Revision stapes surgery: A critical evaluation

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Fifty-six revision stapes surgeries performed in the last nine years were evaluated retrospectively for their preoperative symptoms, intraoperative findings and postoperative results according to the causes of failure, at the Gruppo Otológico, Piacenza, Italy. The most frequent causes of failures were found to be prosthetic misalignments, a reaction to the surgical trauma in the form of excess fibrous tissue proliferation or new bony regrowth at the oval window and ossicular chain problems. The location of the pathology was found to be an important factor in the outcome. Sixty percent of cases resulted in 0-20 dB air-bone gap. The causes of these failures, management and their prevention during primary surgeries are also discussed. [Turk J Med Res 1994; 12(1): 48-52]

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Stapes surgery is one of the finest otologic surgeries. Its revision needs another dimension of skill and experience. All previous studies have reported less satisfactory results of revision compared to primary stapes surgeries (1-12).

Analysis of these revision surgeries have shown some clues for prevention of some complications and failures. These studies indicated significant correlation between oval window fistula and the use of polyethylene tube and gelfoam pad procedures (1,3,5). Understanding this cause of failure made possible to abandon these techniques, with resultant lessening of this complication. Also poor outcome of lateralized neomembrane, fibrotic obliteration of the oval window.repeat obliterative otosclerosis or cases with inner ear symptoms is well known (1-4) In spite of these previous evaluations, the most frequent causes of failures namely dislocated prosthesis, excessive tissue reactions to the surgical trauma and lateral chain pathologies remain unadressed. The aim of this study is to analyse results and causes of failure in revision stapes surgery as reflected by our intraoperative findings. This would help tfc provide additional knowledge for the prevention of these failures.

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MATERIALS AND METHODS

The records of 56 operations of 52 patients operated upon for revision stapes surgery, from April 1983 to July 1992, at Gruppo Otológico, Piacenza, Italy, were reviewed. This corresponds to less than 7% of our otosclerosis cases. Their age ranged from 22 to 74 years with a mean of 42.5 years. Thirty-four (66%) cases were females and 18 (33%) males. The time lapse between the previous operation and the revision varied from one month to 28 years. The mean postoperative follow-up was 1.6 years, with a range of one month to seven years. Twenty-five (45%) had more than one year and 18 (32%) more than two years follow-up.

Evaluation of the functional results

Postoperative functional results are reported as closure of the conductive deficit which are calculated by subtracting the mean preoperative bone conduction values for 500, 1000, 2000, 4000 kHz from the most recent mean postoperative air conduction at the same frequencies. A change in bone conduction more than 10 dB or 12% SDS compared to preoperative level was considered significant.

Table 1. Preoperative symptoms(N=54)*

Hypoacusis	47(83%)
Tinnitus	16(28%)
Vertigo	10(18%)
Instability	4(7%)

* Charts of two cases were lacking

Table 2 Pre.op and post.op air-bone gap

Air-bone Gap	Pre.op No (%)	Post.op No (%)
0-10	0(0%)	8(17%)
11-20	3(5%)	21 (43%)
21-30	11(20%)	8(17%)
>30	42(75%)	10(20%)
Dead	0(0%)	2(4%)
Total	56(100%)	49(100%)

Table 3 Intraoperative findings

A- Prosthetic Malfunctions (N=37)		
Short		5(14%)
Long		2(50%)
Fixed		10(27%)
Dislocated		18(49%)
Not Found		2(5%)
B- Oval Window Problems (N=24)		
Fibrotic Closure		13(62%)
New Bony Format ion		.8(38%)
Oval Window Fistula		2(10%)
Reparative Granuloma		1(5%)
C- Ossicular Chain Problems (N=14)		
	Incus	Malleus
Erosion	10(71%)	—
Fixed	2(14%)	2(14%)

RESULTS

The main preoperative symptom in these patients for revision surgery was conductive hearing loss in 46(85%). In 10 patients (18%) the symptom was vertigo, and in 4(7%) instability. In two patients the preoperative charts of symptoms were lacking, Table 1. In eighteen cases (32%) primary surgery was performed in our center, while 38 (67%) had one or more procedure(s) performed elsewhere. Seven of these patients underwent second or third revision surgery in our center. The preoperative and postoperative air-bone gap of the patients are shown in Table 2.

Causes of Failures

Dislocation of the prosthesis from the oval window was the commonest cause of failure in 18(32%) usually accompanied by a variable degree of erosion of the long process of incus Obliteration of the oval window by either fibrotic tissue 13(23%) or bone regrowth 8(16%), was found to be the second most frequent cause of failure. In 10 out of 19 (18% of total) cases with incus erosion, the extent of erosion required removal of the incus for reconstruction of the sound conducting system by means of one of the incus by-pass procedures (mostly with TORP (seven cases), wire from malleus to oval window in two and homograft cartilage in one case) being the third problem in frequency found in stapes revision. In seven patients an inappropriate length of the prosthesis was the cause of conductive failure being short in five (%9), and long in the other two (4%). In two cases (4%) fixation of the incus and in another two (4%) fixation of the malleus were found to be the reason for failure. Five patients with vertiginous symptoms were suspected for fistula. Only two of them (4%) were confirmed to have perilymphatic fistulas intraoperatively. Reparative granuloma was detected in one case (2%) upon exploration, Table 3. In 14 cases more than one related pathology were observed. In order to facilitate evaluation each finding was analyzed separetely.

Functional evaluation

Only 49 operations were included in the functional evaluation, since four cases were lost to follow up and three cases were not reconstructed, one of whom was showing a large posterosuperior wall erosion and retraction and the other two had fistulas. Seven cases resulted in speech discrimination drop; less than 30% in five and more than 30% in two. Of these seven patients, five resulted in bone conduction loss less than 16 dB in three, and in two were more than 80 dB. Two other cases had dead ears postoperatively. All other cases had the same preoperative hearing level or better postoperatively. The results showed that in 8 (17%) the air bone gap closed to within 0-10 dB, while in 29 to within 0-20 dB (60%),and in 36(77%) the gap was closed to 0-30 dB, Table 2. The results are presented according to the causes of failure in Table 4 and according to the frequency of revision in Table 5. An overall mean hearing gain, in terms of air-bone gap closure of 12.6 dB was achieved.

DISCUSSION

Stapes surgery is one of the most delicate microsurgeries in otology. Revision adds further difficulty because of the disturbed state of anatomy. The importance of the experience of surgeon in this surgery.has been emphasized by other authors (2-3). It became more important, especially with the increasing number in practicing surgeons, a progressively fewer number of cases performed by each surgeon with a resultant decreased familiarity with the surgical procedure. For the benefit of patients, the first attempt

Table 4 Results according to the causes of failures

	0-10	11-20	21-30	>30	Dead	Total
DP	4(21%)	10(53%)	3(16%)	2(10%)	0(0%)	19(100%)
VS	0(0%)	2(19%)	1(9%)	6(54%)	2(19%)	11(100%)
FC	1(9%)	4(36%)	2(19%)	4(36%)	0(0%)	11(100%)
OC	1(25%)	0(0%)	2(50%)	1(25%)	0(0%)	4(100%)
SP	2(33%)	0(0%)	1(17%)	3(50%)	0(0%)	6(100%)
LP	0(0%)	1(50%)	0(0%)	0(0%)	1(50%)	2(100%)
IBP	2(20%)	3(30%)	3(30%)	2(20%)	0(0%)	10(100%)

DL: Cases with dislocated prosthesis
VS: Cases with vestibular symptoms
FC: Fibrotic closure of the oval window
OC: Osseos closure of the oval window
SP: Cases with short prosthesis
LP: Cases with long prosthesis
IBP: Cases with incus by-pass procedures

should be performed well and the failures due to technical faults should be kept to a minimum.

In the evaluation, we found favorable hearing results when the pathologies are located away from the oval window thus allowing to accomplish a reconstruction without manipulation of the vestibule or the surrounding tissues. However in patients with vestibular symptoms, the reason for revision was relief of vertigo or to prevent further deterioration of the hearing rather than the closure of the conductive deficit. This fact, with the possibility of further deterioration of hearing should be known by the surgeon and should be explained to the patient preoperatively. As it is seen in this study, most of the cases with vestibular symptoms resulted in unfavorable hearing including two dead ears. The reason for this poor outcome is probably that most of these cases were presented with a violated vestibule as indicated by the preoperative sensorinueral hearing loss (SNHL) (5).

The most favorable results in our series were obtained in the dislocated prosthesis group with a 74% of air-bone gap closure to the 0-20 dB. We believe that the location of the pathology away from the oval window mostly contributed to this better outcome compared to the cases with other pathologies. In contrast, results of the fibrotic closure of the oval window are not as good. More than half of our cases resulted in more than 20 dB air-bone gap. Similar poor outcome has been reported by others (2,4) In evaluating the bony closure of the oval window, three out of four cases resulted in an unfavorable functional hearing level. On the contrary comparing the results of bony and fibrotic closure of the oval window, Glasscock reported better results in cases with bony regrowth (4). Although we observed the opposite in our series, yet it is difficult for us to reach a precise conclusion because of the very small number of these cases. The excess reaction in the form of fibrotic or bony regrowth was attributed to surgical trauma. As we discussed earlier, lessening the surgical trauma and therefore the resultant tissue reaction in primary surgeries is one of the keys to the successful outcome in many of these cases.

Results of revisions of cases with short prosthesis are poor because of the associated lateralized neomembrane which does not transmit the sound energy sufficiently. Trial of relocation of the neomembrane into the vestibule often results in SNHL. In these cases -we prefer to perform a hole in the posterior third of the oval window neomembrane till perilymph is seen. Then the prosthesis is inserted without disturbing the remaining part of the neomembrane. Adopting this method, we obtained better results as we previously reported in another series of 114 cases (3). In two cases with long prosthesis,one with preoperative vestibular symptom resulted in a dead ear. Although the number of these cases is very small, again the poor outcome can be seen with one dead ear out of 2 cases. In these cases, removal of the prosthesis is probably respon-

Table 5. Results of first and second revisions

	0-10	11-20	21-30	>30	Dead	(No Rec.)**'	Total
1st Rev.	6(15%)	19(49%)	6(15%)	7(17%)	1(3%)	(0)	39(100%)
2nd Rev.*	2(20%)	2(20%)	2(20%)	3(30%	1(10%)	(3)	3(100%)

No Rec: Not Reconstructed.
* Including two third revision
** Not included in the evaluation

sible for the SNHL because of the adhesion between otolitic membrane and prosthesis (16). Cutting and leaving previous prosthesis in situ and insertion of a new prosthesis may provide an atraumatic reconstruction. Therefore, adjustment of the length of the posthesis should be perfect since it is an easily avoidable technical error and the results of revisions of these cases are not favorable.

In the 10 cases with incus erosion, sound transmission was reconstructed by means of incus by-pass procedures. Results of these cases are, however, worse compared to cases with intact incus, in agreement with Glasscock (4).

We observed relatively better results in cases revised for the first time on the contrary of others (1,4,8).

An overall air-bone gap closure to 0-10 dB 17% and 0- 20 dB was obtained in 60% of the patients with an overall mean hearing gain of 12.6 dB. In our series we obtained an overall 0-10 dB gap closure slightly lower than others, yet, comparable results in the 0-20 dB gap (1-13). However, it is difficult to compare different series for hearing results since they include different patient material.

By analysing the findings, we can group the pathologies responsible for the failures under three main headings; 1. Prosthetic misalignments, mostly in the form of dislocation from the oval window. 2.0val window problems, being a secondary reaction to trauma by means of excess fibrous tissue proliferation or osseous neoformation causing impaired sound transmission, and 3.Lateral ossicular chain problems.

With a suitable surgical technique and experience most of these failures could have been prevented in the primary surgeries. In the primary stapes surgery utilization of the stapedotomy technique seems to be useful in decreasing these problems. Stapedotomy offers a calibrated hole in the footplate to stabilize both ends of the prosthesis. This avoids dislocation of the prosthesis by the pulling effect of the contracting fibrotic tissue. With a lesser amount of trauma to the vestibule, as shown by significantly lower incidence of postoperative vestibular symptoms following stapedotomy,(14) it also offers maintaining the normal anatomy as much as possible and the avoidance of postoperative fibrous tissue reaction and irritative bony neoformation. Maintenance of the remaining footplate helps to guide the surgeon during the primary surgery as well as in revision surgery, in case it is needed. It also avoids rupture of the annular ligament and any damage to the attached vestibular epithelium as has been described by House (15).

Temporal bone histologic examinations of post-stapedectomy patients have shown the presence of adhesions between the neomembrane or the prosthesis and the membranous labyrinth (16). In the light of this fact, the importance of minimizing manipulation over the neomembrane in revision stapes surgery should be understood. This understanding implies maintenance of the normal anatomy during the primary operations which greatly helps by keeping the inner ear unviolated by soft tissue attachments.

Although laser stapes surgery seems rewarding in lessening the surgical trauma, multicenter long term results are still lacking and its availability is limited because of its high cost (13).

Besides these two most frequent problem namely dislocated prosthesis and the tissue reaction at the oval window as a third frequent problem, the erosion of the incus in the long term, remains as a problem. In order to lessen this problem the use of a softer wire (4) or preservation of the stapedius tendon and the vascular supply to the incus were suggested (17). A better prosthesis design would help to lower this problem.

Finally, another factor that should be remembered in every case, before and after the definitive procedure is the asssesment of ossicular chain mobility. In one of the cases in spite of initial stapedectomy following by two revisions elsewhere, the patient reported no improvement. Upon exploration, the patient was found to have fixed malleus head. This single case is very valuable in demonstrating the importance of systematic examination of the ossicular chain mobility.

Revizyon otoskleroz cerrahisinin kritik bir değerlendirilmesi

Son 9 yılda Gruppo Otológico, Piacenza İtalya'da yapılan 56 otoskleroz revizyon vakası preoperatif semptomlar, intraoperatif bulgular ve başarısızlık nedenlerine göre postoperatif fonksiyonel sonuçlar açısından retrospektif olarak değerlendirildi. En sık başarısızlık sebepleri olarak sırasıyla prostetik dislokasyonlar, cerrahi travmaya aşırı fibröz doku proliferasyonu veya oval pencerede yeni kemik oluşumu tarzında bir cevap ve kemikçik zincir problemleri bulunmuştur. Sonuçlar da patolojinin lokalizasyonu önemli bir faktör olarak bulunmuştur. Vakaların %60'ı 20 dB hava-kemik aralığı ile sonuçlanmıştır. Başarısızlık sebepleri, bunlara yaklaşım ve primer otoskleroz cerrahisi sırasında önlenmesi de tartışılmıştır. [Turk J Med Res 1994; 12(1): 48-52]

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