patients with medial tympanoplasty with canaloplasty as compared to $14.3 \text{ dB} \pm 11.1$ air bone gap in patients with medial tympanoplasty alone, but the difference was statistically significant [9]. Similarly, Virendra et al. in their study had 9 dB improvement in hearing in cases with canaloplasty as compared to tympanoplasty alone [10]. Prakash et al. in their study also achieved 13.48 dB of air bone gap closure in cases with canaloplasty as compared to 11.26 dB air bone gap closure in cases without canaloplasty, and the difference was statistically significant too [11]. This is similar to what we have seen in the current study; however, the difference was not statistically significant with a p value of 0.506. There are a few studies available which assessed the impact of canaloplasty in hearing outcomes in patients undergoing type 1 tympanoplasty. In the current study, confounding factors were removed as much as

possible thus accessing the outcomes more accurately. However, the Eustachian function status is the confounding factor in this study. The results seen in the current study showed similar trends as seen in the previous studies as the percentage of graft uptake and air bone gap closure were better in patients undergoing canaloplasty along with medial graft tympanoplasty as compared to patients undergoing medial tympanoplasty alone.

5. CONCLUSION

In the nutshell, the present study suggests better outcomes with respect to graft uptake and air bone gap closure in patients who underwent tympanoplasty with canaloplasty as compared to patients who underwent tympanoplasty alone but the difference was not statistically significant. However, the surgical procedures should be decided according to the individuals' needs of the patient as well as the experience and the skills of the surgeon.

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