

Original Article

Comparison of Uncomfortable Loudness Level in Stapedotomy with or without Stapedial Tendon Preservation

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Abstract:

Background: *Otosclerosis is one of the commonest diseases of the ear mostly involves the otic capsule. Most often otosclerotic foci appear in stapes region leading to stapes fixation, predominantly affect the adolescence female. The most common presenting symptom of clinical otosclerosis is conductive deafness. The mainstay of treatment for otosclerosis is surgery. Surgical options include stapedectomy, stapedotomy with or without stapedial tendon preservation. The latter being is the procedure of choice.*

Aim: *The aim of this study is to compare the outcome of uncomfortable loudness level in stapedotomy with or without stapedial tendon preservation.*

Methods: *A prospective observational study was conducted in the Department of Otolaryngology-Head & Neck Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka for 18 months in patients with otosclerosis. Total 30 subjects were selected based on the inclusion and exclusion criteria. All patients were assessed pre-operatively by clinical examination, otoscopy and microscopic examination. Hearing was assessed by pure tone audiometry. Uncomfortable level and stapedial reflex threshold were tested in all cases. The selected cases were placed into two groups. Stapedial tendon resection in Group-I and stapedial tendon preservation in Group-II. Post-operative follow up was done at 3 months and 6 months. Hearing and uncomfortable loudness level were evaluated with PTA during follow up by calculating the average of 500Hz, 1000Hz, 2000Hz and 4000HZ. The data were calculated manually. The statistical significance was set to $P < 0.05$. Results of the study were expressed*

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as mean, standard deviation (\pm SD), frequency and percentages. Means and standard deviations were reported for continuous variables. Frequencies and percentages were reported for categorical variables. Unpaired Student's *t* test was done to compare the continuous variables and Chi Square test was done to compare the categorical variables.

Results: In this study preoperative average ABG for group I and group II were 35 ± 4.57 dB and 34 ± 4.17 dB respectively. In group I, post operative average ABG after 3 months and 6 months were 14 ± 3.7 dB and 13 ± 3.3 dB respectively. Post operative average ABG after 3 months was 13 ± 5.7 dB and was 12 ± 4.4 dB for group II. But the hearing improvement between two groups was not statistically significant. In case of preoperative mean UCL was 95 ± 1.8 dB and 96 ± 2.5 dB for group I and group II respectively. Postoperative mean UCL after 3 months was 96 ± 3.57 dB and after 6 months was 99 ± 6.28 dB in group I. For group II, postoperative mean UCL after 3 months and 6 months was 107 ± 4.2 dB and 113 ± 3.2 dB respectively. Here mean UCL was on average 11 dB higher for group II in 3 months and additional 6 dB improvement noted after 6 months, but show minimal change in group I. This finding was statistically significant. **Conclusion:** Preservation of the stapedial tendon is the choice in the surgical treatment of otosclerosis which helps to improve functional outcomes as well as to provide the more physiologic protection of middle ear. Postoperative discomfort threshold levels were increased in patients who had their stapedial tendon restored.

Key words: Otosclerosis, stapedotomy, Stapedial tendon preservation stapedotomy, Stapedial tendon resection stapedotomy, Loudness discomfort level.

Introduction:

Otosclerosis is a clinico-pathological condition which occurs due to abnormal bone resorption and formation at the oval window, and it causes fixation of stapes footplate¹. It is one of commonest causes of conductive hearing loss in adult population with intact tympanic membrane². It is an autosomal dominant hereditary disease with incomplete penetrance and varied expression. It is an ankylosis of the stapes to the margins of the oval window^{3,4}.

Otosclerosis is more common in Caucasians and Asians than in Africans. Though definite etiology of otosclerosis is still not identified, some factors associated with it such as pregnancy and measles virus, have been reported in various literatures⁵. The period of onset is mainly between 20 to 45 years of age, with a higher prevalence in women than in men. It occurs approximately twice as often in women than men⁶. It usually affects both ears (85% - 90%)^{7,8}.

At the end of 19th century stapedial surgery as stapedectomy was started by Kassel et al. The mobilization of the stapes to treat otosclerosis was firstly advocated by Rosen in 1952. Shea revolutionized the otosclerosis surgery in 1958, initially as stapedectomy then stapedotomy⁹.

Silverstein et al, had conducted the study to see the difference in hearing outcome and uncomfortable loudness level between stapedial tendon preservation and resection stapedotomy. There was a conclusion that the stapedial tendon should be preserved whenever possible during stapes surgery¹⁰.

Among various surgical techniques including stapedectomy or stapedotomy, the surgical choice for otosclerosis is stapedotomy. Stapedotomy is relatively easier, less traumatic, shorter duration surgery, has fewer complications than stapedectomy¹¹. The stapedial tendon preservation stapedotomy may have advantages of cochlear protection

during intense noise. Stapedial reflex produced by the contraction of stapedial muscle, which can produce a low frequency filter function help to protect against acoustic trauma, and serve for a better hearing in noise¹². It may help in preservation of the vascularity that prevents the necrosis of long process of incus by ischemia thereby preventing the prosthesis displacement¹³. Audiometric test showed similar type of hearing outcome whether the tendon is preserved or not¹². In the recent years, stapedial tendon preservation surgery has been advocated by some surgeons in hopes of obtaining better functional outcomes^{11,14}.

Methods:

This is a prospective observational type of study conducted in the Department Otolaryngology – Head & Neck surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka from January 2019 to June 2020. After obtaining clearance and approval from Institutional Review Board, 30 patients (15 in each group) of otosclerosis, fulfilled the inclusion and exclusion criteria, were selected for the study. Inclusion criteria were: a) Diagnosed cases of otosclerosis by clinical examination and audiometric tests, b) Age - 18 to 50 years, c) Characteristic changes in audiogram (air–bone gap at least 20 dB) and exclusion criteria were: a) Patients with sensorineural hearing loss b) Patients present with muscular dystrophy and neurogenic muscular atrophies c) Patients with only hearing ear and d) Patients were not fit for general anesthesia. All patients with a clinical diagnosis of otosclerosis underwent a detailed clinical examination including otoscopic and microscopic examination and all findings were recorded. Audiological evaluation was done by pure tone audiometry, impedance audiometry, and stapedial reflex threshold. Selected patients were treated by two different surgical procedures. One group

of patients was submitted to stapedotomy without tendon preservation (group I) and another stapedotomy with tendon preservation (group II). An informed written consent was taken before operation. Operation was performed under general anesthesia. Stapedotomy was carried out by transcanal incision or endaural incision. Then tympanomeatal flap was elevated. The mobility of malleus, incus and stapes were checked in both cases. Posterosuperior bony meatal was scooped and or drilled to proper visualiz the long process of incus, horizontal segment of facial nerve canal, pyramid, stapedial tendon and foot plate. Then in tendon resection stapedotomy the following steps were followed as- stapedial tendon was cut by microscissor, incudostapedial joint was disconnected, then posterior and anterior crurotomy was done, stapes superstructure was removed. Stapedotomy was made on posterior one third of footplate with 0.7mm diamond skeeter burr. After measuring the distance between long process of incus and stapedotomy hole a Teflon piston prosthesis (according to the size of measuring rod) was placed between long process of incus and stapedotomy hole, and few pieces of fat or gelfoam was placed around stapedotomy hole. Chorda tympani nerve was preserved in most of the cases if possible. Tympanomeatal flap was repositioned. In tendon preservation stapedotomy most of the steps were similar except the preservation of stapedial tendon and incudostapedial joint with remnant stapes superstructure.

Post-operative PTA, impedance audiometry and stapedial reflex threshold were done. Uncomfortable loudness level threshold was recorded at the end of 3months and 6 months. Postoperative A-B gap was noted at 500 Hz, 1000Hz, 2000Hz, 4000Hz.

Data collection technique: Data were collected from self-reported questionnaires and history sheet.

Presentation of data: After compiling data were arranged and presented in simple ways in tables and figures

Statistical analysis: Data were processed and analyzed by using Microsoft Office 365, Excel 365 (version 2019) software. Data presented as mean±standard deviation (SD) or percentages. Finally, the results were evaluated by using proper statistical test for significance. To compare the data of each parameter before and after operation unpaired student's t-test were used. P value of less than 0.05 was considered statistically significant.

Results:

The results of total 30 patients were assessed. Tendon resection and tendon

preservation technique were used in 15 patients of each group. Post-operative follow up was done after 3 months and 6 months of surgery.

All results has shown in tables.

Table I :

Distribution of study subjects according to site of otosclerosis (N=30)

Side	Group I (n=15)	Group II (n=15)
Right	1 (6.7 %)	2(13.3 %)
Left	1(6.7%)	1 (6.7%)
Both	13 (86.6%)	12(80.0%)
	p value	p value
	>0.3	>0.2

Table II :

Post-operative hearing gain with stapedial tendon resection

ABG (dB)	Pre-operative	3 rd month Post-operative	6 th month Post-operative
0-10 (Excellent)	0	0	3(20%)
11-20 (Good)	0	14(93.3%)	12(80%)
21-30 (Fair)	3(20%)	1(6.7%)	0
>30 (Poor)	12(80%)	0	0

Table III :

Hearing outcome (ABG) of study subjects in Group I (Stapedial tendon resection group)

Preoperative (dB)(Mean ± SD)	Post-operative (dB)(Mean ± SD)	Improvement (dB)	P value
35 ± 4.47	After 3 rd months	14 ± 3.7	21
	After 6 th months	13 ± 3.3	22

Table IV :

Post-operative hearing gain with stapedial tendon preserve:

ABG (dB)	Pre-operative	3 rd month Post-operative	6 th month Post-operative
0-10 (Excellent)	0	5(33.3%)	8(53.3%)
11-20 (Good)	0	7(46.6%)	7(46.6%)
21-30 (Fair)	2(13.3%)	3(20%)	0
>30 (Poor)	13(86.6%)	0	0

Table V :
Hearing outcome (ABG) of study subjects in Group II (Stapedial tendon preservation)

Preoperative(dB) (Mean ± SD)	Post-operative (dB)(Mean ± SD)	Improvement (dB)	P value
34 ± 4.17	After 3 rd month	13 ± 4.17	< 0.0001
	After 6 th month	12 ± 4.4	< 0.0001

Table VI :
Uncomfortable level (UCL) in Group I (Stapedial tendon resection group)

Preoperative (dB) (Mean ± SD)	Post-operative(dB) (Mean ± SD)	Improvement (dB)	P value
95±1.8	After 3 rd months	96±3.57	<0.0001
	After 6 th months	99±6.28	<0.0001

Table VII :
Uncomfortable level in (UCL) Group II (Stapedial tendon preservation group)

Preoperative (dB) (Mean ± SD)	Post-operative (dB) (Mean ± SD)	Improvement (dB)	P value
96±2.5	After 3 rd month	107±4.28	<0.0001
	After 6 th month	113±3.21	<0.0001

Discussion:

This study was conducted to assess the surgical outcome of stapedotomy with or without stapedial tendon preservation. Action of stapedial tendon is to reduce the incidence of middle ear complication by preserving vascularization, preserving the necrosis by ischemia and maintain the stabilization of prosthesis. On the other hand, it protects the inner ear by damping of excessive vibration of stapes and increasing the stiffness of ossicular chain¹⁵. The total population in this study was 30 which were divided into two groups. Among them 15 patients were selected in each group. The majority of patient in this study were female, with male female ratio were 2:3 and 1:2 in tendon resection and tendon preservation group respectively.

This finding was like the finding of Al-Husban and Iannella^{16,17}. But dissimilar with the findings of Fakir et al, where male was more than female. This difference may be due to demographic variation. Regarding the occupation in the study population were service holders, housewives and students¹⁸.

Most of the patient in both groups were within 21-30 years of age, with an age range from 18-50 years. But the mean age of tendon resection group was 26.6 years and tendon preservation group were 28.6 years, which was almost like the findings of Harikumar and Kumar¹.

Preoperative average ABG for tendon resection was 35±4.57 dB with a range of 28 to 45 dB. The average post-operative ABG

after 3rd months was 14±3.7 dB with a range 10-22 dB. After 6th months was 13±3.3 dB with a range of 10 to 20 dB.

Preoperative average ABG for tendon preservation was 34±4.17 dB with a range of 25-42 dB. The average post operative ABG after 3rd month was 13±5.7 dB and a range of 6-23 dB and after 6th month was 12±4.4dB and a range of 6-20 dB . There was significant postoperative hearing improvement in both groups.

But there was no statically significant hearing improvement noted between stapedotomy with or without tendon preservation. This finding of study was correlated with the study conducted by Arnold et al¹² and Vallejo et al¹³.

In the study preoperative mean UCL for tendon resection group was 95±1.8 dB and with a range of 94 to 98 dB. The post operative UCL after 3rd months was 96±3.57 dB with a range from 95 to 100 dB and after 6th months 99± 6.28 dB with a range from 98 to 100 dB.

Preoperative mean UCL for tendon preservation group was 96±2.5 dB with a range of 92 to 100dB. The post operative UCL after 3rd months was 107±4.2 dB with a range of 105 to 110 dB and after 6th months was 113±3.2 dB with a range of 111 -117 dB. Here mean UCL was on average 11 dB higher for tendon preservation group in 3rd months of surgery and additional 6 dB improvement noted after 6 months but show minimal change in tendon resection stapedotomy.

This finding of stapedial tendon preservation stapedotomy was statistically significant which was quite similar to finding of Silverstain et al¹⁰ Gross et al¹⁴ and Rasmy et al²⁰.

Conclusion:

Stapedotomy is the definite surgical treatment for otosclerosis. Stapedial tendon preservation shows better outcome of

uncomfortable loudness level than stapedial tendon resection stapedotomy. So, preservation of stapedial tendon should be tried whenever it is possible.

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