THE HEARING RESULTS IN OTOSCLEROSIS AFTER STAPEDOTOMY

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Abstract- Otosclerosis is the most frequent cause of conductive hearing loss in patients with intact tympanic membrane. It can be treated by surgery with various techniques. Because of limited manipulation and comparably similar results, stapedotomy at present is preferred over other surgical techniques by most surgeons. Here we present the operative results of 114 otosclerotic patients who underwent stapedotomy between 1997-2002 in Rahnemoom hospital, Yazd and Amiralam hospital, Tehran. The aim of this study is to evaluate the efficacy and safety of stapedotomy in otosclerosis surgery. The average air-bone gaps of patients improved significantly from 41.82 db to 14.23 db after operation. Other hearing parameters of patients (including air conduction, bone conduction and speech discrimination score) also improved significantly. Permanent vertigo did not occur after operation and preoperative tinnitus resolved in 56 of 78 patients. Stapedotomy is a safe and effective modality for improving conductive hearing loss in otosclerotic patients.

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Key words: Otosclerosis, stapedotomy, hearing loss

INTRODUCTION

Otosclerosis is the most common etiology of conductive hearing loss in 15-50 years old patients with intact tympanic membrane (1). This is a disorder of bone which is confined to otic capsule and can cause sensory-neural or mixed hearing loss as well as conductive hearing loss (2). The disease presents clinically in about 1% of the Caucasians and is transmitted primarily as an autosomal dominant trait with incomplete peneterance. Females are affected more frequently than males with an approximately 2:1 ratio (3).

Surgical management requires replacement of all or a part of the fixed stapes. From the first successful operation by John Shea in 1956 (4), there has been many innovation in the surgical treatment of otosclerosis.

A recent trend has been movement from total stapedectomy to small fenestrae stapedotomy.

This trend reflects the thoughts that the limited opening of the vestibule in small fenestrae techniques carries a reduced risk of damage to the inner ear (5). Some surgeons have reported better closure of the air-bone gap at high frequencies and better postoperative speech discrimination scores with small fenestrae techniques compared with total stapedectomy (6).

Regardless of the technique, it is anticipated that the hearing level of approximately 90% of patients should improve after surgery and that less that 1% of patients should have severe sensorineural hearing impairment following surgery (7).

The aim of the present study was to evaluate the effectiveness of stapedotomy in improving hearing in patients with conductive hearing loss due to otosclerosis.

Results of stapedotomy in patients with otosclerosis were reviewed with regard to hearing improvement and incidence of complications.

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MATERIALS AND METHODS

The operation results of 114 patients who underwent primary stapedotomy for treatment of conductive hearing loss due to otosclerosis between 1997 to 2002 (Rahnemoon hospital, Yazd and Amiralam hospital, Tehran) were reviwed. We obtained informed consent from all patients.

All surgeries were performed under local anesthesia. After exposure of stapes and oval window with a transcanal approach and removal of suprastructure, a 0.7 mm fenestra in the foot plate was created and a Teflon piston of 0.6 mm width was used instead of stapes. Foot plate was sealed with auricular subcutaneous fat. After testing prosthesis position and mobility, the flap was returned to its position and secured by Gelfoam. All patients were discharged from hospital the day after surgery.

All patients had preoperative and postoperative audiograms. Air conduction thresholds were obtained from 500 to 4000 Hz and bone conduction thresholds were obtained from 500 to 4000 Hz. Pure-tone average (PTA) thresholds were calculated from 0.5, 1, 2 and 4 kHz.

Air-bone gap was calculated from air and bone conduction thresholds obtained at the same day. Speech discrimination score (SDS) was tested using standard 25 word list and speech reception threshold (SRT) was obtained. The first postoperative hearing test was performed at least 3 months after surgery.

Student *t* test and one way ANOVA were used to test differences between the pre and postoperative results. The nonparametric chi square test and Fisher exact test were used to compare data.

RESULTS

A total of 114 patients (39 male and 75 female) between 20-60 years with a mean (± SD) age of 33.9 (±11.91) years underwent operation. All patients had bilateral disease but operations were performed only in one ear (the worse ear).The mean (± SD) follow-up period was 28.14 (± 10) months and patients with less that 3 months follow-up were excluded from study. Twenty three patients had some degree of true vertigo postoperatively that resolved with conservative treatment.

Episodes of movement induced dizziness continued in 11 patients for a while but no patient had permanent vertigo. Tinnitus was recorded in 78 patients preoperatively that resolved or improved in 56 patients. In 22 patients tinnitus continued with the same severity, postoperatively.

Hearing results

The preoperative and postoperative hearing statuses of patients are summarized in table l.

Air conduction threshold

The mean air conduction thresholds of all patients were evaluated in 500 ,1000, 2000 and 4000 Hz frequencies. The average threshold improved from 63.87 db preoperatively to 28.75 db postoperatively ($P = 0.0001$)

Bone conduction threshold

The average preoperative bone conduction threshold in speech frequencies (500, 1000, 2000, 4000 Hz) was 22.05 db which reduced to 14.53 db postoperatively ($P = 0.0001$)

Table 1. Hearing results in patients with otosclerosis treated by stapedotomy

	Hearing status			
Parameter	**Preoperative**	**Postoperative**	**Improvement**	***P* value**
Air conduction	63.87	28.75	35.12	0.0001
Bone conduction	33.05	14.52	7.53	0.0001
Air-bone gap	41.82	14.23	27.59	0.0001
SNHL	32.97	19.04	13.93	0.001
SDS	94.01	97.18	3.17	0.001
SRT	54.47	22.55	31.92	0.001

Abbreviations: SNHL, sensory neural hearing loss; SDS, speech discrimination score; SRT, speech reception threshold.

Air-bone gap

The mean preoperative and postoperative air-bone gaps were 41.82 and 14.23, db, respectively that showed significant improvement (P =0.0001).

SDS and SRT

The mean SDS was 94% preoperatively that increased to 97% after operation. The average SRT of patients reduced from 54.47 db before operation to 22.55 db postoperatively. Both these figures showed significant improvement (P = 0.001).

DISCUSSION

The pathological incidence of otosclerosis is the same in males and females but clinical disease is more frequent in females, with an approximately 2:1 ratio (8). In our study a ratio of 1.9: 1 was obtained.

The goals of otosclerosis surgery are closure of air-bone gap and producing the capability of hearing without amplification. Success, defined as closure of air-bone gap to less than 10 db, was obtained in most of our patients. However, the average postoperative air-bone gap in our patients was 14.23 db. Most patients with air-bone gaps greater than 10 db had mixed sensory-neural hearing loss preoperatively. Furthermore, air-bone gaps of less than 20 db are considered desirable as well by some authors (9,10).

The ability to hear without amplification is the goal of any surgery for hearing improvement. This goal is obtainable if the postoperative SRT is less than 30 db (11). The average postoperative SRT of our patients (22.55 db) is well within this range and compares favorably with others series (12).

Although the complications of sensorineural hearing loss or permanent vertigo are rare following stapes surgery (1,2), it remains a serious side effect. Advocates of stapedotomy have suggested that it is a safer technique because it requires less manipulation of footplate (13). In our series no patient suffered from total loss of hearing or permanent vertigo. Tinnitus is a common finding in otosclerosis patients and surgery has an unpredictable effect on it and it may worsen after operation (3). In our study tinnitus of 56 patients was improved; however, in 22 patients tinnitus continued postoperatively. Gersdorff *et al.* in a European experience have reported similar results (14).

In conclusion, stapedotomy is a safe and effective treatment for conductive hearing loss in otosclerosis patients. With regard to good results and relative safety of this procedure, it may be offered to patients instead of wearing hearing aids for long terms that has its own complications. It must be considered that the experience of the surgeon plays a major role in the results of stapes surgery.

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