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RESEARCH ARTICLE

Evaluation of Hearing Improvement Following Type 1 Tympanoplasty at a Tertiary Medical Center in Bangladesh

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Abstract

Background: The presence of a perforation of the tympanic membrane with intermittent discharge and conductive hearing loss are the indications of Type-1 tympanoplasty.
Objective: To evaluate hearing improvement after type-1 tympanoplasty in Bangladeshi populations. Methodology: It was a two-year-long cross-sectional study conducted at the Sir Salimullah Medical College and Mitford Hospital, Dhaka from 2022 to 2024. A total of 50 patients with chronic otitis media were enrolled and observed in this study. MS Excel and SPSS were used as data analysis tools.
Results: The mean age was found 28.5 years with a range from 15 to 41 years and the male-female ratio was 1.3:1. Almost half (48.0%) of patients had medium size perforation. Preoperative hearing status according to the size of the perforation shows that hearing loss was observed in all sizes of perforation but minimum loss was found in small perforation (34.7% dB) and maximum loss in subtotal perforation (47.0 dB). In postoperative audiometry, the mean improvement of the air conduction threshold was found 12.5 dB in small, 12.8 dB in medium, 13.3dB in large, and 14.7 dB in subtotal perforation. Although improvement of hearing status was found in all sizes of perforation no significant differences were observed between different sizes of perforation. The mean air conduction threshold of all (50) patients was found 40.2 dB preoperatively and 27.1 dB postoperatively. Air-bone gap was found at 26.9 dB in the preoperative and 16.1 dB in the post-operative group. Two-thirds (66.0 %) of patients improved <15 dB air conduction threshold and 17 (34.0%) improved ≥15 dB air conduction threshold.
Conclusion: Size & site of perforation affects the degree of hearing loss. Significant improvement of air conduction threshold and AB gap observed after type-1 tympanoplasty. Thus, from this study, it can be concluded that type-1 tympanoplasty is an effective technique for hearing improvement in inactive mucous type of chronic otitis media.

Keywords: Inactive Mucous Type Of Chronic Otitis Media, Type-1 Tympanoplasty, Hearing Improvement.

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1. Introduction

Hearing is one of the essential sensory criteria for human beings to survive. Loss of hearing interferes with daily life imbalance. In 2024. WHO reported that nearly 2.5 billion people worldwide suffer from deafness and hearing impairment [1]. Middle ear infections, excessive noise, inappropriate use of certain drugs, problems during childbirth, and unawareness of vaccinations are some preventable causes of hearing impairment in low and middle-income countries mostly which is preventable [1]. Although risk factors behind deafness are not the same in developing countries, some other factors like poor living standards, overcrowding, lack of personal hygiene, malnutrition, smoking, lack of health education, bottle feeding in the supine position, repeated upper respiratory tract infection of viral origin and lack of access to healthcare initiates deafness among the people [2]. Perforation of the tympanic membrane in chronic otitis media is one of the major reasons for hearing loss [3]. The mucous type of chronic otitis media (COM) is characterized by perforation in the pers-tensa of varying size and shape. It is usually associated with aural discharge and hearing loss [4]. The degree of hearing loss is influenced by the size and site of perforation and condition of the ossicular chain but other important factors such as the presence of granulation tissue, mucous adhesion, tympanosclerosis, and eustachian tube function are also of importance in determining the hearing level [5]. Chronic otitis media can be managed by topical quinolones or surgically with tympanoplasty [6]. Tympanoplasty is a surgical procedure to repair the perforated tympanic membrane, with or without reconstruction of the ossicles [7]. This study aimed to evaluate hearing improvement after type 1 tympanoplasty with some focus on the possible influencing factors.

2. Methodology

A cross-sectional study on hearing assessment before and after type-1 tympanoplasty was held in the Department of Otolaryngology & Head Neck Surgery, Sir Salimullah Medical College and Mitford Hospital, Dhaka. The study duration was from July 2022 to June 2024. A total of 50 patients were enrolled in the study by maintaining all ethical considerations. Study-specific inclusion and exclusion criteria were followed during enrollment.

2.1 Inclusion Criteria

- Inactive mucous type of chronic otitis media.
- Conductive type of hearing loss.
- Successful type I tympanoplasty.

2.2 Exclusion Criteria

- All other types of chronic otitis media except inactive mucous.
- Sensorineural and mixed types of hearing loss.
- Previous surgery in the same ear.
- Graft failure cases.

After taking informed written consent data were collected in a data collection sheet for each patient who underwent successful type I tympanoplasty. After 3 months pure tone audiometry was performed according to ISO standard. The hearing thresholds were measured at 500, 1000 & 2000 Hz. The assessment of the patient was established based on history, clinical examination, radiological examination, and pure tone audiometry. MS Excel and Social Sciences version (SPSS) 20.0 was used as a data analysis tool for the study. P values <0.05 were considered statistically significant.

3. Result

Table I shows the distribution of age and sex of respondents, it was observed that the majority (46.0%) of the respondents belonged to age 21-30 years. The mean age was found 28.5±6.8 years with a range from 15 to 41 years. Twenty-eight (56.0%) respondents were male and 22(44.0%) respondents were female. Male female ratio was 1.3:1.

Table I. *Distribution of respondents by age and sex (N=50)*

Age (in years)	Number	Percentage
10-20 Yrs.	7	14.0
21-30 Yrs.	23	46.0
31-40 Yrs.	19	38.0
41-50 Yrs.	1	2.0
Mean±SD	28.5±6.8	
Range (min, max)	15,41	
Sex		
Male	28	56.0
Female	22	44.0

Figure 1 shows that almost half (48.0%) of respondents had medium-size perforation followed by 11(22.0%) large, 10(20.0%) small, and 5(10.0%) subtotal perforation.

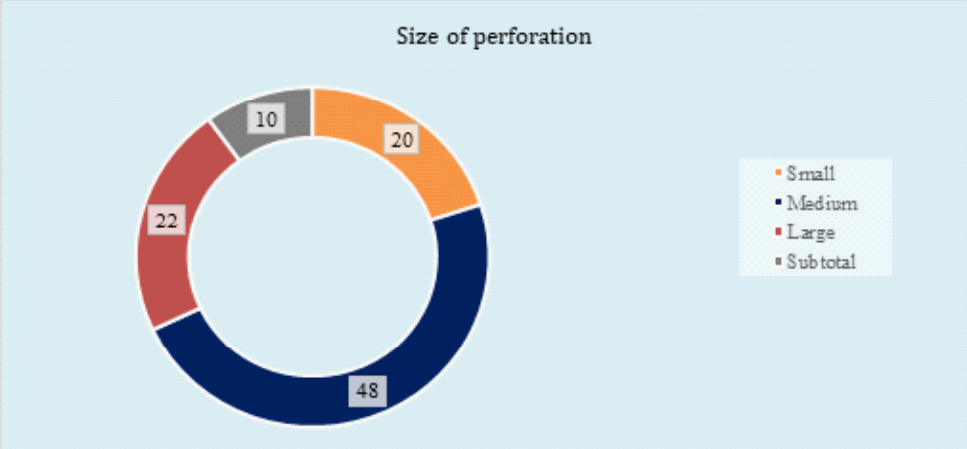

Figure 1. *Ring chart showed size of perforation of the patients (N=50)*

Table II (a). *Preoperative hearing threshold about perforation size (N=50)*

Pure tone audiometry	Small (n=10)	Medium (n=24)	Large (n=11)	Subtotal (n=5)	P value
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	
Bone conduction threshold (dB)	11.0±6.1	12.8±6.1	15.0±4.7	16.3±4.3	0.254^{ns}
Range (min, max)	5,23	5,23	7,22	10,22	
Air conduction threshold (dB)	34.7±4.0	38.7±8.1	45.3±9.9	47.0±8.4	0.006^{s}
Range (min, max)	30.0,41.0	28.3,56.7	31.7,58.3	38.3,56.7	
Air-bone gap (dB)	23.7±5.1	25.8±5.4	30.3±12.8	30.7±11.2	0.187^{ns}
Range (min, max)	13.3,30.0	13.3,35.0	15.0,46.7	21.7,46.7	

Table II (a) showed preoperative audiometry, the mean air conduction threshold among the four groups was statistically significant ($p<0.05$).

Table II (b). *Postoperative hearing threshold about perforation size (N=50)*

Pure tone audiometry	Small (n=10)	Medium (n=24)	Large (n=11)	Subtotal (n=5)	P value
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	
Bone conduction threshold (dB)	9.0±5.3	10.9±5.2	12.1±3.9	13.0±3.8	0.383^{ns}
Range (min, max)	5,20	5,20	7,18	7,17	
Air conduction threshold (dB)	22.2±3.2	25.9±6.3	32.0±8.6	32.3±7.3	0.003^{s}
Range (min, max)	18.3,26.7	18.3,41.7	21.7,45.0	25.0,41.7	
Air-bone gap (dB)	13.2±3.5	15.0±4.1	19.8±10.1	19.3±9.8	0.068^{ns}
Range (min, max)	6.7,18.3	6.7,23.3	5.0,31.7	11.7,31.7	

Table II (B) showed postoperative audiometry shows that the mean air conduction threshold among the four groups was statistically significant ($p<0.05$).

Table III (a). *Statistical analysis (level of significance) of inter-group variation in pure tone audiometry about perforation size*

Group of study subjects		Preoperative air conduction threshold (dB) P-value
Small	Medium	1.000^{ns}
	Large	0.022*
	Subtotal	0.041*
Medium	Large	0.160^{ns}
	Subtotal	0.230^{ns}
Large	Subtotal	1.000^{ns}

Table III (b). *Statistical analysis (level of significance) of inter-group variation in pure tone audiometry about perforation size*

Group of study subjects		Postoperative air conduction threshold (dB) p-value
Small	Medium	0.813^{ns}
	Large	0.007**
	Subtotal	0.039*
Medium	large	0.083^{ns}
	subtotal	0.301^{ns}
Large	Subtotal	1.000^{ns}

Table IV. *Distribution of improvement of hearing status after type I tympanoplasty about the perforation size (N=50)*

Pure tone audiometry	Small (n=10)	Medium (n=24)	Large (n=11)	Subtotal (n=5)	P value
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	
Bone conduction threshold (db)	2.0±1.3	1.9±1.4	2.91.3	3.3±1.2	0.068^{ns}
Air conduction threshold (dB)	12.5±2.6	12.8±3.2	13.3±2.1	14.7±2.2	0.499^{ns}
Air-bone gap (dB)	10.5±2.7	10.8±3.1	10.5±2.9	11.3±2.2	0.095^{ns}

Table IV The mean improvement of bone conduction threshold, air conduction threshold, and air-bone gap of different sizes of perforation were not statistically significant (p>0.05).

Table V (a). *Distribution of respondents by improvement of hearing status after type I tympanoplasty (N=50)*

Gain of air conduction threshold (db)	Number	Percentage
<15	33	66.0
≥15	17	34.0

Table V (a), shows that two third (66.0%) of patients gained <15 dB air conduction threshold and 17(34.0%) gained ≥15 db air conduction threshold.

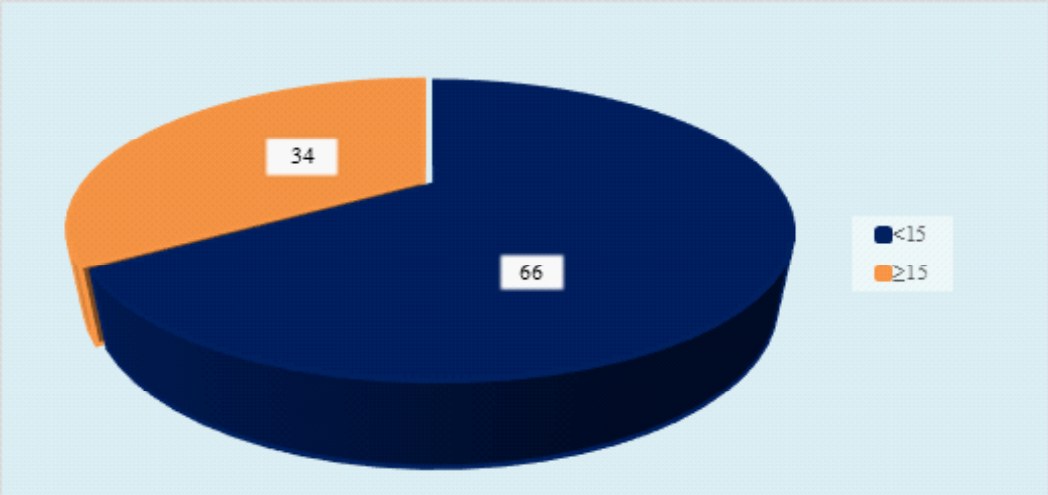

Figure 2. *Pie chart showed improvement of hearing status after type I tympanoplasty among patients (N=50)*

Table V (b). *Distribution of respondents by improvement of hearing status after type I tympanoplasty (N=50)*

Hearing status	Preoperative		Postoperative		Z value	P value
	n	%	n	%		
Air conduction threshold within 40 dB	31	62.0	46	92.0	3.81^{s}	0.001^{s}
Air-bone gap within 20 dB	11	22.0	40	80.0	7.12^{s}	0.001^{s}

Regarding the improvement of the hearing status of the respondents, it was observed that an air conduction threshold within 40 dB was found in 31(62.0%) patients in preoperative and 46(92.0%) in postoperative. Air-bone gap within 20 dB was found 11(22.0%) in preoperative and 40(80.0%) in postoperative. The differences were statistically significant ($p<0.05$) compared between preoperative and postoperative.

4. Discussion

Previous research claims that the success rate of type-1 tympanoplasty is 35-95% [8]. This cross-sectional study evaluates post-operative hearing improvement and compares the hearing status with preoperative conditions. In this study, we found that the majority of study subjects are male. However, the male-female ratio is 1.3:1. Similarly Hofman J. et al., 2017 reported that men are most susceptible to loss of hearing in the USA. He concluded that the mean age of patients with hearing impairment is 43.6 years [9]. In Bangladesh, the age varies from 15 to 41 years and the mean age detected was 28.5±6.8 years. Some Bangladeshi study agrees with this result and describes that almost 9.6 percent of Bangladeshi children lose greater than 30dB of their hearing abilities at the age of 15 [10]. We observed that 48% of patients with medium-size perforation, 22.0% of large, 20.0% of small, and 10.0% of subtotal perforation patients came to the research site to seek type-1 tympanoplasty. In 2019, another study in Bangladesh reported that 48% of patients with small perforation, 38.33% with medium, and 13.34% of patients with large perforation underwent type-1 tympanoplasty which resembles that with time the rate of perforation at the eardrum is increasing to the worst [11]. We evaluated that in preoperative audiometry, the mean air conduction threshold was 34.7 dB in small, 38.7 dB in medium, 45.3 dB in large, and 47.0 dB in subtotal perforation (table- IIa). Statistically significant ($p<0.05$) difference was found between small and large & small and subtotal groups (table- IIb). In postoperative audiometry, the mean air conduction threshold was found 22.2 dB, 25.9 dB, 32.0 dB, and 32.3 dB in small, medium, large, and subtotal perforation respectively (table- IIIa). A statistically significant difference was also found between the two groups which was observed preoperatively (table- IIIb). Similarly, Vaiday *et al.*, 2014 found maximum hearing loss was in subtotal perforation (49.31 dB) followed by, 45.50 dB in large, 44 dB in medium, and 34.26 dB in small perforation [12]. The mean improvement of the air conduction threshold was found 12.5 dB in small, 12.8 dB in medium, 13.3 dB in large, and 14.7 dB in subtotal perforation (table- IV). The difference was not statistically significant ($p>0.05$) among the four groups, though there are slight higher improvement with increasing size of perforation. Vaidya *et al.,* 2014 reported that after surgical treatment, concerning size, subtotal perforation had maximum hearing improvement (16.25 dB) and minimum hearing improvement (14.93 dB) was noted in small perforation [12]. Sarker *et al.*, 2012 found post-operative hearing gain was 11.17 dB, 21.60 dB & 18.67 dB in small, medium & large perforations respectively [13]. In this study, it was observed that two-thirds (66.0%) of patients improved <15 dB air conduction threshold, and 17(34.0%) improved ≥15 dB air conduction threshold (table- Va). Shrestha and Sinha (2006) found that 39 (78%) patients had a hearing gain exceeding 15 dB [14]. In Bangladesh Biswas *et al.,* 2010 study showed hearing gain occurred in 31 (60.78%) patients and no improvement was seen in 20 (39.21%) patients when a gain of 10 dB or more was considered significant [15]. Joshi et al., 2013 found that hearing gain occurred in 29 ears (67.44%) and no improvement was seen in 14 (32.56%) ears [16]. Regarding air conduction threshold within 40 dB, was found 31(62.0%) patients in preoperative and 46(92.0%) in postoperative & AB gap within 20 dB was found 11(22.0%) in preoperative and 40 (80.0%) in postoperative (table- Vb). The differences were statistically significant ($p<0.05$) compared between preoperative and postoperative groups. Using the proportion of patients with postoperative hearing within 40 dB as the criterion, Shrestha and Sinha's (2006) study showed, 100% of patients achieved their hearing level within 40 dB and using postoperative air-bone gap within 20 dB as the criterion, 41 (84%) patients had their air-bone gap within 20 dB. The above findings are consistent with the current study[14].

5. Conclusion

Hearing loss is one of the most common presenting complaints in Bangladesh. The majority of patients presented during the late course of their disease process and had moderate hearing loss with large perforation. Although overall improvement of air conduction threshold and AB gap after type 1 tympanoplasty was statistically significant. Thus from this study, it can be concluded that type I tympanoplasty is an effective technique for hearing improvement.

Recommendation

Further studies can be undertaken by including a large number of patients from multiple centers and also long-term follow-up of the patients.

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