

Main Articles

Stapedectomy following tympanoplasty

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Abstract

The aim of this study was to evaluate the success of stapedectomy in patients who have previously had a tympanoplasty because of chronic otitis media (COM). Fourteen patients from a private otology practice had undergone tympanoplasty for COM and subsequently underwent stapedectomy. Measurements were taken of the air-bone gap (ABG) closure and pure tone average (PTA) which showed hearing improvement. Patients had a mean 36.9 dB PTA hearing gain with 79 per cent closing the ABG to within 20 dB. The need for stapedectomy alone is a rare occurrence for patients with a history of COM requiring a tympanoplasty. Hearing improvement following stapedectomy in these cases was significant, although somewhat less than following traditional stapedectomy in otosclerosis alone.

Key words: Surgical Procedures; Operative; Stapes Surgery; Otitis Media

Introduction

The success of stapedectomy for correcting hearing loss in otosclerosis is well known. What has received less attention in the literature is the success of stapedectomy following tympanoplasty. We elected to review during a 10-year period patients who were post-stapedectomy with prior tympanoplasty. Over this period we found only 14 patients with a history of COM who, after tympanoplasty underwent stapedectomy, out of a total of 4678 stapedectomies. We present in this review the associated pathological findings, surgical technique and short- and long-term post-operative audiometric results.

Materials and methods

A total of 14 patients with COM and tympanoplasty having subsequent stapedectomy were reviewed. The goal for surgery in all cases was to correct conductive hearing loss. Age, sex and ear operated on are noted.

Audiometric testing was done in double-walled sound rooms using standard procedures. Pre-operative air and bone conduction thresholds were recorded at 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz. Post-operative air conduction thresholds were recorded at 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz. Pure tone averages were calculated using 500, 1000, 2000 and 4000 Hz. Frequency of PTA improvement was noted for the following ranges: 1–10 dB,

11–20 dB, 21–30 dB, 31–40 dB, and >40 dB. Post-operative bone conduction thresholds were not available in this retrospective review since the original testing protocol only included post-operative bone conduction for patients in whom the hearing did not improve. Consequently, pre-operative bone conduction scores were used for all air-bone gap calculations. Post-operative PTA air-bone gap was noted for the following groups: closure/overclosure, 1–10 dB, 11–20 dB, 21–30 dB and >30 dB. Pre- and post-operative word recognition scores (WRS) were recorded using W-22 word lists. Long-term testing was done on average 8.9 years (range = 1–19 years, median = 9.5 years) post-operatively. Perforation size and location were noted with any associated ossicular fixation. The cause of stapes fixation was noted and degree of footplate removal was described.

The standard technique for stapedectomy has been previously described.¹ In routine stapedectomy the 4 mm Robinson prosthesis is almost always used. In this study, the modified Lippy Robinson Prosthesis² was used in four (28.6 per cent) of 14 cases. Due to the extent of the disease, more than half of the footplate was removed with hooks in all 14 cases. It was not necessary to use the laser.

Results

The mean patient age at the time of stapedectomy was 47.5 years. Four of the patients were male, and

TABLE I
PRE-OPERATIVE AND POST-OPERATIVE AUDIOMETRIC RESULTS*

	500 Hz	1000 Hz	2000 Hz	4000 Hz	PTA	WRS
Pre Air	78.6	78.6	73.2	73.2	76.8	90.7%
Pre Bone	22.5	31.8	38.6	38.6	30.9	
Post Air	40.7	40.4	38.6	58.6	39.9	96.4%
Long-term Air	51.4	47.5	53.9	69.6	50.9	95.3%

*Mean long-term follow-up = 8.9 yrs.

10 were female. The right ear was operated in eight cases and the left ear in six. Perforation size at time of tympanoplasty was as follows: six total, four subtotal, one moderate and two small with one tympanic membrane lateralized. Perforation location at time of tympanoplasty was as follows: six total, five central, one posterior and one marginal.

Otosclerosis was identified in nine patients. Two patients from the group of nine otosclerotics were observed to have tympanosclerosis limited to the tympanic membrane. The remaining five patients had significant tympanosclerosis of the stapes and footplate with the following ossicular problems at the time of stapedectomy: one eroded incus and four with significant malleus and incus fixation of which three had an eroded lenticular process. An eroded incus required the use of the modified Lippy Robinson prosthesis in four patients. It was not possible to remove the tympanosclerosis without disturbing the integrity of the remaining footplate. Stapedectomy was performed an average of 26 months post-tympanoplasty. The amount of footplate removal was: 6: total, 5: 3/4, 1: 2/3 and 2: 1/2.

Audiometric results in Table I illustrate the large conductive hearing loss in these patients pre-operatively and the hearing gain following surgery. Long-term air conduction results showed continued benefit from surgery. Hearing improvement was stable with minimal deterioration (mean = 1.2 dB PTA per year, median = 1.2 dB per year) following stapedectomy. Table II shows the frequency of hearing improvement. Table III illustrates that almost 80 per cent of patients closed their ABG to within 20 dB. Table IV emphasizes the significant difference in hearing gain in patients with and without associated malleus and/or incus fixation. The three patients with a post-operative ABG greater than 20 dB all had malleus and incus fixation in addition to stapes fixation. There were no cases of prolonged dizziness. There was no correlation between the size of the perforation and the post-operative ABG. There was also no correlation between the number of months between the tympanoplasty and stapedectomy and the size of the post-operative ABG.

Discussion

The success of stapedectomy for otosclerosis is well known. What is discussed much less in the literature is the occurrence of otosclerosis in chronic otitis media (COM).³ We elected to review those cases of stapedectomy post-tympanoplasty over a 10-year interval. Only 14 stapedectomies out of 4678 had a prior tympanoplasty for COM yielding an incidence of 0.3 per cent. Our review was done to answer the following questions regarding this group in comparison to routine stapedectomies. Do the short- and long-term audiometric results differ? What are the associated findings? How were these cases managed surgically?

All patients initially had a type I tympanoplasty to correct the perforation caused by COM, and an average of 26 months later stapedectomy was performed. No cases had tympanoplasty and simultaneous stapedectomy, hence avoiding increased risk of infection. Although most of the perforations were fairly large, there was no correlation between the size of the perforation and the post-operative results. In addition, there was no correlation between the number of months between the tympanoplasty and stapedectomy and the post-stapedectomy ABG. In all of our cases there was significant involvement of the stapes and footplate. Removal of tympanosclerotic foci from the stapes and footplate might have sufficed if the disease was limited. The most definitive treatment in this series was felt to be stapedectomy.

The pre-operative audiometric presentation post-tympanoplasty is significantly different than the average otosclerotic. Table I illustrates the significantly greater pre-operative ABG in these patients. In our recent review⁴ of otosclerotics including obilateral cases, the pre-operative ABG was much smaller. Long-term follow-up in this study demonstrated durable hearing gain with a mean deterioration of 1.2 dB PTA per year, slightly more than the mean of 0.7 dB per year we have reported in our routine stapedectomy.^{5,6} Table II shows that all patients had significant hearing improvement with a mean gain of 36.9 dB. Table III shows that almost

TABLE II
PTA HEARING IMPROVEMENT

1-10 dB	0
11-20 dB	2 (14.3%)
21-30 dB	2 (14.3%)
31-40 dB	5 (35.7%)
>40 dB	5 (35.7%)

TABLE III
POST-OPERATIVE PTA AIR-BONE GAP*

Closed/over closed	5 (35.7%)
1-10 dB	1 (7.1%)
11-20 dB	5 (35.7%)
21-30 dB	3 (21.4%)
>30 dB	0

*Measured using pre-operative bone conduction.

TABLE IV
PTA HEARING RESULTS FOR FIVE PATIENTS WITH LATERAL
OSSICULAR INVOLVEMENT AND NINE PATIENTS WITHOUT LATERAL
OSSICULAR INVOLVEMENT

	Lateral ossicular involvement	No ossicular involvement
Mean hearing improvement	30.7 dB	40.4 dB
Mean air-bone gap	22.3 dB	1.5 dB

80 per cent of patients closed their ABG to within 20 dB. This is somewhat less than the 96 per cent to 97 per cent closure to within 10 dB that our pure otosclerotic patients enjoy.^{1,5,6} These results resemble ABG closure rates in chronic ear disease. Table IV illustrates clearly that the lower closure rates are associated with the lateral ossicular involvement (malleus, incus).

Conclusion

In conclusion our findings can be summarized as follows:

- (1) The incidence of COM in otosclerosis is very rare.
- (2) Patients with COM requiring stapedectomy generally have a larger ABG.
- (3) Closure of ABG will be significant but less than the average otosclerotic stapedectomy.
- (4) Results will be durable but less so than otosclerotic stapedectomy.

- (5) Associated ossicular involvement should be anticipated.

References

- 1 Rizer FM, Lippy WH. Evolution of techniques of stapedectomy from the total stapedectomy to the small fenestra stapedectomy. *Otolaryngol Clin North Am* 1993;**26**:443–51
- 2 Lippy WH, Schuring AG. Prosthesis for the problem incus of stapedectomy. *Arch Otolaryngol* 1974;**100**:237–9
- 3 Shea MC. Stapes fixation in chronic middle ear disease. *Laryngoscope* 1976;**86**:230–2
- 4 Lippy WH, Berenholz LB, Burkey JM. Otosclerosis in the 1960s, 70's, 80's and 90's. *Laryngoscope* 1999;**109**:1307–9
- 5 Lippy WH, Burkey JM, Schuring AG, Rizer FM. Stapedectomy in patients with small air-bone gaps. *Laryngoscope* 1997;**107**:919–22
- 6 Lippy WH, Burkey JM, Schuring AG, Rizer FM. Short- and long-term results of stapedectomy in children. *Laryngoscope* 1998;**108**:569–72

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