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ORIGINAL ARTICLE

Assessment of Preservation of Stapedial Tendon During Stapedectomy for Management of Otosclerosis

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ABSTRACT

Background: Otosclerosis is one of the most common cause of progressive hearing loss in young adults. Otosclerosis is a primary disease of the otic capsule and middle ear ossicles just anterior to stapes footplate which is more specifically.

Aim of the work: This study was to evaluate the success rates of stapedectomy with preservation of stapes suprastructure with stapedial muscle tendon compared to stapedectomy without preservation of stapedial muscle tendon in the operative management of otosclerosis. **Patients & Methods:** This study was conducted in Otorhinolaryngology Department, Faculty of Medicine, Zagazig University during the period from October 2018 to July 2019 on 18 patients with conductive hearing loss. Arranged into two groups, group I with preservation of stapedial tendon and group II with cut of stapedial tendon. Number of each group is 9 patients. **Results:** There is statistically insignificant difference between two groups as; regard pre and post-operative air conduction, bone conduction, air bone gap. The difference was statistically significant.

There was statistically significant difference regarding air conduction of pre and postoperative group I and group II at all frequencies while it was insignificant at 8 KHz . There is statistically significant difference of air bone gap.

Conclusions: Preservation of the stapedial tendon in the surgical treatment of otosclerosis is associated with improvement in functional outcomes, as well as provides the patient with stapedial reflex that had primary protective effect against strong acoustic stimuli.

Keywords: Preservation of stapedial tendon, During Stapedotomy , surgical treatment

INTRODUCTION

Otosclerosis is one of the most common causes of progressive hearing loss in young adults. Otosclerosis is a primary disease of the otic capsule and middle ear ossicles just anterior to stapes footplate which is more common^[1].

A part of bone will grow abnormally. Overgrowth of bone will prevent the stapes from moving in relation to sound response. If stapediovestibular joint is involved by the disease a picture of hearing loss will appear^[2].

About 10% of patients develop clinical otosclerosis with conductive hearing loss with or without a sensory neural hearing loss^[3].

Valsalva was the first to describe hearing loss due to stapes ankylosis in 1704^[4].

It is more common in caucasian population than black American population. Histological incidence in Caucasian varies between studies from 3.4% to 13 %^{[1], [2], [5]}.

The ossicles become knit together into an immovable mass, and do not transmit sound. The bone surrounding the inner ear is also affected, only about 0.3% of population has otosclerosis. The percentage is going down word, although hearing loss is usually diagnosed in early adult life, the prevalence increases 7 times with age^[6]. It occurs twice in women than men^[7]. Hearing loss begins between the age of (11-30) or up to 45. The

hearing loss can be two types a conductive hearing loss when the cochlear function is normal this type can be corrected by hearing aids as well as by surgical procedures called stapedotomy or stapedectomy. When otosclerosis markedly involves the bone that surrounding the inner ear, sensory hearing loss results. This type of hearing loss is not managed by surgery and hearing aids may be ineffective. The amount of sensory hearing loss is related with decrease bone mineral density of cochlea [8].

AIM OF THE WORK

The aim of this study was to evaluate the success rates of stapedectomy with preservation of stapedial muscle tendon compared to stapedectomy without preservation of stapedial muscle tendon in the operative management of otosclerosis.

PATIENTS AND METHODS

This study was conducted in Otorhinolaryngology Department, Faculty of Medicine, Zagazig University during the period from October 2018 to July 2019. The sample size is 18 patients with conductive hearing loss. Arranged into two groups, group I with preservation of stapedial tendon and group II with cut of stapedial tendon. Number of each group is 9 patients.

Inclusion criteria : Patients included in this study fulfilled these criteria. Age >18 years old. Patient with conductive hearing loss, ABG >20 db. No apparent middle ear pathology on otoscopic examination (normal tympanic membrane)

Exclusion criteria

Patient exclusion criteria included ; Patient with sensory neural hearing loss or mixed hearing loss or ABG < 20db. Associated with endolymphatic hydropes. Patient with E.T dysfunction. Divers , professional athletes and hard workers. Working in noise environment.

All the patients had the following tests performed; pure tone audiometry, tympanometry and acoustic reflex. The average hearing loss was measured in decibel [dB] by air and bone conduction at frequencies of 500, 1000, 2000 and 4000 Hz. With patients from first group; The fibrous tympanic annulus is elevated with the tympanomeatal flap to expose the middle ear

(**Figure 1**), Scutal bone is curetted to allow visualization of the pyramidal process, tympanic segment of the facial nerve, and the stapedial footplate (**Figure 2**).

The stapedial tendon and incudostapedial joint was preserved and breaking both crura at the base of footplate , a new window was formed. Prosthesis was inserted into the new window and attached to the distal end of long process of incus.

The second group with routine transection of tendon, separation of incudostapedial joint and breaking both crura (**Figure 3**). Prosthesis was inserted into the new window and attached to the distal end of long process of incus (**Figure 4**).

Ethical Clearance: Written Informed consent was taken from the patient parents to participate in the study. Approval for performing the study was obtained from Pediatrics and Clinical Pathology Departments, Zagazig University Hospitals after taking Institutional Review Board (IRB) approval.

Statistical Analysis

All data were collected, tabulated and statistically analyzed using SPSS 20.0 for windows (SPSS Inc., Chicago, IL, USA). Quantitative data were expressed as the mean \pm SD and (minimum- maximum), and qualitative data were expressed as number and (percentage). t-test was used to compare between two groups of normally distributed variables. Mann Whitney U test was used to compare between two groups of non-normally distributed variables.

RESULTS

That post-operative bone gap had low value at Stapedotomy with preservation of stapedial tendon group 7.1 ± 3.2 compared to 11.4 ± 8.2 at Stapedotomy with cut off stapedial tendon group, while the difference statistically insignificant $p > 0.05$. (**Table 1**)

The above table clarified: 100% improvement of hearing among Stapedotomy with preservation of stapedial tendon group and 88.9% improvement among Stapedotomy with cut of stapedial tendon group the difference statistically insignificant $p > 0.05$. Also post operative tinnitus improvement 88.9% among Stapedotomy with preservation

of stapedial tendon group and 11.1% improvement among stapedotomy with cut of

stapedial tendon group the difference statistically significant $p < 0.05$. (**Table 2**)

Table (1): Comparison between Stapedotomy with preservation of stapedial tendon group and Stapedotomy with cut of stapedial tendon group as regard, Air bone gap post-operative):

	Stapedotomy with preservation of stapedial tendon group mean± SD db	Stapedotomy with cut of stapedial tendon mean± SD db	MW	p
Post-operative air bone gap				
Air Bone Gap	7.1±3.2	11.4±8.2	1.03	0.3

MW= Mann-Whitney U

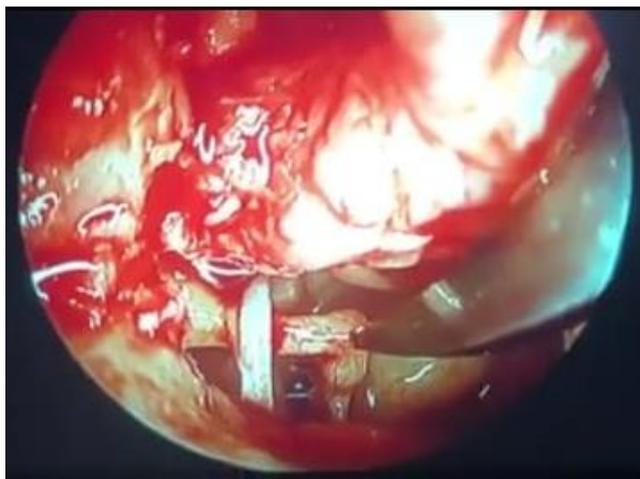
Table (2): Comparison between Stapedotomy with preservation of stapedial tendon group and Stapedotomy with cut of stapedial tendon group as regard post operative hearing improvement, and tinnitus resolution .

	Stapedotomy with preservation of stapedial tendon group No (%)	Stapedotomy with cut of stapedial tendon No (%)	χ^2	p
Post- operative hearing Improved slight	9(100) 0	8(88.9) 1(11.1)	f	0.99(NS)
Post- operative tinnitus Complete cured Improved Slight	1(11.1) 8(88.9) 0	0 1(11.1) 8(88.9)	16	0.0001(S)
Post- operative Tympanometry a b as	8(88.9) 0 1(11.1)	7(77.7) 1(11.1) 1(11.1)	1.1	0.59(NS)

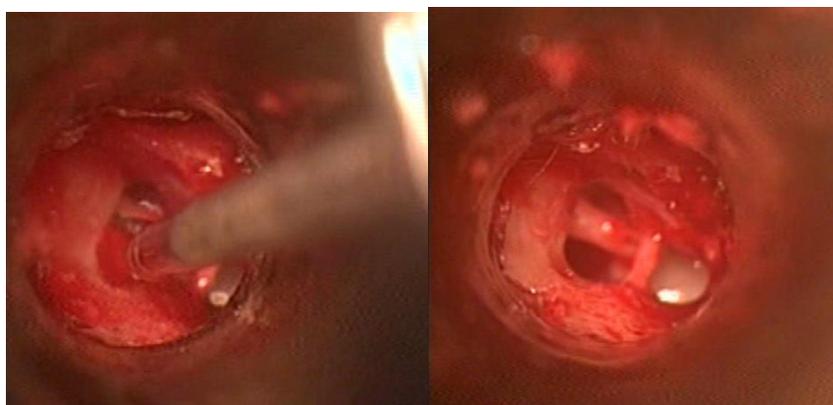
χ^2 chi square test of significant

NS=insignificant

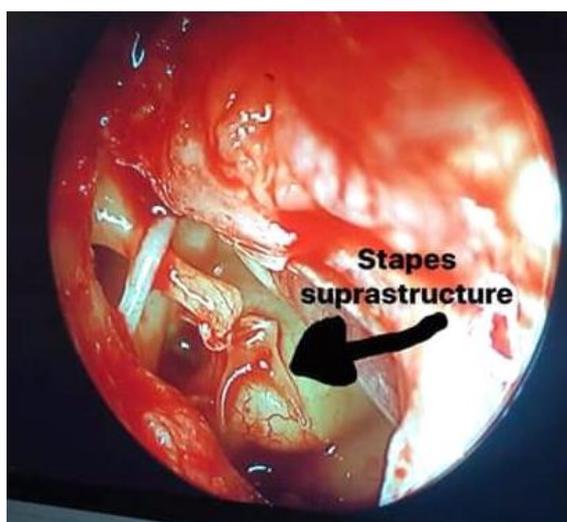
Surgical steps :



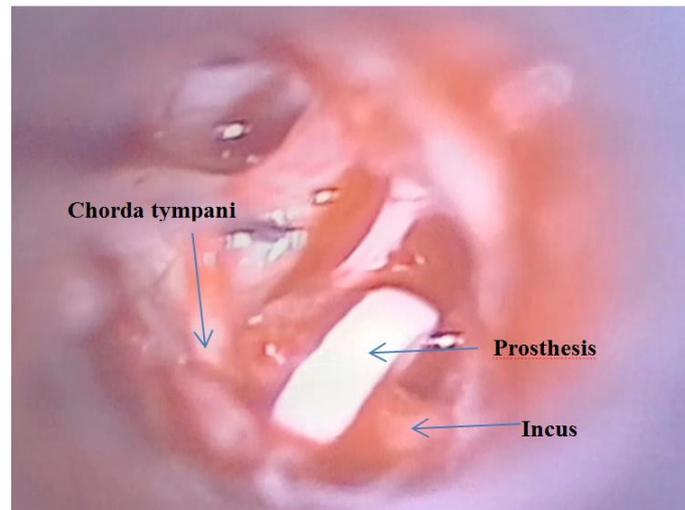
The fibrous tympanic annulus is elevated with the tympanomeatal flap to expose the middle ear (**Figure 1**).



Scutal bone is curetted to allow visualization of the pyramidal process, tympanic segment of the facial nerve, and the stapedial footplate (**Figure 2**).



The incudostapedial joint is disarticulated (**Figure 3**).



Prosthesis is inserted in place and attached with long process of incus (**Figure 4**).

DISCUSSION

The stapedial tendon is routinely transected during stapes surgery. Preserving the stapedial tendon when possible, makes the incus more stable during prosthesis insertion and may help maintain the blood supply to the incus. The middle ear compliance is improved in preservation of the tendon better than non preservation of stapedial tendon. **Vittorio Colletti et al.**,^[9].

In our study, there was insignificant difference between the studied groups regarding postoperative air conduction threshold where mean ACT at 250Hz was 17.8 dB in group I versus 22.8 dB in group II (p-value=0.474), mean ACT at 500Hz was 16.7 dB in group I versus 20.6 dB in group II (p-value=0.96), mean ACT at 1KHz was 17.2 dB in group I versus 23.3 dB in group II (p-value=0.36), mean ACT at 2KHz was 21.1 dB in group I versus 29.4 dB in group II (p-value=0.065), mean ACT at 4KHz was 30 dB in group I versus 36.7 dB in group II (p-value=0.55), and lastly mean ACT at 8KHz was 47.8 dB in group I versus 53.9 dB in group II (p-value=0.21), our result was in agreement with **Gros et al.**,^[11], where average postoperative ACT in group A was 19.7 dB and in group B was 20.1 dB.

In our study, there was insignificant difference between the studied groups regarding postoperative bone conduction threshold where mean BCT at 500Hz was 11.7 dB in group I versus 15 dB in group II (p-value=0.31), mean BCT at 1KHz was 11.1 dB

in group I versus 16.7 dB in group II (p-value=0.09), mean BCT at 2KHz was 20 dB in group I versus 23.3 dB in group II (p-value=0.36), and lastly mean BCT at 4KHz was 22.8 dB in group I versus 29.4 dB in group II (p-value=0.59), our result was in agreement with **Gros et al** ^[10], study which Included 500 otosclerosis patients that operated by the author himself at the ENT departments of The Calcutta Medical College and Ramakrishna Mission Seva Pratisthan and Vivekananda Institute of Medical Sciences, Kolkata, from 1991 to 2000. The patients were divided in two groups for the comparative study; one group of 140 patients with preservation of the stapedial muscle and incudostapedial joint (Group-A) and another group of 360 patients where the stapedial muscle was cut (Group-B). where average postoperative BCT in group A was 18 dB and in group B was 20 dB.

We found insignificant difference between the studied groups regarding postoperative air bone gap where mean ABG was 7.1 dB in group I versus 11.4 dB in group II (p-value=0.3), our result was dissimilar to **Gros et al.** ^[11], where average postoperative ABG in group A was 1.7 dB and in group B was 0.1 dB. Our result was similar to **Taiwo Olugbemiga Adedeji et al.**, ^[11], where 33 (61.1%) had ABG < 10 dB, 13 (24.1%) had ABG 11 – 20 dB, 4 (7.4%) had ABG 21– 30 dB and 4 (7.4%) had ABG > 30 dB (mean 12.48).

In this study, there was insignificant difference between the studied groups regarding postoperative hearing improvement where 100% of group I had excellent improvement while 88.9% had excellent improvement among group II and the remaining 11.1% had slight improvement. Also post operative tinnitus improvement 88.9% among group I and 11.1% improvement among group II, Our result was in agreement with **Taiwo Olugbemiga Adedeji et al.**,^[11].

Conclusion:

Preservation of the stapedial tendon in the surgical treatment of otosclerosis is associated with improvement in functional outcomes, as well as provides the patient with stapedial reflex that had primary protective effect against strong acoustic stimuli, but in our study the stapedial reflex was absent postoperative in both groups.

Declaration of interest

The authors report no conflicts of interest. The authors along are responsible for the content and writing of the paper.

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