

HEARING OUTCOMES OF STAPEDOTOMY IN PATIENTS WITH OTOSCLEROSIS

HOSSAIN MD¹, AREFIN MK², FERDOUS J³, ALAM I⁴, ASADUZZAMAN AKM⁵, SHARMIN UA⁶, RUMI SNF⁷

Abstract

Objective: This study was focused on the assessment of patient's improvement in hearing, as measured by pure tone audiometry after stapedotomy for primary otosclerosis.

Materials and Methods: This prospective clinical study was performed in a total of 156 patients diagnosed with Primary Otosclerosis, who underwent Stapedotomy at the Department of ENT & Head-Neck Surgery, Combined Military Hospital Dhaka between January 2013 to January 2019. All patients were evaluated as per the candidacy criteria for stapedotomy and selected patients underwent surgery during the study period and were followed up for a period of 12 months in the Otology clinic. Pre and Post-operative audiometric evaluation was done using conventional pure tone audiometry with standard calibrations. Post-operative audiometry was performed at 03 month, 06 months and 12 months. The bone-conduction & air conduction thresholds and the Air-Bone gap (ABG), were documented and analyzed at 0.5 KHz, 1 KHz, 2 KHz and 4 KHz frequencies respectively. The subjective outcomes in hearing were also recorded with a patient satisfaction questionnaire to assess improvement in quality of hearing after stapedotomy.

Results: Overall, the frequency specific pre-operative mean averaged Air Conduction thresholds were 63.3dB at 500Hz, 57.5dB at 1 KHz, 55.1dB at 2 KHz and 45.7dB at 4 KHz. The frequency specific post-operative mean averaged Air conduction thresholds were 34.6 dB at 500Hz, 28.9 dB at 1Kz, 30.5dB at 2Kz and 33.3dB at 4Kz. The frequency specific mean average post operative Air Bone Gap (ABG) closure was achieved by 28.7dB at 500Hz, 27.6 dB at 1KHz, 24.6 dB at 2KHz and 12.4 dB at 4KHz by the time of completion of the study at 01 year. A successful closure of AB gap to less than 10dB was achieved in the speech frequencies of 2 KHz and 4 KHz in 83.97% of cases. Overall, the frequency specific bone-conduction thresholds were unchanged postoperatively in all cases except 03, showing that no significant sensori-neural impairment had occurred due to the stapedotomy procedure. 04 patients developed post-op severe vertigo which was self-limiting after six weeks. 01 patient developed transient facial weakness which was subsided over a time period of 03 months. Patients included in our study had significant subjective audiological improvement and responded satisfactorily to the questionnaire formulated to assess their hearing quality after stapedotomy.

Conclusions: Our case study confirms that stapedotomy is a safe and successful procedure providing long-term hearing improvement in primary otosclerosis. Our study shows that meticulous selection of cases for stapedotomy will result in highly successful audiological outcomes.

Key words: Primary Otosclerosis, Stapedotomy, Teflon piston, Carhart's notch, obliterative otosclerosis, persistent stapedia artery.

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1. Lt Col (Dr.) Mohammad Delwar Hossain, Classified ENT Specialist & head-Neck Surgeon, Department of ENT & Head-Neck Surgery, CMH, Chittagong.
2. Dr. Mostafa Kamal Arefin, Registrar, Dhaka Medical College Hospital, Dhaka
3. Capt. Jannatul Ferdous, BASLP, Audiologist, CMH, Dhaka.
4. Lt Col Iftekharul Alam, Classified ENT Specialist, CMH Dhaka
5. Lt Col AKM Asaduzzaman, Head, Dept. of ENT & HNS, CMH, Dhaka.
6. Dr. Ummey Ayeman Sharmin, ENT Consultant, BIHS General Hospital, Mirpur, Dhaka
7. Prof. SK Nurul Fattah Rumi, Professor, Department of ENT and Head neck surgery, Dhaka Medical College, Dhaka

Correspondence: Lt Col (Dr) Mohammad Delwar Hossain, Classified ENT Specialist & head-Neck Surgeon, Department of ENT & Head-Neck Surgery, CMH, Chittagong.

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Introduction

Stapedotomy surgery is safe and efficacious in the hands of an experienced otologist and audiological outcomes are often adjudged based upon this surgical acumen. Minor issues like post op vertigo and tinnitus needs to be adressed in detail during counselling for stapedotomy in order to provide comprehensive patient awareness in preparation for surgery.

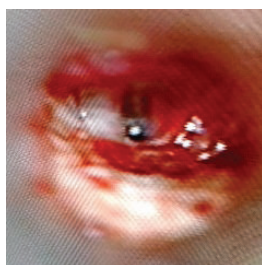
Otosclerosis is a primary disease of the labyrinth bone capsule consisting of one or more localized foci in which bone resorption and deposition take place repeatedly. This focus may gradually invade the annular ligament and the stapes, causing bony ankylosis and deterioration of the air conduction of sound. Treatment of otosclerosis can be medical, surgical or hearing aid support but undoubtedly the surgical treatment of otosclerosis is the most preferred option. Sodium fluoride (NaF) and biphosphonates are the two most commonly used substances for medical treatment of otosclerosis. In practice, an intervention should only be considered in cases with deafness over 30 dB and a Rinne value in this order, although the possibility of recovery by bone conduction (Carhart effect) can and should be taken into account. The short-term results are undoubtedly very good in the recent literature.

Material and method:

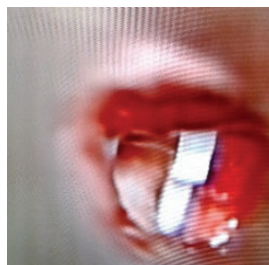
This prospective clinical study was performed in a total of 156 patients diagnosed with Primary Otosclerosis who underwent Stapedotomy at the

Department of ENT & Head-neck Surgery, Combined Military Hospital Dhaka between January 2013 to January 2019. All patients suspected to have Otosclerosis, were evaluated as per the candidacy criteriae for stapedotomy and selected patients underwent surgery during the study period and were followed up for a period of 1 year in the Otology clinic. Pre and Post-operative audiometric evaluation was done using conventional pure tone audiometry. Post-operative audiometry was performed at 3 month, 6 months and 1 year. The bone-conduction and air conduction thresholds and the Air-bone gap (ABG) were assessed at 0.5 KHz, 1 KHz, 2 KHz and 4 KHz frequencies. The subjective outcomes were also recorded with a patient satisfaction questionnaire to assess improvement in quality of life after stapedotomy.

We conducted a prospective clinical study in 156 patients operated on for stapedotomy in the period from January 2013 to January 2019 at our hospital. The surgical technique used in all patients was reverse stapedotomy. The basic technique was performed under local anaesthesia with deep sedation, by common transmeatal approach and fracture of posterior crus of stapes & fenestration of the foot plate with a skeeter drill and incudo-stapedial disarticulation, dissection of the stapes tendon. Prostheses used were 0.6 mm diameter Teflon piston of appropriate length. Fenestrum sealed with ear lobule fat autograft after the placement of the prosthesis.



Fenestration on posterior Middle 3rd of footplate

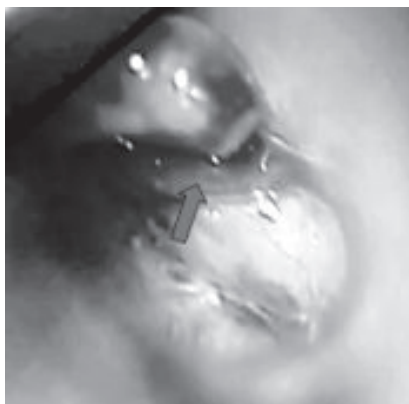


0.6 mm Teflon piston in situ.



Corda tympani nerve is anchored to prevent displacement.

Fig 1: Stapedotomy procedure



Persistent Stapedial Artery

Fig 2: *Intra op special anatomical variations*

Few special anatomical rare scenarios were observed during surgery. 02 Patients had monopodal stapes and 1 had persistent stapedial artery those were encountered very carefully.

Audiometric Assessment included the pre and postoperative air-bone gap (ABG), air-conduction (AC) thresholds and bone-conduction (BC) thresholds were done at 3 months, 6 months and 12 months after surgery. AC and BC results that were obtained pre and post operatively, used for calculation of ABG and pure-tone averages (PTAs). We used a four-frequency PTA for AC and BC thresholds (0.5, 1, 2, and 4 kHz) obtained at the last follow-up visit.

Statistical analysis:

The results were recorded in an Excel spreadsheet which was then processed using the SPSS statistics package for Windows. The descriptive analysis of quantitative variables was performed by determining the mean and

standard deviation for continuous variables and absolute & relative frequencies for categorical variables. The comparative analysis was performed using the nonparametric Friedman test (Friedman analysis of variance by ranks), taking into account the audiometric results in the 3 periods. The accepted level of statistical significance in our work is $P=.05$.

Results:

All 156 operated ears have been included in this study 90 (57.69%) in male and 66 (42.31%) in female. The age range is 20-63 years with a mean of 36 years. 60% of patients were younger than 40, 30% were between 41 and 49, and 10% were over 50 years of age at the time of the intervention. The most common clinical presentation among our patients was hearing loss (80%), followed by a combination of hearing loss and tinnitus (48%). Less commonly, we encountered the combined presentation of hearing loss & giddiness (4%) and the combination of hearing loss, giddiness & tinnitus, which was only observed in 2% of patients.

We noted that there were more operations on the right ear in 97 cases (62.17%) than on the left 59 cases (37.82%).

Post-operative audiometry was conducted in an interval of 3 months, 6 months and 12 months after surgery. Overall, the postoperative ABG closure was closed to 10 dB in 131 (83.97%) cases. The individual frequency specific postoperative ABG closure was 28.7 dB, 27.6 dB, 24.6 dB and 12.4 dB respectively. The frequency specific bone-conduction thresholds were unchanged postoperatively in almost all cases.

Table -I

Mean average Air Conduction Thresholds pre op and post op at 3 month, 6 month and 1 year (N=156)

PTA	Pre op (dBHL)	Post-op (3 month) (dBHL)	Post-op (6 months) (dBHL)	Post-op (1 year) (dBHL)
500Hz	63.3	45.2	38.3	34.6
1KHz	57.5	39.4	31.6	28.9
2KHz	55.1	37.7	32	30.5
4KHz	45.7	34.8	34.2	33.3

Table – II*Mean average Air Bone Conduction Gap Closure Post Stapedotomy in dBHL (N=156)*

Frequency	R.Ramalingam et al ¹²	E A myrvoll et al ⁹	Our study
500Hz	28.4	29.0	28.7
1 KHz	24.6	26.7	27.6
2KHz	18.34	19.0	24.6
4KHz	14.52	12.7	12.4

A significant postoperative sensorineural hearing loss (SNHL) was seen in 3 (1.92%) of cases in this series. 04 patients developed post op persistent vertigo which subsided over time. 01 patient had transient facial weakness which subsided over a period of 03 months.

Discussion:

As for the airborne route, the short-term results are, without question, very good; Birch et al¹ showed in their study a gain of between 25 and 35 dB on average for the air route.

Previous reports of otosclerosis surgery have shown that stapedotomy gives better high-frequency gain and reduces the risk for sensorineural hearing loss (SNHL).^{2, 4}

In a study presented by Spandaw et al³ the DHT descended from 36 dB before surgery to 11 dB 1 year after surgery, only to rise again up to 17 dB 10 years after surgery.

The symptom that most often affects patients with otosclerosis is hypoacusis, although the main reason for consultation is often tinnitus.^{5,6} In a study presented by del Bo et al,⁴ 56% of patients had tinnitus before surgery. In our study, the figures are lower, 46% of our patients subjected to surgery. Vertigo is a common symptom in patients operated on for otosclerosis.^{5,6} In their study, Sedwick et al⁷ found that 23.3% of post-surgical patients presented this symptom after stapedectomy or stapedotomy. Our study found intractable vertigo in 4 (2.56%) of patients. Several studies have commented on the variable of patient age at the time of stapes surgery.^{7, 8} Stapedectomy in seniors is controversial. It is indicated to avoid the use of a hearing aid or to facilitate hearing aid fitting, when the association of otosclerosis and presbycusis makes hearing aid provision unsatisfactory.^{9,10} In a series of 154 cases of

stapedectomy in the elderly, Lippy et al¹¹ stated that the percentage of patients (90.9%) having a successful surgical result (postoperative ABG within 10 dB) was similar to younger patients in the comparison group with a successful surgical result (90%). Our results compare favorably with previous series, and our low rate of complications also confirms that advanced age is not a contraindication to stapedotomy. Moreover, surgery will stop the progression of the disease and allow the patient better use of a hearing aid with a significant improvement in sound discrimination.⁸

In our study of 156 patients mean difference between pre and post op air conduction threshold (dbHL) was 28.7, 27.6, 24.6 and 12.4 at 0.5, 1, 2 and 4 KHz respectively. (Table-2)

In one study by R.Ramalingam¹² et al Mean difference between pre and post op air conduction threshold (dbHL) was 28.4, 24.6, 18.4, and 14.52 at 0.5, 1, 2 and 4 KHz respectively. In another Study done by E A Myrvoll et al⁹ Mean difference between pre and post op air conduction threshold (dbHL) was 29, 26.7, 19, 12.7 at 0.5, 1, 2 and 4 KHz respectively. A significant postoperative sensorineural hearing loss (SNHL>15 dB) was seen in 0.5% of cases in a study by Robert vincent et al.¹⁰ In our study, the postoperative four-frequency ABG was closed to 10 dB in 131 (83.97%) cases compared with 23.58 dB preoperatively. The postoperative four-frequency average AC threshold was 31.82 dB compared with 55.4 dB preoperatively. Postoperatively, the four-frequency average BC threshold was 25.5 dB compared with 25.8 dB preoperatively (remains unchanged), and over closure (post op improvement) occurred in 2(4%) cases.

90.9% tinnitus patients reported improvement and 9.09% noted no change in tinnitus in a study conducted by Carlos A Oliveira⁵ While in our study 86% tinnitus patients reported improvement.

In study by Robert Vincent et al.¹⁰ the overall rate of failures was 6.6%. There were 7.8% cases of severe postoperative SNHL. In our study, post op SNHL rate was in 3 (1.92%) case.

Conclusion:

Stapedotomy surgery is safe and efficacious in the hands of an experienced otologist and audiological outcomes are often adjudged based upon this surgical acumen. Rare scenario like monopodal stapes and persistent stapedial artery may be encountered during stapedotomy needs to address judiciously. Minor issues like post op vertigo and tinnitus needs to be addressed during counselling for stapedotomy in order to provide patients awareness in preparation for surgery.

Declaration

Ethical approval:

Prior to the study ethical approval was acquired from Ethical review committee of Combined Military Hospital (CMH), Dhaka Cantonment.

Informed consent:

All of the patients or their attendants gave written informed consent to participate in the study willingly without any prejudice.

Availability of data and material:

All data and material are available.

Competing interests:

All of the authors declare that they have no competing interest.

Funding:

No funding was received.

Conflict of interest

All of the authors declare that they have no conflict of interest.

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