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Original Article

A Retrospective Comparative Study on Use of Slow Speed Micro Drill Versus Hand Held Micro Burr Drill for Stapedotomy in Otosclerosis Patients

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Abstract

Background: Stapedotomy is the standard procedure adopted in the surgical treatment of otosclerosis. In spite of advanced methods like laser being used in higher centers, handheld burr and low-speed drill remain the choice of method for the beginners.

Aim of the Study: The aim of this study is to compare the two methods of stapedotomy: Handheld burr and slow-speed drill in stapedotomy in terms of results and complications.

Materials and Methods: A retrospective study of 68 stapedotomy procedures performed in the past 6 years was reviewed. Both handheld burr and slow speed micro drill were used in creating stapedotomy. Post-operative evaluation was done using audiometric results (air-bone gap closure and pure tone audiogram). The immediate and late complications were noted and analyzed. In Group A, slow-speed drill was used to cut the posterior crus of stapes as close to the footplate as possible. Fenestration is made in the central area of the footplate using the micro drill. In Group B, handheld 0.2 mm burr was used to drill an initial hole followed by enlargement using a right-angled pick. In both the groups, appropriate size Teflon piston was used.

Conclusions: There was no statistical significant difference in the auditory gain in both the groups. Both procedures were safe for stapedotomy and the natures of complications were similar and manageable without permanent long-term effects.

Key words: Hearing loss, Micro drill, Otosclerosis, Stapedotomy, Stapes

INTRODUCTION

Otosclerosis is a familial, progressive disease affecting the bony otic capsule, characterized by replacement of compact bone with spongy bone, resulting in fixation of the foot plate of stapes, and clinically characterized by slow progressive hearing loss of conductive type in majority of patients; also, sensorineural type of deafness occurs in a few. The disease is more common in women of childbearing age. It occurs between the second and third decades of life. Surgery is the method of choice in the treatment of otosclerosis. The stapes surgery can lead to 95% improvement in hearing.[1] As a technical advancement in instrumentation nowadays surgeons are using laser to create fenestration in the foot plate of stapes as it to improves precision. As the thickness and diameter of the bone charred while creating a fenestration in the foot plate is controlled with high precision laser, complications are reported to be less frequent[2,3] However, several earlier and latter studies showed no significant differences between laser-assisted, micro drill, and manual microsurgical stapedotomy in regard with auditory gain.[4-10] Many authors who used laser opined that instead of better hearing outcome, the micro drill and/or laser were very helpful in providing greater accuracy during precise manipulations and thereby reduce surgical trauma, which has important advantage over patients' safety compared to handheld instruments.[11-14] In this context, the present study was undertaken to evaluate and compare the clinical auditory gain after primary stapedotomy both with handheld micro burr and slow-speed micro drill methods of fenestration.

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Type of Study
This was a retrospective, comparative clinical study.

Institute of Study
This study was conducted at Kakatiya Medical College, Warangal, Telangana.

Period of Study
The study duration was from January 2015 to September 2017.

MATERIALS AND METHODS

A total of 68 patients' case studies were included in the present study from the medical records section of a tertiary teaching hospital over 6 years. These patients had undergone stapedotomy procedure for their condition of otosclerosis. An ethical committee clearance was obtained before the commencement of the study.

Inclusion Criteria
The following criteria were included in the study:
1. Patients aged above 25 years and below 55 years
2. Patients undergoing primary stapedotomy
3. Patients with purely conductive deafness.

Exclusion Criteria
The following criteria were excluded from the study:
1. Patients aged below 25 and above 55 years
2. Patients with cochlear otosclerosis
3. Patients with history of tinnitus and vertigo
4. Patients with history of middle ear surgery
5. Patients with history of intake of ototoxic drugs
6. Patients with sensorineural deafness.

Case records of the patients from medical records section were taken and studied carefully to include the records of those with the diagnosis of otosclerosis based on a history of progressive hearing loss, negative Rinnes' test, conductive hearing loss in pure tone audiometry, normal speech discrimination, and the absence of acoustic reflexes. High-resolution computed tomography temporal bone had been done preoperatively in cases when there was a history of previous middle ear pathology and if congenital inner ear anomalies were suspected. Records showing surgery performed using stapedotomy techniques using either handheld micro burr of 0.02 mm initially and the micro drill system were taken for evaluation. Patients undergoing surgery under local anesthesia were used. In all the patients, no antibiotics were given before surgery and were given only after surgery. In all cases, an endomeatal approach was used and the tympanomeatal flap was elevated. All operations were performed with the small-fenestra stapedotomy technique which creates a fenestration in the stapes footplate for the placement of prosthesis. The surgical technique is described as follows: After local infiltration of external auditory meatus with 1% xylocaine, an endaural skin incision was carried out using plesters metal knife. Elevation of the tympanic ring from the tympanic sulcus begins at the posterior tympanic spine. The chorda tympani were left attached to the retracted drum. After elevation of the tympanomeatal flap, the bone covering the oval window niche is removed with the small end of a sharp curette. A malleable measuring rod is used to determine the distance between the footplate and the lateral surface of the incus. The prosthesis is trimmed on the cutting block to reach the desired length. A 0.4 mm diameter Teflon piston with varying lengths (4–5.5 mm) was used in all patients. Perforation of the footplate is performed using the micro drill (skeeter otologic drill system and medtronic xomed surgical products) with balanced speed. The speed was limited to 4000–6000 rpm. Separation of the incudostapedial joint is done with a joint knife. The stapedial tendon was cut with small tympanoplasty microscissors. The stapes crura were fractured using a 1.5 mm, 90° hook. After confirmation of the prosthesis correct size, the prosthesis is moved over the stapedotomy opening and advanced into the vestibule. In cases where a handheld method was used, a micro burr measuring 0.2 mm with blunt tip was used to create an indentation initially on the middle of the foot plate before using 0.2 mm perforator. The prosthesis was looped over the long process of incus after keeping the base of the piston in the stapedotomy hole. A fat goblet harvested from the post-aural region was placed around the piston to prevent endolymph leak. A tuning fork test and mild conversational voice were used to assess the auditory gain on the operation table. The tympanomeatal flap is repositioned and gelfoam pledgets were used to keep the tympanomeatal flap in place. The external auditory meatus was filled gelfoam pieces, and the ear was closed using neosporin cotton ball. The chorda tympani were preserved in all cases. The packing is left in place for 4 weeks. After 6 months, a post-operative audiometry was done using pure tones. All the patients were followed up for 3 years. All the data were analyzed using standard statistical methods.

OBSERVATIONS AND RESULTS

A total of 68 patients were divided into 2 groups. Group A consisted of 33 patients whose stapedotomy was done using handheld micro burr and Group B consisted of 35 patients in whom slow-speed micro drill was used. In Group A, there were 19 females and 16 males with a male-to-female ratio of 1:1.18. The mean age was 31.46 ± 2.10. In Group B, there were 20 females and 15 males

with a male-to-female ratio of 1:1.33. The mean age was 33.18 ± 3.70 [Table 1].

The mean pre-operative pure tone average (PTA) for air conduction in Group A was 66.18 ± 2.30, and in Group B, it was 64.30 ± 3.98. The mean post-operative PTA for air conduction in Group A was 21.454.21, and in Group B, it was 23.47 ± 2.61. The mean pre-operative PTA for bone conduction in Group A was 44.20 ± 2.30, and in Group B, it was 42.40 ± 3.98. The mean post-operative PTA for bone conduction in Group A was 19.76 ± 3.15, and in Group B, it was 20.75 ± 2.18. The mean pre-operative a-b gap in Group A was 38.37 ± 2.42, and in Group B, it was 39.50 ± 3.15. The mean post-operative a-b gap in Group A was 15.26 ± 2.43, and in Group B, it was 17.11 ± 1.86. Comparison of values of both the groups showed no statistical significance as the p value was above 0.05 for all values (*P* taken as statistically significant <0.05), [Table 2].

The incidence of complications was similar in both the groups in the study and there was no statistical significance [Table 3].

Table 1: Age and gender incidence, (*n*=A-33; B-35)

Observation	Group A	Group B	P value
Male			
Female			
Mean age	31.46±2.10	33.18±3.70	

Table 2: The pre- and post-operative PTA values, a-b gap (*n* =A-33; B-35)

Observation	Group A	Group B	*P* value
Mean pre-operative PTA Air conduction	66.18±4.25	64.30±3.80	0.643
Mean post-operative PTA Air conduction	21.45±4.21	23.47±2.61	0.712
Mean pre-operative PTA Bone conduction	44.20±2.30	42.40±3.98	0.891
Mean post-operative PTA Bone conduction	19.76±3.15	20.75±2.18	0.845
Mean pre-operative a-b gap	38.37±2.42	39.50±3.15	0.612
Mean post-operative a-b gap	15.26±2.43	17.11±1.86	0.901

a-b gap: Air-bone gap, PTA

Table 3: The incidence of complications in the study Group (n-A-33, B-35)

Complications	Group A	Group A
Sensorineural HL		
Mild	2	2
Moderate	0	1
Severe	1	0
Slippage or displacement of prosthesis	1	1
Recurrent CD	3	2
Serous labyrinthitis	1	1
Vertigo		
Early	4	4
Delayed	1	1
Perilymph fistula	0	0
Tinnitus	3	2
Chorda tympani damage	1	1

HL: Hearing loss, CD: Conductive deafness

DISCUSSION

The present study is a comparison between the two methods of stapedotomy used all over the world. The study revealed that stapedotomy with the use of the micro drill technique was a safe surgical method for the treatment of otosclerosis. The micro drill (skeeter) has low noise intensity, low torque, and the duration of a few seconds, and it seems to be a safe tool in the perforation of the footplate of the stapes, without causing acoustic trauma. Intraoperative monitoring of the facial nerve is not done when performing stapedotomy in the present study. In a study by Sedwick *et al.*,[6] it was shown that there was no significant difference in either post-operative air-bone gap closure or post-operative sensorineural hearing loss, regardless of whether the fenestra was created by micro drill or laser. Somers *et al.*[7] reported that no statistically significant difference was found between the laser stapedotomy and the micro drill technique in the creation of calibrated hole, whereas Mangham[14] reported that hearing results were better after fenestration of the footplate with a micro drill when compared to results with a hand drill. In the present study, there was no statistical significance between handheld micro burr or slow-speed micro drill. Gjuric[5] was of the opinion that the micro drill in experienced hand is not more traumatic than the perforator to the inner ear. Barbara *et al.*[15] reported that micro drill stapedotomy showed good hearing results. Cuda *et al.*[10] in their comparison of three different devices used to perforate the stapes footplate in otosclerosis patients opined that there was no significant difference in the auditory gain or complications observed; the study reported that the use of the CO_2 laser does not differ significantly from that obtained with micro drill stapedotomy and the piezoelectric stapedotomy is associated with a slight but significant deterioration of bone conduction at high frequency and a higher vertigo rate. Yavuz *et al.*[9] compared micro drill and pick stapedotomy techniques; their study revealed that the micro drill and pick stapedotomy techniques produced similar hearing results and complication rates and no evidence of micro drill-induced acoustic trauma. The post-operative audiometry showed closure of the air-bone gap and improvement of the hearing result. The micro drill stapedotomy is a safe surgical technique to perforate the stapes footplate in otosclerosis patients. The question as to which surgical technique is better depending on the experience of the surgeon.

CONCLUSIONS

There was no statistical significant difference in the auditory gain in both the groups. Both procedures were safe for stapedotomy and the natures of complications were similar and manageable without permanent long term effects.

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