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Hearing Status after Successful Myringoplasty in Relation to Size of the Tympanic Membrane Perforation

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ABSTRACT
Background: *Myringoplasty is one of the surgical techniques for the management of inactive mucosal type of chronic otitis media.*
Objectives: *The aim of this study was to assess the gain of hearing in relation to size of the tympanic membrane perforation following successful myringoplasty.*
Methods: *This prospective study has been conducted in the Department of Otolaryngology & Head-Neck Surgery at Dhaka Medical College Hospital, Dhaka from January 2019 to June 2020. Patients were selected by purposive sampling. Thorough examination of Ear, Nose and Throat was done. Preoperative hearing impairment was assessed by pure tone audiometry. All patients were undergone myringoplasty by underlay technique with temporalis fascia graft. Multiple follow up were ensured for 3 months of surgery and all graft failure cases were excluded from this study. Finally consecutive 100 successful myringoplasty cases were selected from 122 patients who underwent myringoplasty and completed follow up schedule. Postoperative hearing status was also evaluated by pure tone audiometry. Postoperative hearing gain was assessed by improvement of air bone gap on the basis of pure tone audiometry. Statistical analyses of the results were be obtained by using window-based Microsoft Excel and Statistical Packages for Social Sciences (SPSS-24).*
Results *Improvement of air bone gap (hearing gain) was 8.17±2.66 dB, 12.24±2.53 dB, 14.58±2.55 dB for small, medium and large size perforation respectively following successful myringoplasty and it was statistically significant (P< 0.001). Post-operative improvement of mean air-bone gap was 8.27±3.92 dB, 11.30±2.51 dB, 11.23±3.29, 14.77±2.78 dB for anterior, posterior, inferior and subtotal perforations respectively.*
Conclusion: *Gain of hearing was more in larger size perforation of tympanic membrane than smaller one following successful myringoplasty.*
Keywords: *Myringoplasty, Size of the tympanic membrane perforation, Hearing gain*

I. INTRODUCTION

Chronic otitis media (COM) is an inflammation of the mucoperiosteal lining of the middle ear and mastoid cavity. It is a common otological disease in Bangladesh. The prevalence of the disease is high in Bangladesh because of low socio-economic condition, overcrowding, poor nutrition and lack of health education. The prevalence of the disease is 6.02% in rural and 2.07% in urban population, 10.8% in tribal and 7.2% in non-tribal population. [1] Chronic otitis media is classified as healed, active or inactive mucosal, active or inactive squamous. [2] Healed and inactive mucosal COM are more common. [3] Inactive mucosal chronic otitis media is characterized by central perforation without middle ear inflammation, with or without hearing loss. Perforation of pars tensa of the tympanic membrane is called central perforation. [2] Hearing disability in adults is a burden to the individual, family and entire society. There is a significant correlation between the size and site of perforation with hearing loss. The size of the central perforation is graded as small, medium and large. [4] Treatment of

inactive mucosal variety of COM is mainly surgical repair of the tympanic membrane perforation which is called myringoplasty.

Myringoplasty was introduced by Berthold in 1878. Wullstein and Zoellner developed some fundamental principles in modern practice in 1956. [5, 6] Austin first described the underlay technique and Haugh modified this technique. [7] Myringoplasty is a surgical technique used to restore the integrity of the tympanic membrane and to improve hearing level. [8] Outcome of myringoplasty is determined by graft take rate and hearing improvement. Some factors like- age of the patients, size and site of perforation, surgical approach, nature of grafting materials, condition of the diseased ear, Eustachian tube function, status of contralateral ear influence the outcome of myringoplasty. [9] Short term success rate is favorable almost without exception, varying from 81-96% whereas long-term results vary from 78% to 92%. [10] One of the outcomes of successful myringoplasty is hearing gain. But this is a debatable issue whether significant amount of hearing gain occur after successful myringoplasty. Another issue is that the size of the TM perforation influences the postoperative hearing gain. In one study, average preoperative air-bone gap (ABG) was reduced from 23.7 dB to 13.9 dB and postoperative ABG was less than 20 dB in 77.9% of the patient. [11] The results obtained from the study conducted by Lee, showed that closure of large perforation resulted in greater hearing gain than small perforation (small perforation +7.2 dB, large perforation +10.2 dB). [12] Sarker, showed that hearing gain of 10.45 dB, 19.24 dB, 18.67 dB for small, medium and large size tympanic membrane perforation respectively which was conducted in BSMMU, Bangladesh from 2007 to 2009. [13] Another study showed that there is no correlation between the size of the perforation and postoperative hearing gain. [14] This present study is an attempt to assess the hearing gain following successful myringoplasty in relation to the size of the tympanic membrane perforation.

II. METHODOLOGY

This Prospective observational study was carried out in the Department of Otolaryngology and Head - Neck Surgery at Dhaka Medical College and Hospital, during January 2019 to June 2020. A total of 100 patients were participated in the study. All the patients with inactive mucosal variety of chronic otitis media admitted for myringoplasty in the inpatient department of Otolaryngology and Head -Neck Surgery, Dhaka Medical College & Hospital, fulfilling the inclusion and exclusion criteria during study period. Consecutive 100 successful myringoplasty cases were selected by purposive sampling from 122 patients who had fulfilled the inclusion and exclusion criteria and completed postoperative follow up schedule. Due to graft failure, 22 cases were excluded from the study. Patients of inactive mucosal variety of COM were evaluated properly by detailed history taking, clinical examination and investigations. Size of the perforation was measured by visual inspection with otoscope and microscope. Size of the tympanic membrane perforation was categorized as: small- less than 50%, medium-50 to 75%, large- more than 75% perforation of pars tensa of the tympanic membrane. [15] Site of the perforation classified as anterior, posterior, Inferior and subtotal. [15, 16] Perforation defined as anterior when whole or maximum portion of the perforation rest anterior to the handle of the malleus, posterior when the perforation rest posterior to the handle of the malleus, Inferior when the perforation rest inferior to the handle of the malleus and subtotal when perforation involve all the three quadrants of the tympanic membrane. [15] Myringoplasty was done under local anaesthesia by various skilled surgeons. Incision was given in the post auricular region. Graft was harvested from temporalis fascia. After preparing the tympanic membrane, temporalis fascia graft was placed by underlay technique. Patients were followed up at 1st, 7th and 14th postoperative day. Another two follow up were given and noted at the end of 1st month and 3rd months. During follow-up condition of the wound, condition of the external auditory canal, condition of the tympanic membrane, hearing status were noted. Patients with complete failure of the graft or residual perforation or re-perforation of neo-tympanum (within the follow up period) were excluded from the study. Pure tone audiometry was done after 3 months of myringoplasty. Hearing outcome was assessed by comparing pre-operative and post-operative air-bone gap (ABG) averages at 0.5 KHz, 1 KHz, 2 KHz frequencies. Hearing gain after successful myringoplasty was measured by reduction of air bone gap on the basis of pure tone audiometry. After taking consent and matching eligibility criteria, data were collected from patients on variables of interest using the predesigned structured questionnaire by interview, observation. Statistical analyses of the results were be obtained by using window-based Microsoft Excel and Statistical Packages for Social Sciences (SPSS-24).

III. RESULTS

Table I: Distribution of the patients according to baseline characteristic (N=100)

	n=100	%
Age group (years)		
≤ 20	26	26.0
21 – 30	37	37.0

31 – 40	22	22.0
41 – 50	9	9.0
> 50	6	6.0
Total	100	100
Age range	15-55 years	
Gender Distribution		
Male	39	39.0
Female	61	61.0
Residence Distribution		
Urban	43	43.0
Rural	57	57.0
Occupational Distribution		
Farmer	4	4.0
Student	33	33.0
Service	17	17.0
Business	8	8.0
Housewife	28	28.0
Other	10	10.0
Education Distribution		
Illiterate	7	7.0
Primary	19	19.0
Secondary	40	40.0
Higher secondary	29	29.0
Graduation & above	5	5.0

Age range of the patients was 15 to 55 years. Maximum patients (37%) were in the age group 21 -30 years. Out of 100 patients 39 patients were male and 61 patients were female. Male and female ratio was 0.64: 1. The patients (57%) came from rural area. The most of the patients (33%) were students. The most of the patients (40%) had completed secondary school level.

Table II: Distribution of the patients on the basis of involvement of the ear (N=100)

Involved ear		n=100	%
Bilateral		16	16.0
Unilateral	Right	38	38.0
	Left	46	46.0

Table II showed that most of the patients had unilateral ear (84%) involvement and it was mostly on left side (46%).

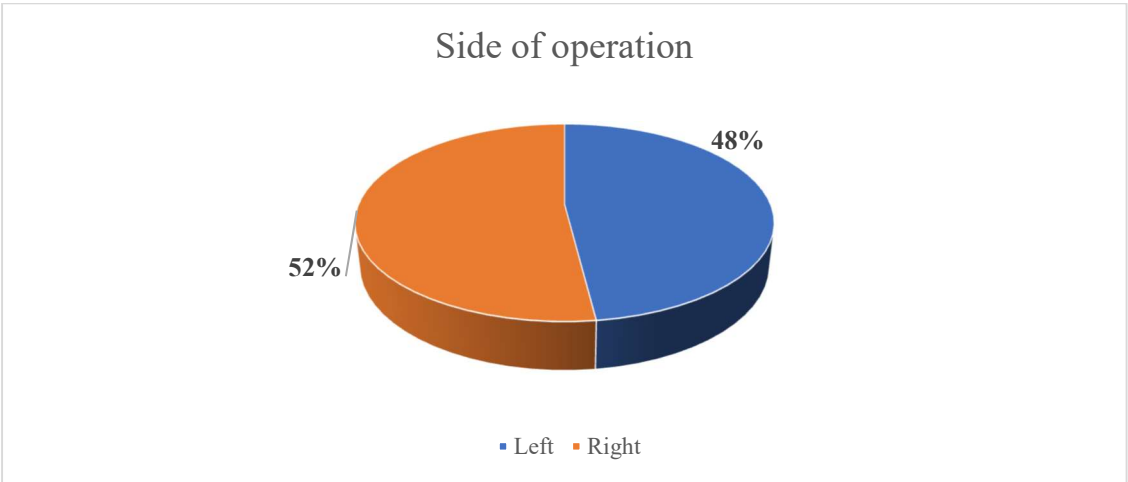

Figure I: Pie chart showing distribution of the patients according to the side of operation (N=100)

Figure I showed that most of the patients (52%) had right side operation.

Table III: Distribution of the patients according to duration of dryness of ear (N=100)

Duration of dryness of ear (Months)	n=100	%
<1 m	24	24.0
1-6 m	47	47.0
>6 m	29	29.0

Table III showed that most of the patient (47%) had dry ear for 1 -6 months before surgery

Table IV: Distribution of the patients according to size of the perforation of tympanic membrane (N=100)

Size of the tympanic membrane perforation	n=100	%
Small	34	34.0
Medium	48	48.0
Large	18	18.0

Table IV showed that most of the patients (48%) had medium size TM perforations.

Table V: Distribution of the patients according to site of the perforation of tympanic membrane (N=100)

Site of perforation of tympanic membrane	n=100	%
Anterior	16	16.0
Posterior	38	38.0
Inferior	32	32.0
Subtotal	14	14.0

Table V showed that most of the patients (38%) had posterior perforations.

Table VI: Distribution of Pre-operative, Postoperative and Improvement of hearing thresholds according to the size of the tympanic membrane perforation (N=100)

	Size	Air conduction threshold (Mean ± SD) (dB)	Bone conduction threshold (Mean ± SD) (dB)	Air- bone gap (Mean ± SD) (dB)
Pre-operative hearing Status	Small (n=34)	24.72 ± 4.66	5.55 ± 1.28	19.17 ± 3.85
	Medium (n=48)	39.03 ± 5.35	10.22 ± 2.75	28.80 ± 3.01
	Large (n=18)	47.74 ± 4.46	13.58 ± 3.33	34.15 ± 3.12
	p-value	<0.001	<0.001	<0.001
Postoperative hearing status	Small (n=34)	15.06 ± 2.93	4.06 ± 1.19	11.00 ± 2.03
	Medium (n=48)	23.02 ± 5.51	6.46 ± 1.83	16.56 ± 4.55
	Large (n=18)	29.08 ± 5.07	9.51 ± 3.63	19.57 ± 4.33
	p-value	<0.001	<0.001	<0.001
Improvement of hearing thresholds	Small (n=34)	9.66 ± 2.45	1.49 ± 0.91	8.17 ± 2.66
	Medium (n=48)	16.00 ± 3.29	3.76 ± 1.97	12.24 ± 2.53
	Large (n=18)	18.65 ± 2.99	4.07 ± 1.61	14.58 ± 2.55
	p-value	<0.001	<0.001	<0.001

One-way ANOVA test was performed among groups

Table VI showed that pre-operative (mean) air-bone gap was 19.17 dB, 28.80 dB, 34.15 dB for small, medium and large size perforations respectively. These data were statistically significant for small, medium and large size perforation ($p< 0.001$), The post-operative (mean) air-bone gap was 11 dB, 16.56 dB, 19.57 dB for small, medium and large size perforations respectively. These data were statistically significant for small, medium and large size perforation ($p < 0.001$). The post-operative improvement of air-bone gap (Gain) was 8.17 dB, 12.24 dB, 14.58 dB for small, medium, large size perforations respectively. Gain was more in larger perforation than smaller one. These data were statistically significant for small, medium and large size perforation ($p< 0.001$)

Table VII: Distribution of preoperative, postoperative and improvement hearing thresholds according to the site of perforation of tympanic membrane (N=100)

Site		**Air conduction threshold** (Mean ± SD) (dB)	Bone conduction threshold (Mean ± SD) (dB)	Air bone gap (Mean ± SD) (dB)
Pre-operative, hearing status	Anterior	27.77 ± 11.04	7.08 ± 3.33	20.69 ± 7.98
	Posterior	35.07 ± 7.47	8.96 ± 3.37	26.11 ± 4.46
	Inferior	35.39 ± 9.07	8.80 ± 3.58	26.59 ± 5.90
	Subtotal	47.38 ± 4.45	13.46 ± 3.17	33.91 ± 3.18
	p-value	<0.001	<0.001	<0.001
Postoperative hearing status	Anterior	16.91 ± 6.66	4.48 ± 2.03	12.42 ± 4.96
	Posterior	20.82 ± 5.44	6.01 ± 2.18	14.81 ± 3.88
	Inferior	21.19 ± 6.89	5.82 ± 2.28	15.36 ± 5.38
	Subtotal	28.63 ± 5.55	9.48 ± 3.76	19.14 ± 4.69
	p-value	<0.001	<0.001	0.005
Improvement of hearing thresholds	Anterior	10.86 ± 4.84	2.59 ± 1.80	8.27 ± 3.92
	Posterior	14.25 ± 3.87	2.95 ± 2.16	11.30 ± 2.51
	Inferior	14.21 ± 4.29	2.98 ± 1.82	11.23 ± 3.29
	Subtotal	18.75 ± 3.15	3.98 ± 1.74	14.77 ± 2.78
	p-value	<0.001	0.379	<0.001

One-way ANOVA test was performed among groups

Pre-operative (mean) air-bone gap was 20.69 dB, 26.11 dB, 26.59 dB, 33.91 dB for anterior, posterior, inferior and subtotal perforations respectively. These data were statistically significant for anterior, posterior, inferior and subtotal perforations (P= <0.001). The post-operative mean air-bone gap was 12.42 dB, 14.81 dB, 15.36 dB, 19.14 dB for anterior, posterior, inferior and subtotal perforations respectively. These data were statistically significant for anterior, posterior, inferior and subtotal perforations (P = 0.005). The post-operative improvement of mean air-bone gap was 8.27 dB, 11.30 dB, 11.23, 14.77 dB for anterior, posterior, inferior and subtotal perforations respectively. Gain was more in posterior perforation than anterior perforation. These data were statistically significant for anterior, posterior, inferior and subtotal perforations except for improvement of bone conduction threshold (P=0.379).

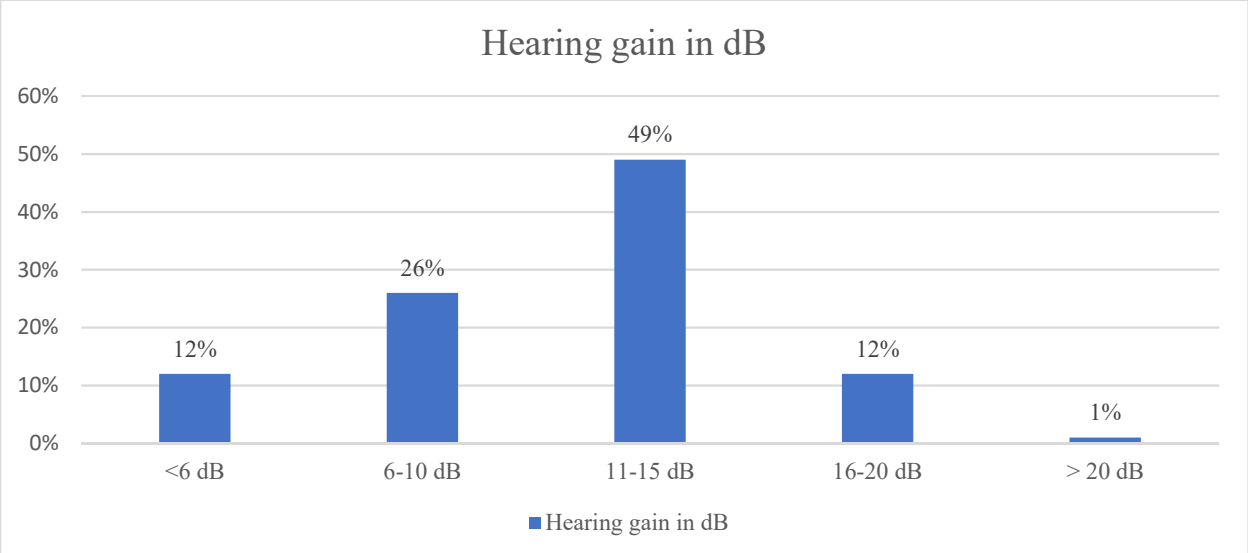

Figure II: Bar diagram showing distribution of patients according to the level of hearing gain.

Diagram VI showed that most of the patients (49%) achieved hearing gain within the range of 11 – 15 dB.

IV. DISCUSSION

Total 100 cases were selected for this study on the basis of inclusion and exclusion criteria. Failed myringoplasties were excluded from this study. Hearing gain was assessed by postoperative improvement or closure of air bone gap on pure tone audiometry.

Out of 100 patients, male was 39% and female was 61%. The most of patients who underwent myringoplasty were in the age range was 21years to 30 years. 57% patients came from rural area and 43% came from urban area. This may be due to high prevalence of COM in rural area. The prevalence of COM was 6.02% in rural and 2.07% in urban population. [1]

In this study, most of the patients (47%) had dry ear for 1 -6 months before surgery followed by 29% had dry ear for more than 6 months and 24% had dry ear for less than 1 month. In one study, Zaman and Omar showed that most of the patients (73.6%) had dry ear for 1 to 6 months and graft take up rate was directly related to the period of dry ear before surgery. [17]

On the basis of involvement of the ear, unilateral involvement was more (84%), of which left ear (46%) was more than right ear (38%). Bilateral involvement was only 16%. Surgery was done in single ear at a time. In this study, most of the perforations (48%) were medium in size followed by 34% were small in size and 18% were large in size.

Gap between the air conduction and bone conduction thresholds is the measure of conductive hearing loss. According to the size of the perforation, pre-operative mean air-bone gap was 19.17±3.85 dB, 28.80±3.01 dB, 34.15±3.12 dB for small, medium and large size tympanic membrane perforation respectively. In this study, hearing loss was more in larger perforation. Mondal et al. (2019) showed that preoperative air bone gap for small, medium, large perforation was 26.48 dB, 34.87 dB, 45.88 dB respectively. [18] He observed that preoperative hearing loss was more in large perforation. Maharjan stated that the larger the perforation, greater the decibel loss in sound perception. [19] Post-operative mean air-bone gap was 11±2.03 dB, 16.56±4.55 dB, 19.57±4.33 dB for small, medium and large size perforations respectively. Here postoperative air bone gap was more in larger perforations. Mondal showed that the postoperative air bone gap was 21.24 dB, 21.74 dB, 24.00 dB for small, medium, large size perforations respectively. [18] These data might be different from our study, possibly due to difference in other parameter like sample size, preoperative hearing loss, variation in size calculation. But one observation was similar in both studies that despite the reduction of postoperative ABG, larger perforation had greater ABG than smaller one.

Post-operative improvement of air-bone gap (Gain) was 8.17±2.66 dB, 12.24±2.53 dB, 14.58±2.55 dB for small, medium and large size perforations respectively. These data were statistically significant ($p< 0.001$) which was done by one way ANOVA test among the groups. In this study, postoperative improvement of ABG (Gain) showed a linear relation with the size of the perforation. Gain of hearing was more in larger size perforation. This observation was consistent with other studies. Wasson concluded that audiometric gain was directly related with preoperative perforation size. [20] In other studies, hearing gain was more in larger size tympanic membrane perforation than smaller one following successful myringoplasty. [18] Lee found hearing gain 7.2 dB and 10.2 dB in small and large size perforation respectively. [12] Sarker showed that the hearing gain was 10.45 dB, 19.24 dB, 18.67 dB in small, medium and large respectively. [13] Hearing gain was greater after closure of large perforation than smaller one. Another study revealed that hearing improvement occurred 6.33 dB, 9.56 dB, 13.14 dB in small medium and large perforations respectively. [21]

The current study also showed that postoperative hearing gain varies with the site of the perforation. Post-operative improvement of mean air-bone gap was 8.27±3.92 dB, 11.30±2.51 dB, 11.23±3.29 dB, 14.77±2.78 dB for anterior, posterior, inferior and subtotal perforations respectively. Gain of hearing was more in posterior perforation than anterior perforation. Some studies demonstrated that posterior perforation showed the greatest preoperative hearing loss and postoperative hearing gain. [22] But according to Karela hearing gain was not dependent upon the site of the tympanic membrane perforation. Average hearing gain was 11.28 dB which was statistically significant. [14] This data was consistent with other studies conducted by Aslam and Aslam. [8] Most of the patients (49%) achieved 11- 15 dB hearing gain (improvement of ABG). In one study, revealed that maximum patients (50%) had hearing improvement at 10 – 20 dB. [17]

Limitations of the study

Size of the perforation was determined by visual inspection through otoscopy and microscopy not any objective method. Short follow up period as re perforation of the tympanic membrane may occur up to two years of successful myringoplasty.

V. CONCLUSION

Gain of hearing was more in larger size tympanic membrane perforation than smaller one after successful myringoplasty.

VI. RECOMMENDATION

Further study on a large number of patients over a long period of times should be carried out in our country. Size of the tympanic membrane should be measured by objective method.

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