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Original Article

Evaluation of Hearing Status after Type-1 Tympanoplasty

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Abstract

Objective: To evaluate hearing outcome after type-1 tympanoplasty in inactive mucosal type of chronic otitis media.

Methods: This was an observational cross sectional study which was carried out in the department of Otolaryngology and Head Neck Surgery of Sir Salimullah Medical College Mitford Hospital during period of January 2016 to December 2016. A total of 50 patients who underwent successful type-1 tympanoplasty were collected. Majority of the patients were operated on under local anaesthesia. After 3 months pure tone audiometry was performed according to ISO standard. The hearing thresholds were measured at 500, 1000 & 2000 Hz. Air and bone conduction thresholds were determined with appropriate masking technique throughout.

Result: In this study, majority of the patients belong to age 21 to 30 years and most of patients were female. About 28 (56%) patients had inferior perforation and 31 (62%) had medium size perforation. Mean pre-operative air conduction threshold was 43.6 dB and significantly reduced to 32.0 dB after type-1 tympanoplasty. Mean change in air conduction threshold was 11.5 dB. Mean pre-operative air-bone gap was 33.1 dB and significantly reduced to 22.9 dB after type I tympanoplasty. Mean change in air-bone gap was 10.1 dB.

Conclusion: Overall improvement of air conduction threshold and AB gap after type I tympanoplasty was statistically significant. Thus from this study it can be concluded that type I tympanoplasty is an effective technique for hearing improvement in inactive mucous type of chronic otitis media.

Keywords: Tympanoplasty, Hearing improvement, Chronic otitis media, Audiometry.

Introduction

Ear is an important organ of hearing and balance for all living creature. A person deprived of hearing (or suffering from hearing loss) feels terribly handicapped, isolated, and ineffective in communication with others. It should be noted that this ability is susceptible to pathology that causes hearing impairment may also end up causing hearing disability.[1] In 1985, WHO estimated that there were 42 million deaf persons in the world.[2] More recent estimates put the number approximately 278 million people presented with moderate to profound hearing loss worldwide.[3] Despite being the most prevalent disabling condition globally and one of the major contributors to the global burden of disease, hearing loss has historically been ignored on global health care agendas.[4] The major preventable causes of hearing impairment in low and middle-income countries are middle ear infections, excessive noise, inappropriate use of certain drugs, problems during childbirth and vaccine-preventable infections. The burden of otitis media occurs overwhelmingly in the developing world with almost nine times more cases reported compared to developed countries.[5] The poor living standard, overcrowding, lack of personal hygiene, malnutrition, smoking, lack of health education, bottle feeding in supine position, repeated upper respiratory tract infection of viral origin and lack of access to healthcare all have been suggested for the wide spread prevalence of chronic otitis media in developing countries.[6] Thus a cycle of hearing loss contributing to poverty and poverty contributing to hearing loss may be perpetuated in the developing world.[4] It affects both sexes and all age groups. The overall prevalence rate is more in rural than urban population. It is also the single most important cause of hearing impairment in affected population.[7]

Perforation of tympanic membrane in chronic otitis media (COM) is one of the major reasons of hearing loss[8]. Chronic otitis media may be divided into active COM and inactive COM.

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In active COM there is active inflammation and production of pus and it is further divided into mucosal and squamosal variety. In inactive COM where middle ear mucosa is not inflamed but has the potential to become active. Among these types mucosal variety is the commonest [9].

Chronic otitis media can be managed medically or surgically or via a combination of both. Active mucosal chronic otitis media is managed via aural toileting and appropriate antibiotics (topical and systemic), nasal decongestants and vitamin (C and A) supplements to enhance healing.[10] Once total disease eradication and dryness is achieved the level of function loss is evaluated in order to decide the need for further surgical intervention in the form of type I tympanoplasty surgery. Three principal indications for surgery in inactive mucous type of chronic otitis media have been documented (a) prevention of recurrent otorrhoea, (b) to improve the conductive hearing loss and (c) desire to swim without wearing water proof material in the ear. The classification of tympanoplasty related to ideal and theoretical postoperative hearing outcomes, based on middle-ear mechanics, consists of five types, each of which is based on the most lateral intact structure that remains connected to the inner ear.[11] For the purpose of the current study type I tympanoplasty is investigated. When presenting with an inactive mucous type of chronic otitis media, one receives type I tympanoplasty procedure, to seal the eardrum.[12] Type I tympanoplasty refers to the grafting of the tympanic membrane without reconstruction of the ossicular chain.[13] The primary goal in type I tympanoplasty is the restoration of the integrity of the tympanic membrane, and this result can be obtained by means of surgical techniques based on the positioning of the connective tissue at the site of the ear drum perforation. Thus, the main purpose of surgery is to stimulate skin and mucosal regeneration, leading to permanent closure of the defect.[14]

It has been suggested that factors such as the age of the patient, site of the perforation, size of the perforation, length of time that the ear has been dry for prior to surgery, the presence of infection at the time of surgery, as well as the status of the opposite ear may all be influencing factors affecting outcome of type 1 tympanoplasty.[12]

The concept of surgical repair of tympanic membrane was first introduced by Berthold in 1878, whereby a thick skin graft by overlay technique was used. Wullstein and Zollner used the split skin grafts. In the 1960s and 1970s, homograft (cadaveric) materials, including tympanic membrane, dura, and pericardium, among others, were used with varying success.[10] Since then, over the period of many decades, different grafts and techniques evolved and tympanoplasty has gone through many changes in technique and materials.[10,15] Temporalis fascia continues to be the material of choice for reconstruction of the tympanic membrane.[10]

There are different criteria for assessing hearing status after ear surgery such as social hearing method, hearing gain method and mean A-B gap for each frequency but none are universally accepted method.[16] Japan Clinical Otology Committee has used following three criteria for calculation of the hearing improvement (a)postoperative hearing within 40 dB, (b)hearing gain exceeding 15 dB, (c)postoperative air-bone gape within 20 dB.[17] In this study Japan Clinical Otology Committee criteria's are followed. Thus the current study aimed to evaluate hearing outcome after type 1 tympanoplasty.

Methodology

This cross sectional study was conducted in the department of Otolaryngology & Head Neck Surgery, Sir Salimullah Medical College Mitford Hospital, Dhaka from January 2016 to December 2016. Study population included the patients of any sex who had undergone successful type-1 tympanoplasty in the department of Otolaryngology & Head Neck Surgery, Sir Salimullah Medical College and Mitford Hospital, Dhaka. A total of 50 patients who underwent successful type-1 tympanoplasty were collected from the department of Otolaryngology & Head Neck Surgery, Sir Salimullah Medical College Mitford Hospital, and Dhaka. The assessment of the patient was established on the basis of history, clinical examination and pure tone audiometry. Majority of the patients were operated on under local anaesthesia and rests were on under general anaesthesia. After post-auricular incision, temporalis fascia graft was taken and placed by underlay technique. After 3 months pure tone audiometry was performed according to ISO standard. The hearing thresholds were measured at 500, 1000 & 2000 Hz. Air and bone conduction thresholds were determined with appropriate masking technique throughout. Data were collected in a data collection sheet for each of the patient. Statistical analyses were carried out by using the Statistical Package for Social Sciences version 20.0 for Windows (SPSS Inc., Chicago, Illinois, USA). The quantitative observations were indicated by frequencies and percentages. The mean values were calculated for continuous variables. Paired t-test, Z test and ANOVA test was used to analyze the continuous variables, shown with mean and standard deviation. ANOVA test followed by Bonferroni t-test was used to measure the level of significance between groups. P values <0.05 was considered as statistically significant.

Results

Table 1: Distribution of respondents by age and sex (n=50)

Variables	Frequency (n)	Percentage
Age (years)		
10-20	13	26.0
21-30	22	44.0
31-40	8	16.0
41-50	7	14.0
Mean ± SD	27.88 ± 9.85	
Min-max	13-41	
Gender		
Male	22	44.0
Female	28	56.0

Table 1 shows distribution of age and sex of respondents, it was observed that majority (44.0%) of therespondents belonged to age 21-30 years. The mean age was found 27.88±9.85 years with range from 15 to 50 years. Twenty two (44.0%) respondents were male and 28 (56.0%) respondents were female. Male female ratio was 1:1.27.

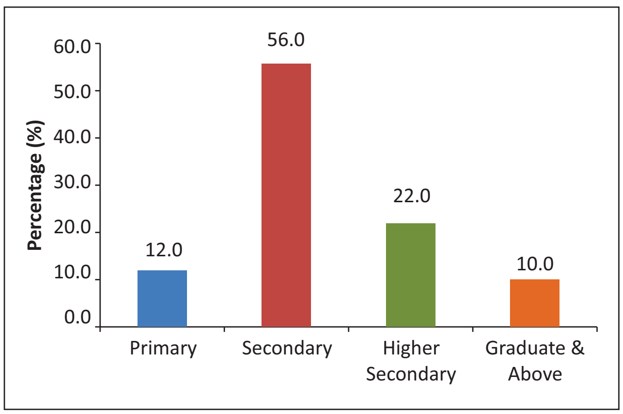

Figure 1: Bar Diagram showing distribution of respondents by Educational status (n=50)

Figure 1 shows educational status of respondents and it was observed that more than half of the patients 28 (56.0%) had completed secondary education followed by 11 (22.0%) had higher secondary, 6 (12.0%) had primary and 5 (10.0%) had graduate and above.

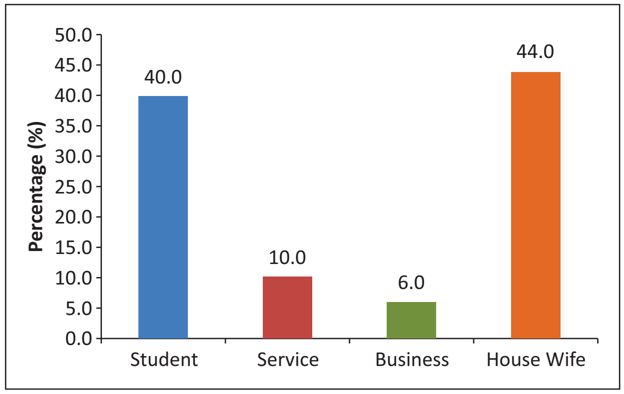

Figure 2: Bar Diagram showing distribution of respondents by Occupational status (n=50)

Occupational status of respondents shows that majority 22 (44.0%) patients were housewife followed by 20 (40.0%) were student, 5 (10.0%) were service holders and 3 (6.0%) were businessmen.

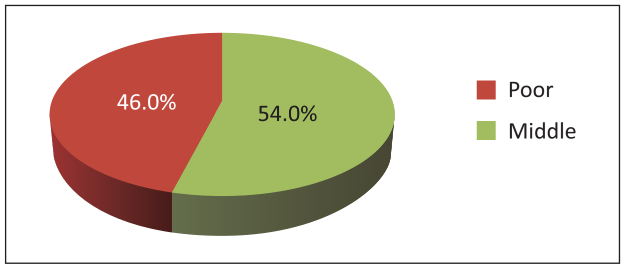

Figure 3: Pie Diagram showing distribution of respondents by Economic condition (n=50)

Figure 3 shows that 27 (54.0%) of the patients came from middle class family, 23 (46.0%) from poor family.

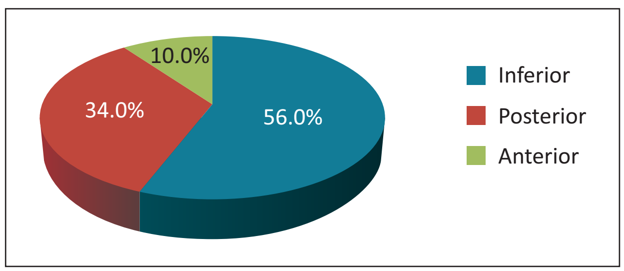

Figure 4: Pie diagram showing site of perforation of the respondents (n=50)

Figure 4 shows that majority 28 (56.0%) patients were inferior perforation followed by 17 (34.0%) posterior and 5 (10.0%) anterior perforation.

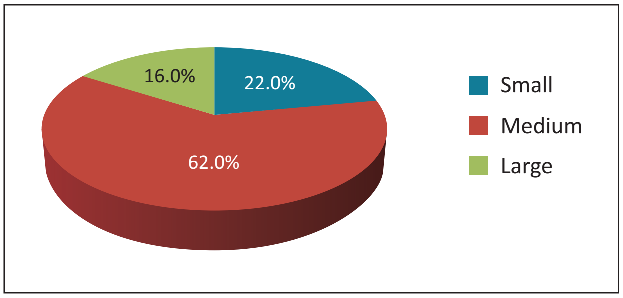

Figure 5: Pie diagram showing Size of perforation of the respondents (n=50)

Figure 5 shows that more than half of the respondents (62.0%) had medium size perforation followed by 11 (22.0%) small and 8 (16.0%) had large perforation.

Table 2: Distribution of respondents by pre-operative air conduction threshold (n=50)

Pre-operative air conduction threshold	Frequency (n)	Percentage
0-25 dB	0	0
26-40 dB	23	46.0
41-55 dB	26	52.0
56-70 dB	01	2.0

Table 2 shows maximum 26 (52.0%) patients' pre-operative air conduction threshold was 41-55 dB and 23 (46.0%) patients had 25-40 dB**.**

Table 3: Distribution of respondents by post-operative air conduction threshold (n=50)

Post operative air conduction threshold	Frequency (n)	Percentage
0-25 dB	1	2.0
26-40 dB	38	76.0
41-55 dB	11	22.0
56-70 dB	0	0

Table 3 shows maximum 38 (76.0%) patients' post-operative air conduction threshold was 25– 40 dB and 11 (22.0%) patients had 41-55 dB**.**

Table 4: Distribution of respondents by Preoperative hearing status (n=50)

Hearing outcome	Mean	p value
Pre operative air conduction threshold	43.6	
Post operative air conduction threshold	32.0	<0.001
Change in air conduction threshold	11.5	
Pre-operative air-bone gap	33.1	
Post operative air-bone gap	22.9	<0.001
Change in air-bone gap	10.1	

Table 5: Distribution of respondents by Post operative hearing outcome (n=50)

Hearing	Frequency (n)	Percentage
statusImproved	43	86.0
Not improved	7	14.0

Table 5 shows that hearing status was improved in 43 (86.0%) cases.

Discussion

In this present study it was observed that majority (44.0%) of the patients belonged to age 21-30 years. The mean age was found 27.88 ± 9.85 years with range from 15 to 50 years (Table 1). Biswas et al[18] found the age of the youngest patient was 12 year and age of the oldest patient was 46 years with mean age was 29 years. Islam et al[19] and Alam et al.[20] found age varied from 15 to 45 years with a mean age of 27 years and 15-45 years with highest number of patients was in the age group of 15-25 years respectively, which are closely resembled with the present study. Similarly, Joshi et al.[10] study found lowest and highest age of patients at presentation was 12 and 42 years respectively with a mean age of 25.5 years. Similar observations regarding the age ranged were also observed by Krishna and Devi[21].

Among 50 patients, twenty eight (56.0%) patients were female and 22(44.0%) patients were male. Male female ratio was 1:1.27 (*table- I*). Similarly, Krishna and Devi[21] and Shetty[22] found female predominant in their respective studies.

In this series it was observed that 28 (56.0%) patients had completed secondary education followed by 11 (22.0%) had higher secondary, 6 (12.0%) had primary, 5(10.0%) had graduate and above (*fig- 5*).

Occupation of the patients shows that majority (44.0%) patients were housewife, 20 (40.0%) were student, 5 (10.0%) were service holder and 3 (6.0%) were businessperson (*fig- 6*).

More than half (54.0%) of the patients came from poor family and 23 (46.0%) from middle class (*fig- 7*). Alam et al.[20] found majority of the patients came from middle class family (53.33%) and a significant number came from poor class family (30%).

In this series it was observed that majority (56.0%) patients had inferior perforation followed by 17 (34.0%) posterior and 5 (10.0%) anterior (*fig- 8*). In Bangladesh Islam et al. (2013) found anterior 45.0% and posterior 25.0%. Shetty[22] found majority (38.0%) of the patients had central malleolar perforation, followed by 28.0% big central, 14.0% anterior central & 10.0% of posterior central perforation. Shrestha and Sinha (2006) observed majority (44.0%) of the patients had big central perforation, followed by 34.0% central malleolar, 14.0% anterior central & 8.0% of posterior central perforation.

Regarding size of the perforation, more than half (62.0%) of the patients had medium size perforation followed by 11 (22.0%) small and 8 (16.0%) large perforation (*fig-9*). Similarly, in Bangladesh Islam et al. (2013) observed small size was found 10.0%, medium 60.0% and subtotal 30.0%. Medium sized perforations were most common in Joshi et al.[10] study. Mehta et al.[23] found 38.0% their patients presented with a moderate sized perforation (greater than 25% to 75% of the tympanic membrane) and 46.0% presented with a large perforation (greater than 75% of the tympanic membrane). Black & Wormald[8] found majority of the patient had small size perforation 36.96 %, followed by 20.85 % large, 18.0% medium & 11.84 % had subtotal perforation.

Regarding air conduction threshold within 40 db, was found 23 (46.0%) patients in preoperative and 38 (76.0%) in postoperative (table- 2 & 3). Using the proportion of patients with a postoperative hearing within 40 dB as the criterion, Shrestha and Sinha[24] study showed, 100% of patients achieved their hearing level within 40 dB. Similar, findings also observed by Alam et al.[20], where they showed that preoperatively 73.08% patients had air conduction threshold within 40 dB but postoperatively 100% patients were within 40 dB of air conduction threshold. Shetty[22]study showed that 19 (38%) patients had air conduction threshold within 40 dB preoperatively but 100% postoperatively.

In this present study it was observed that air conduction threshold was found 43.6 dB preoperatively and 32.0 dB post-operatively & AB gap was found 33.1 dB preoperatively and 22.9 dB post-operatively in all of 50 patients (Table 4). The difference were statistically significant ($p<0.05$) between preoperative and post-operative groups. In our country Biswas et al.[18] found the mean pre and postoperative air conduction threshold in the successful cases were 34 dB and 24 dB respectively, with a mean audiological improvement of 10 dB & improvement of mean air bone gap was 11 dB. In another study in Bangladesh Alam et al.[20] showed the mean pre and post operative air conduction threshold in the successful grafting cases were 31.43 dB and 21.43 dB respectively with a mean audiological improvement of 10 dB & improvement of mean air bone gap was 10.83 dB. Islam et al.[19] found the mean pre and post operative air conduction threshold in the successful grafting cases were 44.5 dB and 35.1 dB respectively with a mean audiological improvement of 9.4 dB & improvement of mean air bone gap was 10.1 dB. Similarly, Joshi al.[10] found the mean pre and post-operative air conduction threshold in the successful cases were 38.69 dB and 30.35 dB respectively with a mean audiological improvement of 8.34 dB & improvement of air bone gap was 10 dB. In another study Black & Wormald[25] found the average pre-operative air-bone gap was closed from 23.7 dB to 13.9 dB (improvement of AB gap 9.8 dB). Above findings are similar to or lower from the current study. But few studies showed greater improvement than this study, such as Shetty[22] observed 18.8 dB hearing improvement and Mehta et al.[23] showed the average improvement of air-bone gap was 13 dB. Vaiday et al.[26] and Sarker et al.[12] also foundgreater improvement than the present study.

In this study it was observed that hearing gain occurred in 43 (86.0%) patients (table- 5).Gain or loss of hearing of 0-10 dB were not considered as significant gain or loss. In that sense, no improvement was seen in 7 patients.Joshi et al[10]. (2013) found that hearing gain occurred in 29 ears (67.44%) and no improvement seen in 14 (32.56%) ears.The above findings are consistent with the current study.

Conclusion

Hearing loss is one of the most common presenting complaints in the chronic otitis media patient. Overall improvement of air conduction threshold and AB gap after type I tympanoplasty was statistically significant. Thus from this study it can be concluded that type I tympanoplasty is an effective technique for hearing improvement in inactive mucous type of chronic otitis media.

Limitations

1. The study population was selected from one selected hospital in Dhaka city, so that the results of the study may not be reflect the exact picture of the country.
2. The present study was conducted at a short period of time.
3. Small sample size was also a limitation of the present study.

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