The Journal of Laryngology and Otology
November 1992, Vol. **106**, pp. 971–973

Long-term results of revision stapes surgery

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Abstract
Results of 45 re-operations for persistent or recurrent conductive deafness after primary stapes surgery were studied. The mean follow-up period after the revision surgery was 7.6 years. Long-term hearing results were found to be disappointing, air-bone gap to within 10 dB was achieved in only 46 per cent of the patients. Mean hearing levels improved by 11 dB or more in 73 per cent. Outcome of surgery was dependent on the surgical pathology, the best hearing results were obtained in cases with re-fixation after stapes mobilization operation. Sensorineural hearing loss as a result of surgical trauma to the inner ear occurred in revision surgery more frequently than in primary operations, cases with regrowth of otosclerotic bone to the oval window after stapedectomy having the greatest risk of labyrinthine trauma.

Introduction

During the past three decades stapes operations for conductive deafness caused by otosclerosis have been widely performed giving excellent results in most cases. In a proportion of the patients, however, the primary operation fails or conductive deafness recurs later and a re-operation should be considered. It has been stated that revision operations are more difficult and carry a higher risk of failure and complications than the primary procedure (Smyth, 1982; Shea, 1988).

We have studied long-term results of our revision operations performed for persistent or recurrent conductive deafness after primary stapes surgery.

Material and methods

The material studied consists of 45 revision operations carried out for persistent or recurrent conductive deafness after a primary operation for stapedial otosclerosis in the Department of Otolaryngology, University of Kuopio, Kuopio, Finland, between 1970 and 1986. The indication for revision surgery was a recurrence of conductive deafness to a level worse than that of the other ear with an air-bone gap greater than 25 dB. Re-operations for perilymph fistula were excluded.

After surgery, all patients were regularly checked in our out-patient department for at least two years. The mean follow-up period was 7.6 years.

TABLE I
TECHNIQUE USED IN THE PRIMARY OPERATION

	n	*(%)*
Posterior crus stapedectomy	25	(56)
Stapedectomy with prosthesis	12	(27)
Stapes mobilization	8	(18)
Total	45	

Audiological examination was performed using a clinical audiometer calibrated according to ISO standards. Audiograms obtained the day before revision operation and at the last follow-up examination were used for comparison. Post-operative air-bone gaps were determined comparing the post-operative mean thresholds of air conduction at 0.5, 1 and 2 kHz with the mean pre-operative thresholds of bone conduction in the same frequency range.

Results

The mean age of patients at the time of revision surgery was 45.3 years (range 19 years–70 years). The time lapse from the primary operation to the revision ranged from eight months to 31 years (mean 7.2 years).

The most common surgical technique used in the primary operation was posterior crus stapedectomy (stapedioplasty) because it has been widely used in our department (Table I). In all primary stapedectomies a large fenestra technique with fascia seal to the oval window was used. Six of the stapes mobilization procedures had been carried out during the 1950s and 1960s. In two cases, operated on in the 1970s, the stapes footplate had been prematurely mobilized during the primary operation.

TABLE II
FINDINGS AT REVISION OPERATIONS

Cause of failure	n	(%)
Posterior crus re-attached to *margins of the oval window*	*17*	*(38)*
Re-fixation of footplate after stapes mobilization	8	(18)
Regrowth of otosclerotic bone in the oval window	6	(13)
Prosthesis dislocated	6	(13)
Necrosis of the posterior crus	5	(11)
Necrosis of the long process	2	(4)
Malleus ankylosis	1	(2)

Accepted for publication: 23 May 1992.

TABLE III
HEARING RESULTS ACCORDING TO THE CAUSE OF FAILURE AFTER THE PRIMARY OPERATION

Cause of failure	Improved by more than 30 dB	Improved by 11–30 dB	Unchanged	Worsened	Dead ear
Re-fixation of footplate after stapes mobilization	3 (37.5%)	5 (62.5%)	—	—	—
Re-growth of otosclerotic bone in the oval window	1 (16.7%)	3 (50.0%)	1 (16.7%)	—	1 (16.7%)
Other causes after posterior crus stapedectomy	1 (4.5%)	12 (54.5%)	8 (36.4%)	1 (4.5%)	—
Other causes after stapedectomy with prosthesis	4 (44.4%)	4 (44.4%)	1 (11.1%)	—	—
Total	9 (20.0%)	24 (53.3%)	10 (22.2%)	1 (2.2%)	1 (2.2%)

Prior to re-operation, 31 patients (69 per cent) had mean hearing levels (0.5, 1 and 2 kHz) of 35–60 dB and the remaining 14 (31 per cent) had hearing levels worse than 60 dB.

Causes of failures of the primary operations as found in revisions are presented in Table II. Stapes re-fixation after mobilization operation was treated with stapedectomy and teflon piston prosthesis, giving the best hearing results in this series (Table III). In cases with regrowth of otosclerotic bone in the oval window after stapedectomy the new bone was removed, the window sealed with a piece of fascia and a teflon piston inserted. This procedure improved the mean hearing level by 11 dB or more in two thirds of the cases and led to total deafness in one ear. When the posterior crus was attached to the margin of the oval window or when it had become necrotic, the stapes superstructure was removed and a prosthesis inserted. The neomembrane over the oval window was not violated, unless it was unavoidable. In this group, hearing improved in 59 per cent.

In cases with a dislocated prosthesis a new prosthesis was inserted and hearing improved in all cases. There were two ears with necrosis of the long process of the incus. In one of them, the incus was transposed between the oval window and the tympanic membrane giving excellent hearing. In the other case, a teflon wire prosthesis was attached to the malleus neck giving a very poor hearing result.

TABLE IV
HEARING RESULTS OF REVISION STAPEDECTOMY (EXCLUDING ONE TOTALLY DEAF EAR). POST-OPERATIVE AIR-BONE GAPS AND AIR CONDUCTION (AC) AND BONE CONDUCTION (BC) THRESHOLDS (0.5, 1 AND 2 KHZ)

	n	(%)
Post-operative air-bone gaps		
≤10 dB	20	(45.5)
11–20 dB	11	(25.0)
21–30 dB	5	(11.4)
>30 dB	8	(18.2)
Post-operative AC thresholds		
<30 dB	17	(38.6)
30–40 dB	10	(22.7)
>40 dB	17	(38.6)
Mean AC threshold		
Pre-operative	57.3 dB (sd 15.2)	
Post-operative	37.1 dB (sd 16.8)	
Mean BC threshold		
Pre-operative	24.3 dB (sd 10.8)	
Post-operative	22.9 dB (sd 11.2)	

For the whole series, mean air conduction thresholds improved from a level of 57.3 dB pre-operatively to 37.1 dB post-operatively. In 24 (53 per cent) of the 45 patients hearing improved by 11–30 dB and in nine (20 per cent) by more than 30 dB. Hearing was unchanged in 10 (22 per cent) and worsened in two patients (4 per cent).

Air-bone gap was achieved to within 10 dB in 46 per cent (Table IV). At the last follow-up examination, 61 per cent of the cases had hearing levels of 40 dB or better in the re-operated ear.

As mentioned above, one ear (2.2 per cent) became totally deaf. In two ears (4.4 per cent) partial sensorineural hearing loss (loss of bone conduction thresholds by 10 dB or more at frequencies 0.5, 1 and 2 kHz) occurred. In addition, in two ears (4.4 per cent) bone conduction thresholds dropped by 15 or more at 4 kHz while they remained unchanged at speech frequencies. Post-operative sensorineural loss was related to opening the oval window in all but one case. The latter had a prosthesis inserted after a failed posterior crus stapedectomy.

Discussion

The most common cause of failure after posterior crus stapedectomy (stapedioplasty) was found to be migration of the posterior crus with re-attachment to the margin of the oval window. Obviously the posterior crus had primarily been too short in these cases. Also necrosis of the posterior crus seems to happen in a few cases. These two risks are the disadvantages of this surgical technique.

Dislocated prosthesis was a common finding after stapedectomy with prosthesis. When the long process of the incus had remained intact, inserting a new prosthesis usually was a simple procedure giving good hearing results in most cases. Incus necrosis leads to a much more difficult situation; incus interposition seems to be the best method in treating it. Palva and Ramsay (1990) also recommend this technique.

Regrowth of otosclerotic bone to the oval window was detected in 16 per cent of revisions after stapedectomy. Removal of this new bone from the oval window was the most common cause of post-operative sensorineural hearing loss, possibly due to adhesions between the neomembrane and the membranous labyrinth after the primary surgery.

Hearing results after revision stapedectomy appeared to be disappointing. After a mean follow-up period of 7.6 years, the air-bone gap was within 10 dB in only 46 per cent of cases. This finding is in agreement with other

authors (Crabtree *et al.*, 1980; Glasscock *et al.*, 1987; Bhardwaj and Kacker, 1988; Farrior and Sutherland, 1991). Pearman and Dawes (1982), Derlacki (1985) and Palva and Ramsay (1990) reported slightly better results but the follow-up period in their series was shorter than in this study.

Revision stapedectomy seems to have a greater chance of sensorineural loss than primary stapedectomy. In the present series, total deafness as a complication of surgery occurred in 2.2 per cent (one out of 45) while the corresponding figure for our primary operations was 0.3 per cent. Partial sensorineural loss (loss of conduction thresholds at speech frequencies by 10 dB or more) occurred 2.2 per cent of the re-operations. Earlier, Crabtree *et al.* (1980), Bhardwaj and Kacker (1988) and Farrior and Sutherland (1991) have stated that the chance of cochlear damage is greater in revision surgery.

We think that re-operation for conductive deafness after stapedectomy can be performed in carefully selected patients and only on the ear with worse hearing. Before revision surgery, the patient must be informed of the possibility of further hearing loss. Revision operations after stapes mobilization appear to give about as good results as primary stapedectomies with little chance of cochlear damage. Today, when the stapes mobilization technique is not used, this revision indication is limited only to the rare cases of unplanned mobilization of stapes footplate during the primary operation.

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Key words: Otosclerosis; Stapes surgery; Surgical revision