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EXPERIENCE IN MICROSCOPIC STAPEDOTOMY TECHNIQUE AND ITS AUDIOLOGICAL OUTCOME IN OTOSCLEROSIS: A CASE SERIES

Otorhinolaryngology

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ABSTRACT

Clinical otosclerosis is a relatively common entity, accounting for 0.5%-2% of the general population. Otosclerosis is characterized by an abnormal bone formation in the temporal bone that eventually causes conductive hearing loss. Bilateral involvement is fairly common. Treatment can be either conservative with medications and a hearing aid, or surgical. Stapedotomy is considered, nowadays, the most effective surgical technique for the management of otosclerosis. The purpose of the present study is to present our long-term results with microscopic stapedotomy, the audiological outcome, as well as the complications encountered. This is an ambispective single-centre study consisting of 50 patients diagnosed with otosclerosis and treated operatively with a stapedotomy. Demographic data, air and bone conduction thresholds, complications and length of the prosthesis were recorded. Our results demonstrate that microscopic stapedotomy is safe and effective technique for the management of otosclerosis with a steep learning curve.

KEYWORDS

Stapedotomy, Otosclerosis, Conductive Hearing Loss, Audiological Outcomes

INTRODUCTION

Otosclerosis is a progressive disease characterized by abnormal bony remodeling, which includes the formation of new bone and bone resorption in the temporal bone [1,2]. In most cases, otosclerosis is presented with conductive hearing loss (CHL) in the low frequencies with a Carhart notch [3]. However, progression of the disease in the cochlea may cause Sensorineural Hearing Loss (SHL) "hyalinization" of the spiral ligament and atrophy of the stria vascularis [4].

Surgical treatment has been evolved through the years. Restoration of hearing in CHL cases and improvement of patients' quality of life are the main goals of treatment. Stapedotomy is considered the most effective, up-to-date, surgical technique for the management of otosclerosis. On the other hand, fenestration of the footplate can be performed (microscopically or endoscopically) either with the use of a micro-drill or a laser beam [5-7].

The aim of the present study is to present our long-term results with microscopic stapedotomy for the management of otosclerosis and compare them with the ones obtained with other techniques reported in the literature. Also, audiological outcomes and complication rates will be presented.

AIM AND OBJECTIVE

- To demonstrate microscopic stapedotomy is an effective technique in management of otosclerosis.
- To present our long term results with microscopic stapedotomy, audiological outcomes and complications encountered.

MATERIALS AND METHODS

Data Acquisition

The present study is a ambispective review of all patients treated with a stapedotomy for otosclerosis in our Otorhinolaryngology department from August 2021 to August 2022. A written informed consent was obtained by all patients. A data extraction form was designed to record the following data: demographic characteristics (including age, gender and side), surgical time, length of prosthesis and complications.

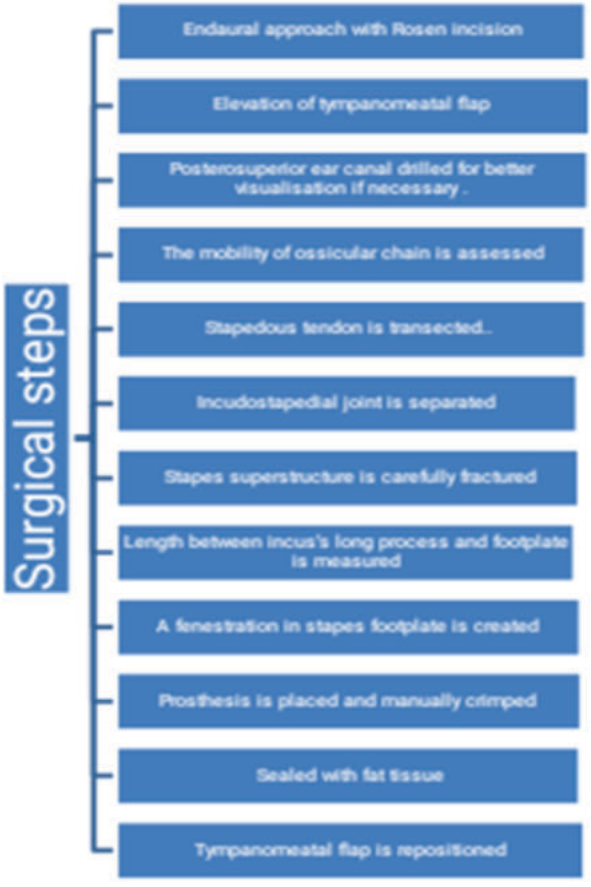
All patients had undergone preoperative and postoperative pure tone audiograms of both air and bone conduction at the frequencies of 250 Hz, 500 Hz, 1 kHz, 2 kHz, and 4 kHz. The preoperative and the postoperative values of the air and bone conduction pure tone thresholds were compared.

Inclusion Criteria

- All patients of all age and sex
- Patients having pure conductive or mixed hearing loss

Exclusion Criteria

- Patients with pure sensorineural hearing loss with or without tinnitus
- Patients with any other cause of conductive hearing loss



Surgical Technique

Operations were performed by experienced surgeons under general anesthesia. Briefly, in all the patients an endaural approach by meatal incision was made and elevation of the tympanomeatal flap. The posterosuperior part of the ear canal was drilled for better visualisation if necessary. The ossicular chain fixation was confirmed. Next, the stapedius tendon was transected and the incudostapedial joint was separated. The stapes superstructure was carefully fractured and the distance between the stapes footplate and the long process of the incus was measured and an appropriate-sized prosthesis was selected. A fenestration was made in the posterior one- third footplate of the stapes, using perforator. The fluoroplastic stapes piston (0.4 mm shaft diameter) was then placed and manually crimped. The length of prosthesis was either 4.50 mm or 4.75 mm. A small fat tissue is used to seal piston with stapes footplate. The tympanomeatal flap was then repositioned to its normal position. [As per surgeon's point of view , this technique is a blessing for surgeons who are still in learning phase as it has advantage of providing wide field of view , good visualisaton of all structures and at once both hands can be used for intruments handling].

Post OP Management

Patient was given mastoid bandage and advised to keep head up position with restricted head movements. I.v. antibiotics were given for 5 days.

Statistics

Data were initially entered into an Excel sheet and were analyzed using appropriate statistical test. Categorical variables were expressed as frequencies and percentages. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The study included a total of 50 patients, 18 males (38%) and 32 females (62%). The mean age was 44 years (median 45). Stapedotomy performed on right ear (56%) was more as compared to left side(44%). The length of prosthesis was either 4.5 mm (n=32, 64%) or 4.75 mm (n=18, 36%).The mean (± SD) follow-up period was 6 (± 1.2) months. Postoperative deterioration or severe hearing loss up to 80 dB was encountered in one patient (2%). Loss or distortion of taste in two patients (4%) and tinnitus in two patients (4%). Piston dislocation was almost nil complication. Mean time of stapedotomy was 45 minutes and no other significant complications were recorded.

The audiological results showed a statistically significant improvement in the air conduction thresholds in all tested frequencies (250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz) ($p<0.001$) done at 6 weeks post operatively. The mean difference in the air conduction thresholds preoperatively and postoperatively was 30 dB in 250 Hz and 500 Hz, 27.5 dB in 1000 Hz, 22.5 dB in 2000 Hz and 15 dB in 4000 Hz. The differences in the air conduction after the stapedotomy are presented in Table 1. Bone conduction thresholds remained almost unchanged after surgery and air-bone gap closed to <10db in 95% of cases. Finally, the length of prosthesis did not influence the audiological outcomes.

Table 1. Pre and post-operative air conduction thresholds.

Length of prosthesis	No. of patients	percentage
4.5mm	32	64%
4.7mm	18	36%

Table 2. Length of prosthesis

Post-operative complications	No. of patients	percentage
Hearing deterioration	1	2%
Loss or distortion of taste	2	4%
Tinnitus	2	4%

Table 3. Post-operative complications

Hz	Mean difference(dB)
250	30
500	30
1000	27.5
2000	22.5
4000	15

DISCUSSION

Clinical otosclerosis is a relatively common disease and its incidence is estimated to be between 0.5% and 2% [8]. According to the literature, otosclerosis is characterized by a female predominance, with a female/male ratio of 2/1, and a median age of onset of 47 years (range 20-75) [9-11]. Our demographic data are similar to those reported in the literature.

Micro-drills and laser beams are often employed to increase the precision in the fenestration of the stapes footplate and to decrease the possibility of footplate fracture or mobilization. It has been suggested that modern equipment reduces the postoperative complications and improves the final audiological outcomes [12]. However, other studies demonstrate that the audiological outcomes in the laser and in the conventional stapedotomy are similar [6]. The CO2 laser has been associated with thermal effects on the inner ear perilymph. Acoustic trauma or even penetration of the neuro-endothelium by Argon and KTP Lasers has been a concern about their use [13-14]. Moreover, there have been cases of delayed facial palsy related to KTP lasers. However, no statistically significant difference between laser and non-laser stapedotomy regarding complications such as sensorineural hearing loss and tinnitus and vertigo was shown in a meta-analysis.

It is important to highlight the role of preoperative CT scan imaging. CT scan is not only recommended for diagnostic purposes but mainly to exhibit possible surgical risks. Several imaging details need to be evaluated, including the facial nerve course, the concurrent middle and inner ear pathology, the status of the oval and round window, the ossicular chain integrity and the jugular bulb location. Otosclerosis is a disease that, in most of the cases, affects the hearing bilaterally. Therefore, we suggest limited or no interventions in cases of anomalies that pose the risk of causing SHL.

The cost of stapes surgery varies and primarily depends on the equipment that is selected. The application of lasers in stapes surgery and especially the CO2 laser has been significantly linked to increased cost.

CONCLUSION

The present study indicates that conventional microscopic stapedotomy is a safe procedure providing good audiological outcomes and at the same time remains cost-efficient.. The air bone gap (ABG) gain was comparable to international studies. Postoperative complications such as giddiness, tinnitus and deterioration of hearing can be managed by injectable steroids and/or oral antihistaminics showing significant improvement .Hence, Microscopic stapedotomy can be considered as a gold standard technique. It is an effective technique for the management of otosclerosis with a steep learning curve. Stapedotomy, when performed by an experienced surgeon, provides excellent outcomes

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