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**ORIGINAL ARTICLE**

# Stapedial Reflex Evaluation after Preservation of Stapedial Tendon during Stapedectomy

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## ABSTRACT

**Background:** Otosclerosis is one of the leading causes of conductive hearing loss with an intact tympanic membrane in adults. The stapedius tendon is routinely transected during stapes surgery. This study aimed to evaluate the success rates of stapedectomy with preservation of the stapedial muscle tendon compared to stapedectomy without preservation of the stapedial muscle tendon in the operative management of otosclerosis.

**Methods:** This is a retrospective study. It was conducted in the Otorhinolaryngology Department, Faculty of Medicine, Zagazig University, from October 2018 to January 2021. The sample size was 36 cases, arranged into two groups: the first group with preservation, and the second group with a cut of the stapedial tendon. The size of each group is 18 cases.

**Results:** There was no significant difference between both groups in hearing improvement, but there was a significant difference between both groups in post-operative tinnitus improvement and acoustic reflex preservation.

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

**Keywords:** Otosclerosis; Stapedectomy; Stapedial tendon

## INTRODUCTION

Otosclerosis is one of the most common causes of conductive hearing loss in people between 15 and 50 years of age [1]. Otosclerosis is a hereditary disease that is transmitted in an autosomal dominant form with incomplete penetrance [2]. Progressive and conductive hearing loss, particularly at low frequencies (500-2000 Hz), which may sometimes occur with sensorineural hearing loss, has been identified as the main clinical finding of otosclerosis [3]. Shea [4] introduced the procedure, and the results of the stapes surgery have been excellent. The procedure includes routine transection of the stapedius tendon to remove the stapes crura before insertion of the prosthesis. The surgery has progressed from total removal of the stapes footplate to partial stapedectomy and now to small fenestra stapedotomy using a microdrill or laser [5]. Preservation of the stapedius tendon was

recommended by several surgeons in hopes of obtaining better functional outcomes [6]. This study aimed to evaluate the success rates of stapedotomy with preservation of stapedial muscle-tendon compared to stapedectomy without preservation of stapedial muscle tendon in the operative management of otosclerosis, to compare the difference in hearing and tinnitus improvement, and to assess stapedial reflex preservation.

## METHODS

Thirty-six patients were arranged into two groups: the first group with preservation and the second group with a cut of the stapedial tendon. The size of each group is 18 cases. Patients included in this study fulfilled these criteria: age >18 years old, patient with conductive hearing loss, ABG > 25 dB, and no apparent middle ear pathology on otoscopic examination (normal tympanic membrane). We excluded patients with sensory neural hearing loss

or mixed hearing loss or ABG < 25 dB, patients with endolymphatic hydrops, and patients with E.T. dysfunction.

#### **Surgical techniques:**

In both groups, all patients underwent stapes surgery under general anesthesia. The external auditory canal was infiltrated with 1% lignocaine, containing 1/200,000 epinephrine. There were no differences in the surgical procedures between the two groups. Briefly, a relatively large tympanomeatal flap was created in the posterosuperior part of the external auditory canal. Then, while preserving the chorda tympani, the bone wall in the posterosuperior part of the external auditory canal was removed by curette until the pyramidal eminence and the horizontal part of the facial nerve came into view, after mobility of the stapes was assessed, a small fenestration was made in the posterior portion of the stapes footplate, with a small needle tip perforating instrument, this fenestration was widened by a hand drill 0.6 followed by 0.8. The incudostapedial joint was separated using a Joint Knife or 90-degree pick, the stapedius tendon was severed by Micro-scissors or Bellucci Scissors, and the superstructure of the stapes was removed. The prosthesis was a Fluoroplastic large loop piston. Medtronic was used in all patients. The prosthesis was placed in this hole and fitted along the long process of the incus subsequently. We avoided frequent suction, especially after opening the footplate. The same stapes were done in stapedotomy with preservation of stapedial tendon except stapedial tendon, incudostapedial joint and posterior crus are preserved just fracture of anterior crus, insertion of prosthesis in place and fixation of the loop of piston with long process of incus. Following that, the tympanic-meatal flap was repositioned, and we then inserted Gelfoam® dressing in the external acoustic meatus without ointments or creams.

#### **Postoperative follow-up:**

All patients were discharged on antibiotics, analgesia and antivertigo may be needed. Follow-up was done in the outpatient clinic. All patients underwent audiological assessment, such as tympanometry, acoustic reflex, and pure tone audiometry, 3 months postoperatively.

#### **Ethical consideration:**

The study was done according to the Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans. The institutional ethical review committee approved the study protocol. Written informed consent was obtained from all patients.

#### **Statistical analysis:**

Statistical analyses were performed using IBM SPSS 22.0. A comparative statistical analysis of all variables was carried out using Student's t-test and Fisher's exact test. The level of significance was set at  $p < 0.05$  for both tests.

### **RESULTS**

In this study 36 patients including 18 patients (50 %) underwent stapedotomy with preservation of the stapedial tendon and 18 patients (50%) underwent stapedotomy with cut-off stapedial tendon. There is a statistically insignificant difference between the two groups as regards postoperative air conduction  $p > 0.05$  (**Table 1**). There is statistically insignificant difference between two groups as regards postoperative bone conduction  $p > 0.05$  (**Table 2**). The postoperative bone gap had a low value at stapedotomy with preservation of stapedial tendon group  $7.1 \pm 3.2$  compared to  $11.4 \pm 8.2$  at stapedotomy with cut-off stapedial tendon group, while the difference was statistically insignificant  $p > 0.05$  (**Table 3**). There was a 100% improvement in hearing among stapedotomy with preservation of stapedial tendon group and 88.9% improvement among stapedotomy with a cut of stapedial tendon group the difference statistically insignificant  $p > 0.05$ . Also postoperative 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 was statistically significant  $p < 0.05$ . Additionally postoperative acoustic reflex was present among stapedotomy with preservation of stapedial tendon group and also absent among stapedotomy with a cut of stapedial tendon group, the difference was statistically significant  $p < 0.05$  (**Table 4**).

**Table 1:** Postoperative air conduction in studied groups

Post-operative air conduction	Stapedotomy with preservation of stapedia tendon group mean± SD db	Stapedotomy with cut of stapedia tendon mean± SD db	MW	p
Air conduction 250Hz	17.8±2.6	22.8±10.6	0.72	0.474
Air conduction 500Hz	16.7±3.5	20.6±12.4	0.047	0.96
Air conduction 1KHz	17.2±5.1	23.3±11.7	0.91	0.36
Air conduction 2KHz	21.1±7	29.4±11.3	1.8	0.065
Air conduction 4KHz	30±10	36.7±17.9	0.59	0.55

**Table 2:** Post-operative bone conduction in studied groups

Post-operative bone conduction	Stapedotomy with preservation of stapedia tendon group mean± SD db	Stapedotomy with cut of stapedia tendon mean± SD db	MW	P
Bone conduction 500Hz	11.7±7.1	15±3.5	1.1	0.31
Bone conduction 1KHz	11.1±7	16.7±5	1.68	0.09
Bone conduction 2KHz	20±7.9	23.3±5.6	0.92	0.36
Bone conduction 4KHz	22.8±14.4	29.4±22.3	0.54	0.59

**Table 3:** Post-operative air bone gap in studied groups

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

**Table 4:** Postoperative follow-up in studied groups

	Stapedotomy with preservation of stapedia tendon group No(%)	Stapedotomy with cut of stapedia tendon no(%)	$\chi^2$	p
Post- operative hearing Improved	18(100)	16(88.9)	f	0.99(NS)
Slight	0	2(11.1)		
Post- operative tinnitus Complete cured	2(11.1)	0	16	0.0001(S)
Improved	16(88.9)	2(11.1)		
Slight	0	16(88.9)		
Post -operative acoustic reflex Present	0	0	f	0.0004(S)
Absent	18(100)	18(100)		
Post-operative Tympanometry a	16(88.9)	14(77.7)	1.1	0.59(NS)
b	0	2(11.1)		
as	2(11.1)	2(11.1)		

## 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 the preservation of the tendon better than nonpreservation of the stapedial tendon (7). In our study, there was an 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. [8], where average postoperative ACT in group A was 19.7 dB and in group B was 20.1 dB. In our study, there was an 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 [8]. We found an 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. [8], where average postoperative ABG in a group A was 1.7 dB and in a group B was 0.1 dB. Our result was similar to Taiwo et al. [9], 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 an 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, postoperative tinnitus improvement was 88.9% among group I and 11.1% improvement

among group II. Our result was in agreement with Taiwo et al. [9], where overall, 94.4% had improvement in their hearing. In this study, there was a significant difference between the studied group I regarding postoperative acoustic (stapedial) reflex where 16 patients among group I had intact reflex, our result was similar to Gros et al. [8].

## CONCLUSION

Preservation of the stapedial tendon in the surgical treatment of otosclerosis is associated with improvement in functional outcomes as well as providing the patient with a stapedial reflex that has a primary protective effect against strong acoustic stimuli.

## RECOMMENDATION

We recommend the preservation of the stapedial tendon (whenever possible) to be the surgical procedure of choice for the treatment of otosclerosis. Small sample size and short follow-up period are the principal drawbacks of our study. The major limitation of our study is that we used “standard-size” prosthesis with adjustments made according to the surgeons’ intra-operative observations, so we advise that similar study with a larger sample size and a longer follow-up period will be done in the near future, also we advise that all patients will be treated with customized well-fitted prosthesis.

**Conflict of Interest:** None

**Financial Disclosures:** None

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