

Effect of ear surgery on bone conduction thresholds of patients with chronic middle ear disease

Muhammad Azeem Aslam

ABSTRACT

Objective: To determine the effects of surgical treatment on bone conduction thresholds in patients with chronic middle ear disease.

Methodology: This prospective quasi experimental study included 83 patients of chronic middle ear disease, which were surgically treated at the department of otolaryngology of a tertiary care teaching hospital in Rawalpindi, between May 2007 to May 2010. The preoperative and postoperative bone conduction thresholds were obtained one day before and six months after the surgical procedure and the data was analyzed in various ways to determine any statistical difference by applying paired *t* test. Statistical significance was accepted if *p* value is <0.05.

Results: Statistically significant deterioration in mean bone conduction thresholds was found only with radical mastoidectomy at 4000 Hz. There was no change in mean bone conduction thresholds in 68 (82%) of patients. A total of 7 (8.4%) patients showed improvement whereas 8 (9.6%) patients showed worsening of postoperative bone conduction thresholds. Mean improvement in bone conduction thresholds was 16.25 db (range 10 to 22.5 dB) whereas mean deterioration of 14.68 dB (range 10 to 30 dB) were noted.

Conclusion: The surgical treatment of chronic middle ear disease does not affect bone conduction thresholds in majority of the patients.

KEY WORDS: Sensorineural hearing loss, Chronic otitis media, Middle ear surgery.

Pak J Med Sci October - December 2010 Vol. 26 No. 4 764-768

How to cite this article:

Aslam MA. Effect of ear surgery on bone conduction thresholds of patients with chronic middle ear disease. Pak J Med Sci 2010;26(4):764-768

INTRODUCTION

The surgical treatment of chronic middle ear disease is associated with a risk of damage to the inner ear resulting in temporary or permanent sensorineural hearing loss. Various factors might be responsible for this untoward outcome. These include damage to oval or round windows during removal of cholesteatoma or granulations from these

areas, excessive manipulation of ossicles resulting in their dislocation or fracture, acoustic trauma from drill generated noise or from suction, inadvertent opening of lateral semicircular canal while removing cholesteatoma matrix resulting in labyrinthine fistula.¹ The damage to hearing during surgery has disastrous consequences for both the patient and the surgeon. That is why this is the most frequently discussed issue while obtaining consent for ear surgery.

Another aspect of surgical treatment for chronic ear disease is that it can result in improvement in bone conduction thresholds. This improvement may be due to the fact that surgical treatment involves removal of cholesteatoma, granulations, adhesions and purulent secretions which are mechanically obstructing the oval and round windows. The ossicular bridge may be stiffened or broken by the chronic ear disease which is also repaired during surgery. An improvement in bone conduction thresholds with

1. Dr. Muhammad Azeem Aslam, F.C.P.S.
Associate Professor of ENT
Islamic International Medical College,
Rawalpindi - Pakistan.

Correspondence:

Dr. Muhammad Azeem Aslam
House No. 57, Main Double Road,
Sector G-8/2,
Islamabad - Pakistan.
Email: drazeemaslam@gmail.com

* Received for Publication: May 18, 2010

* Accepted for Publication: June 28, 2010

surgery has important implications. The surgical treatment for chronic ear disease can be considered in patients with poor cochlear reserve especially in those in which tympanoplasty is being planned.

The issue of deterioration in bone conduction thresholds associated with the surgical treatment of chronic middle ear disease has received much more attention in otology literature as compared to the improvement in postoperative bone conduction thresholds. Various studies have confirmed the association between surgery for the chronic ear disease and postoperative sensorineural hearing loss whereas others have shown that if proper precautions are taken, surgery do not significantly affect bone conduction thresholds.²⁻⁴

The purpose of present study was to clarify this issue by evaluating the effects of various surgical techniques on bone conduction thresholds in patients with chronic middle ear disease.

METHODOLOGY

This study was conducted at the department of Otolaryngology and Head & Neck Surgery of a tertiary care teaching hospital at Rawalpindi over a period of three years i.e. from May 2007 to May 2010. All those cases of chronic suppurative otitis media who presented to outpatient clinic of our department were included in the study irrespective of age and

sex. These patients were evaluated by taking detailed history and clinical examination including examination under otomicroscope. Pure tone audiometry was carried out with Audiometer MA53 (MAICO Germany) in a sound treated chamber one day before surgery. Both air conduction and bone conduction thresholds of normal and diseased ear were recorded. Bone conduction thresholds were recorded at frequencies of 500, 1000, 2000 and 4000 Htz by doing masking of the contralateral ear. Those patients who had profound hearing loss (>90dB) or had previous ear surgery were excluded from the study.

In all patients, ear surgery was done under general anesthesia by employing various surgical techniques depending upon the ear pathology. The patients were followed for a minimum of six months after which pure tone audiometry were again repeated. The results of both pre and postoperative audiometries were evaluated to find out the change in bone conduction thresholds at 500, 1000, 2000 and 4000 Htz. A change of more than 10 dB between the mean preoperative and postoperative bone conduction thresholds at the above mentioned frequencies was considered significant. The results of change of bone conduction thresholds at individual frequencies as well as mean preoperative and postoperative difference of the four above mentioned frequencies were evaluated in relation to the surgical

Table-I: Difference of mean pre-operative and post-operative bone conduction thresholds at 500, 1000, 2000 and 4000 Htz and their statistical significance correlated with the surgical techniques employed.

Surgical Technique	Pre-operative Bone Conduction Thresholds				Post-operative Bone Conduction Thresholds				
	Frequency Htz	Mean	Range	SD	Mean	Range	SD	Diff. of Mean preop. & postop. BC threshold	p value
Myringoplasty	500	19.33	0 to 45	16.24	16.33	0 to 35	12.31	3.00	>0.05
	1000	19.33	0 to 50	13.07	14.0	-5 to 35	11.98	5.33	<0.05
	2000	21.66	0 to 50	13.97	19.33	-5 to 45	13.74	2.33	<0.05
	4000	16.66	-5 to 50	13.84	16.66	-10 to 45	14.35	0.00	>0.05
Tympanoplasty (without ossiculoplasty)	500	11.43	-5 to 35	10.88	12.43	-10 to 40	13.79	-1.00	>0.05
	1000	13.43	-10 to 50	12.53	13.28	-10 to 50	13.82	0.15	>0.05
	2000	18.00	0 to 55	11.58	16.85	-10 to 55	12.89	1.15	>0.05
	4000	14.28	0 to 45	11.89	13.43	-10 to 40	11.55	0.85	>0.05
Ossiculoplasty with Incus autograft	500	15.83	0 to 30	12.00	12.50	-5 to 30	13.69	3.33	>0.05
	1000	28.33	5 to 60	23.16	19.16	-5 to 60	24.98	9.17	<0.05
	2000	36.66	10 to 65	22.94	23.33	-5 to 65	26.20	13.33	<0.05
	4000	24.16	5 to 50	20.59	17.50	-5 to 50	20.18	6.66	>0.05
Modified Radical Mastoidectomy	500	10.93	-10 to 35	15.07	14.38	0 to 60	18.24	-3.45	>0.05
	1000	17.19	-5 to 65	20.97	15.62	-5 to 65	19.13	1.57	>0.05
	2000	26.25	-5 to 80	26.36	28.75	-5 to 75	23.13	-2.50	>0.05
	4000	23.44	0 to 80	25.34	26.56	-5 to 80	26.50	-3.12	>0.05
Radical Mastoidectomy	500	8.63	-5 to 25	11.20	11.36	-5 to 40	12.86	-2.73	>0.05
	1000	9.54	-10 to 25	11.50	11.36	-5 to 35	10.51	-1.82	>0.05
	2000	15.00	0 to 30	8.36	20.00	-5 to 40	12.04	-5.00	>0.05
	4000	9.54	0 to 25	9.07	17.72	5 to 50	12.72	-8.18	<0.05

Table-II: Overall status of change in mean pre-operative and post-operative bone conduction thresholds correlated with the surgical technique.

<i>Surgical Technique</i>	<i>Total No. of cases</i>	<i>Mean Pre-operative BC thresholds</i>	<i>Mean Post-operative BC thresholds</i>	<i>Difference of Means</i>	<i>p value</i>
Myringoplasty	15	19.25	16.58	2.67	<0.05
Tympanoplasty	35	14.28	13.99	0.29	>0.05
Ossiculoplasty with Incus autograft	6	26.24	18.12	8.12	>0.05
Modified Radical Mastoidectomy	16	19.45	21.32	-1.87	>0.05
Radical Mastoidectomy	15	10.67	15.11	-4.44	>0.05

techniques employed. The results were analyzed with statistical software SPSS 10.0 by applying paired t-Test. Statistical significance was accepted if *p* value is < 0.05.

RESULTS

A total of 83 patients were included in this study. Among them 25 (30.12%) were male and 58 (69.87%) of them were female. The male to female ratio was 1:2.3. The patients ranged in age from 10 to 57 years with a mean of 22.16 years (+10.2).

Various surgical techniques employed are shown in Figure-1. The mean preoperative bone conduction thresholds at frequencies of 500, 1000, 2000 and 4000 Htz were compared with respective mean postoperative values obtained with different surgical techniques. The results are shown in Table-I. Statistically significant deterioration in mean bone conduction thresholds were found only with radical mastoidectomy at the frequency of 4000 Htz. Overall status of change in mean preoperative and postoperative bone conduction thresholds were correlated with the surgical technique and results are shown in Table-II.

The difference of mean preoperative and postoperative bone conduction thresholds showed deterioration in modified radical and radical mastoidectomy but the results were not statistically significant. Change in overall hearing status achieved with different surgical techniques was also evaluated by measuring change in mean preoperative and postoperative bone conduction thresholds. A change of > 10 dB in bone conduction thresholds were considered significant. The results are shown in Table-III.

There was no change in mean bone conduction thresholds in 68 (82%) of patients. A total of 7 (8.4%) patients showed improvement whereas 8 (9.6%) patients showed worsening of postoperative bone conduction thresholds. Those patients who showed either improvement or worsening of bone conduction thresholds were further analyzed and results are shown in Table-IV and V. Mean improvement in bone conduction thresholds was 16.25 db (range 10 to 22.5 dB) whereas mean deterioration of 14.68 dB (range 10 to 30 dB) were noted.

DISCUSSION

The surgical treatment of chronic middle ear disease can affect bone conduction thresholds in variety of ways. Some of the factors results in deterioration of bone conduction thresholds by damaging the cochlea. Among them important ones are acoustic trauma by drill generated noise or

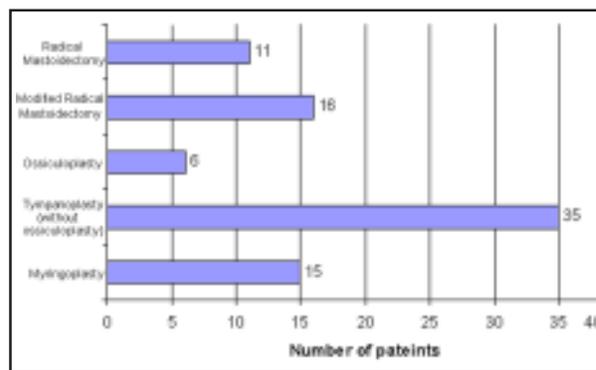


Fig-1: Distribution of patients according to the surgical technique employed.

Table-III: Change in overall hearing status achieved with different surgical techniques.

<i>Surgical Technique</i>	<i>Total No. of cases n (%)</i>	<i>Improved (> 10 dB) n (%)</i>	<i>Unchanged n (%)</i>	<i>Worsened (> 10 dB) n (%)</i>
Myringoplasty	15 (18%)	1 (6.6%)	14 (93.3%)	0
Tympanoplasty	35 (42%)	2 (5.7%)	30 (85.7%)	3 (8.6%)
Ossiculoplasty with Incus autograft	6 (7.2%)	3 (50%)	3 (50%)	0
Modified Radical Mastoidectomy	16 (19.3%)	1 (6.3%)	11 (68.7%)	4 (25%)
Radical Mastoidectomy	11 (13.2%)	0	10 (91%)	1 (9%)
<i>Total</i>	83	7 (8.4%)	68 (82%)	8 (9.6%)

Table-IV: Analysis of patients in which BC thresholds were improved.

<i>Surgical Technique</i>	<i>Total No. of patients operated</i>	<i>No. of patient with deterioration in BC thresholds n (%)</i>	<i>Deterioration in BC thresholds (dB) in each case</i>	<i>Mean deterioration in BC thresholds (dB) with range</i>
Myringoplasty	15	1 (6.66%)	15.0	16.25(10 to 22.5 dB)
Tympanoplasty	35	2 (5.71%)	15.0	
Ossiculoplasty	6	3 (50%)	17.5	
			22.5	
			18.75	
			10	
Modified Radical Mastoidectomy	16	1 (6.25%)	15.0	

suction, excessive movements of ossicles, damage to oval window or lateral semicircular canal during removal of cholesteatoma or granulations from these sensitive areas. On the other hand, the clearance of cholesteatoma, granulations, adhesions or pus results in removal of mechanical obstructions from oval and round window and can result in improvement of bone conduction thresholds in a number of cases.^{1,3}

The results of our study showed that when mean preoperative bone conduction thresholds values were compared with the corresponding post operative ones for individual frequencies of 500, 1000, 2000 and 4000 Htz, statistical significant deterioration in bone conduction thresholds were observed only with radical mastoidectomy. The most affected frequency was found to be 4000 Htz. These results are supported by various other studies which showed that high tone hearing loss involving frequencies above 2000 Htz are the most common type of sensorineural hearing loss following surgery for chronic ear disease.^{1,5} Some other studies also identified 4000 Htz as the most commonly affected frequency.^{1,6-7} When change in mean bone conduction thresholds of all the four frequencies (i.e. 500, 1000, 2000 & 4000 Htz) were studied together and correlated with different surgical techniques employed, it was again evident that among all the surgical procedures considered in our study, only the open techniques like modified radical and radical mastoidectomies were associated with

deterioration of bone conduction thresholds but this difference was not statistically significant. This view is shared by many other studies.^{2,6-7} Radical and modified radical mastoidectomies are usually required in the treatment of extensive cholesteatoma or granulations and also required considerably more bone work utilizing mastoid drill. These factors might be responsible for deterioration of postoperative bone conduction thresholds. Although some other authors do not support this view and observed that mastoid surgery has no effect on bone conduction thresholds.⁴

In the present study, a statistical significant improvement in bone conduction thresholds was observed with myringoplasty at frequencies of 1000 and 2000 Htz. The factors responsible for improvement in bone conduction thresholds in simple myringoplasty are difficult to explain. This observation was also noticed in another study.¹ Lee Hs and Hong SU in a recent study⁸ observed improvement in bone conduction thresholds at 2000 Htz with ossiculoplasty. This finding was also observed in the present study where mean improvement of 13.33 dB was noticed at 2000 Htz in patients treated with ossiculoplasty. Different studies^{1,9} have shown that tympanoplasty procedure is also associated with improvement in bone conduction thresholds but the results of present study do not support this opinion.

In the present study, the change in overall hearing status achieved with different surgical techniques

Table-V: Analysis of patients in which BC thresholds were worsened.

<i>Surgical Technique</i>	<i>Total No. of patients operated</i>	<i>No. of patient with deterioration in BC thresholds n (%)</i>	<i>Deterioration in BC thresholds (dB) in each case</i>	<i>Mean deterioration in BC thresholds (dB) with range</i>
Tympanoplasty	35	3 (8.57%)	-10	14.68(-10 to -30 dB)
			-11.25	
			-11.25	
Modified Radical Mastoidectomy	16	4 (25%)	-12.5	
			-18.75	
			-10	
			-13.75	
Radical Mastoidectomy	11	1 (9.09%)	-30	

was also analyzed. Several studies⁵ have considered a change of 5 dB in pre and postoperative bone conduction thresholds as significant but the change of +5 dB can occur incidentally as test re-test error. Considering this fact, a change of +10 dB is accepted as significant in the present study. The results of the present study showed that majority of the patient (82%) do not have any change in pre and postoperative bone conduction thresholds. This observation is supported by many other studies which showed that in 92 to 100% of patients, surgery for chronic ear disease do not affect bone conduction thresholds.¹⁻⁴ The overall hearing status improved in 8.6% of patients in the present study whereas it deteriorated in 9.6%. Both the improvement and deterioration in bone conduction thresholds in the present study was mild (mean improvement=15 dB, mean deterioration= 16 dB). None of our patient had profound sensorineural hearing loss. Deterioration in bone conduction thresholds observed in other studies ranged between 3% to 55%.^{1,5-6} Majority of the patients who suffered from deterioration in bone conduction thresholds were those in which canal wall down mastoidectomies was performed. This is observed not only in the present study but also in many other studies.^{2,6-7}

CONCLUSION

In majority of the patients, surgical treatment of chronic middle ear disease does not affect bone conduction thresholds.

REFERENCES

1. Vartiainen E, Seppa J. Results of bone conduction following surgery for chronic ear disease. *Eur Arch Otorhinolaryngol* 1997; 254:384-386.
2. Volter C, Baier G, Schon F, Muller J, Helms J. Inner ear depression after middle ear intervention. *Laryngorhinootologie* 2000;79(5):260-5.
3. Iranfar KH, Iranfar SH. Does surgery of chronic otitis media cause sensorineural hearing loss? *Pak J Med Sci* 2009;25(6):972-975.
4. Hornung S, Ostfeld E. Bone conduction evaluation related to mastoid surgery. *Laryngoscope* 1984;94(4):547-9.
5. Rashid D, Arshad M, Asim MU. Hearing results of mastoidectomy. *Pak Armed Forces Med J* 1998;48(1):31-3.
6. Desai AA, Aiyer RG, Pandya VK, Nair U. Post operative sensorineural hearing loss after middle ear surgery. *Indian J. Otolaryngol. Head Neck Surg.* 2004;56(3):240-2.
7. Tos M, Lou T, Plate S. Sensorineural hearing loss following chronic ear surgery. *Ann Otol Rhinol Laryngol* 1984;93:403-9.
8. Lee HS, Hong SU, Hong SH, Cho YS, Chung WH. Ossicular chain reconstruction improves bone conduction threshold in chronic otitis media. *J Laryngol Otol.* 2008;122(4):351-6.
9. Tuz M, Dogru H, Uygurk K, Gedikli O. Improvement in bone conduction threshold after tympanoplasty. *Otolaryngol Head Neck Surg.* 2000;123(6):775-8.