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Obliterative otosclerosis

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Abstract

From January 1990 to December 1996, 293 primary stapedectomies for otosclerosis were performed, among which 14 had obliterative otosclerosis (4.7 per cent). Probability of bilateral obliterative disease was 50 per cent. With this particular condition, a drill-out procedure was used to perform either a stapedectomy or a stapedotomy. In two patients with bilateral 'far-advanced otosclerosis', surgery was effective in enabling the patient to benefit from hearing-aids. In patients with a measurable hearing-loss, an air-bone gap closure to within 10 dB was achieved in 62.5 per cent of the cases and to within 10-20 dB in 37.5 per cent of the cases, with no deterioration of air-conduction thresholds at 8 kHz. A mild sensorineural hearing loss at 4 kHz was observed in 25 per cent of the cases. There was no statistical difference between stapedectomy and stapedotomy. According to these results, the drill-out technique is a safe and effective procedure in cases of obliterative otosclerosis.

Key words: Otosclerosis; Stapes surgery; Post-operative complications

Introduction

Obliterative otosclerosis is present when the footplate is greatly thickened, filling-in the oval window niche and when the annular ligament is invaded with no delineation to indicate the margins of the oval window (Amedee and Lewis, 1987; Raman et al., 1991).

According to previous publications the incidence of obliterative otosclerosis ranges from one to 33 per cent (Raman *et al.*, 1991; Roulleau and Martin, 1994). Most often, this is an operative surprise that poses challenging problems to the otological surgeon. Stapedectomy in the presence of obliterative otosclerosis is considered to be of a less favourable prognosis than the same procedure applied to less extensive forms of the disease. Nevertheless, some authors have reported very good results with stapedectomy or stapedotomy, using the drill-out procedure or argon-laser (Sooy *et al.*, 1964; Amedee and Lewis, 1987; Gherini *et al.*, 1990).

The aim of this study was to report the incidence of obliterative otosclerosis and to present the results of surgery for this specific form of the disease.

Patients and methods

From January 1990 to December 1996, a retrospective study was conducted at the ENT department of Fondation Oph. A. de Rothschild. During this period 293 primary stapedectomies were performed for otosclerosis, among which 14 cases of obliterative otosclerosis were identified in 11 patients.

Surgery was performed under general anaesthesia. In the presence of obliterative otosclerosis, a Bien-Air* electric drill was used with a small diamond burr (diameter = 0.6 mm) to convert the obliterative footplate to a blue-thin footplate (Figure 1). Then either a small fenestra procedure or a total stapedectomy with vein graft interposition was performed with hooks. Data recorded from patient charts included: sex, age, status of the contralateral ear, other intra-operative anomalies associated with the obliterated footplate, surgical techniques and pre- and post-operative hearing results.

For each patient three audiograms were used: the pre-operative audiogram, the first post-operative audiogram (from 15 days to one month after surgery) and the last post-operative audiogram

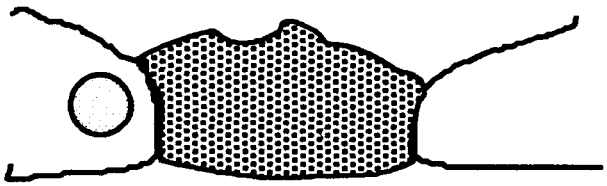

FIG. 1

Obliterative otosclerosis (the oval window niche is invaded by exuberant otosclerotic foci and the margins of the oval window cannot be located).

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TABLE I
PRE-OPERATIVE PURE-TONE THRESHOLDS AND POST-OPERATIVE AIR-BONE GAP (AVERAGE FOR EACH FREQUENCY), IN EIGHT EARS WITH MEASURABLE AUDITION WITH STANDARD EQUIPMENT

	Pre-operative thresholds (dB):		Post-operative air-bone gap (dB):	
	Air-conduction	Bone-conduction	First post-operative audiogram	Latest post-operative audiogram
250 Hz	59.4	13.1	8.75	13.7
500 Hz	58.7	13.1	4.4	10.6
1000 Hz	56.9	21.2	1.9	2.5
2000 Hz	47.5	22.5	3.7	1.9
4000 Hz	51.2	23.7	6.2	6.5
8000 Hz	62.5			

which was included in the patient's medical file (mean follow-up was 13 months, with a range from three to 33 months).

Post-operative results were evaluated by measuring the three following parameters: the post-operative air-bone gap (expressed by the subtraction of the mean pre-operative bone-conduction from the mean post-operative air-conduction average at 0.5, 1 and 2 kHz), the difference between pre-operative and post-operative bone-conduction thresholds at 4 kHz and the difference between pre-operative and post-operative air-conduction thresholds at 8 kHz. Statistical analysis used the chi-square test and the Fisher exact test. Criterion for statistical significance was set at $p < \alpha = 0.05$.

Results

Of the 293 primary stapedectomies performed in this seven-year period, obliterative otosclerosis was diagnosed in 14 instances in 11 patients. The incidence of obliterative otosclerosis was 4.7 per cent in this series.

There were eight female and three male patients. The average age of patients at the time of surgery was 37 years (with a range from 14–62 years). Two patients (two ears) were immediately lost to follow-up in the post-operative period and were excluded from the rest of the study. In the remaining 12 cases of obliterative otosclerosis present in nine patients, the Bien-Air* electric drill was systematically used to remove the exuberant otosclerotic focus, until a blue-thin footplate appeared. The technique for opening the footplate was a total stapedectomy with vein graft interposition to seal the oval window in six cases and a stapedotomy without graft interposition in the other six cases. All interventions were performed by the senior author (PE). These nine patients presented with bilateral otosclerosis in all the cases. In three cases, the diagnosis of otosclerosis was made on clinical and audiometrical examination and only a unilateral operation was performed. In the six other cases the diagnosis was proved during surgery. In these patients the contralateral ear was observed at surgery to have a narrow oval window in three cases and an obliterative otosclerosis in the three other cases.

Two patients with bilateral obliterative otosclerosis had bilateral 'far-advanced otosclerosis' with some unmeasurable bone-conduction thresholds and an air-conduction threshold of 85 dB or greater on standard audiometry equipment (House, 1962). They had no benefit from hearing-aid use (and a cochlear implantation had been discussed for one of them). In these cases, stapes surgery improved hearing to a level at which a hearing-aid might be effective. In eight cases, the air- and bone-conduction thresholds were measurable for each frequency. The mean pre-operative air- and bone-conduction thresholds and the mean post-operative air-bone gap for each frequency are reported in Table I. Post-operative results of surgery (post-operative air-bone gap, thresholds' variations of the bone-conduction at 4 kHz and of the air-conduction at 8 kHz) are presented in Tables II, III and IV.

The comparison of the hearing results with stapedectomy (four cases) or stapedotomy (four cases) on the latest audiograms showed no statistically significant difference between the two procedures, using chi-square and Fisher exact tests (the resulting p was superior to 0.5 for the air-bone gap closure and variations in threshold of the air-conduction at 8 kHz and bone-conduction at 4 kHz).

TABLE II
POST-OPERATIVE AIR-BONE GAP (EIGHT PATIENTS)

Post-operative air-bone gap	<10 dB	10–20 dB
First post-operative audiogram	5	3
Latest post-operative audiogram	5	3

Discussion

The frequency of obliterative otosclerosis in this series was 4.7 per cent of all cases. Previous series reported an incidence ranging from one to 33 per cent (Raman *et al.*, 1991; Roulleau and Martin, 1994). The following factors may partially explain such variations: the definition of obliterative otosclerosis differed from one publication to another and the frequency seemed to vary according to the racial and geographical origin of the patients (Gristwood and Venables, 1984; Raman *et al.*,

TABLE III
THRESHOLDS VARIATIONS OF THE BONE-CONDUCTION AT 4 KHZ (EIGHT PATIENTS)

Bone-conduction at 4 kHz	Unchanged or increased	Worsened
First post-operative audiogram	6	2
Latest post-operative audiogram	6	2
	–	(10 and 15 dB)

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TABLE IV
THRESHOLDS VARIATIONS OF THE AIR-CONDUCTION AT 8 kHz (EIGHT PATIENTS)

Air-conduction at 8 kHz	Unchanged or increased	Worsened
First post-operative audiogram	5	3
Latest post-operative audiogram	8	0

1991). However, the overall factors underlying such variations have not yet been fully elucidated.

In this series all our patients presented with bilateral otosclerosis and the frequency of bilateral obliterative disease was 50 per cent. The incidence of bilateral obliterative otosclerosis was 30.6 per cent according to Amedee and Lewis (1987), but this seemed to be underestimated (as they took into account the bilateral drill-out procedures performed during the study period).

Surgery in obliterative otosclerosis is generally considered to have a poorer prognosis than it has in the less extensive forms of the disease. However, the drill-out procedure has been proposed by some authors who have reported very good post-operative hearing results (Sooy *et al.*, 1964; Amedee and Lewis, 1987). This study confirms that the drill-out technique is a safe and effective method for primary surgery of obliterative otosclerosis, even in patients with far-advanced otosclerosis. Closure of the air-bone gap to within 10 dB was observed in 62.5 per cent and to within 10–20 dB in 37.5 per cent. In patients with a measurable hearing-threshold at 4 and 8 kHz, we have observed no deterioration in air-conduction at 8 kHz but a mild hearing loss in bone-conduction at 4 kHz in 25 per cent of the cases. There was no statistically significant difference between stapedotomy and stapedectomy when comparing hearing results.

The use of argon-laser in obliterative otosclerosis was supported by Gherini *et al.* (1990) who reported 10 cases of small fenestra stapedotomy using a fibre-optic hand-held argon-laser with excellent results (closure of the air-bone gap to within 10 dB and no significant sensorineural hearing loss in 100 per cent of the cases). However, other authors such as McGee (1983) or Vincent *et al.* (1997) felt that a dense obliterative footplate was a limitation in using argon-laser. Further studies should help to delineate the benefits of argon-laser in such cases.

Conclusion

The frequency of obliterative otosclerosis was 4.7 per cent in this series. The probability of bilateral obliterative otosclerosis in this study was 50 per cent. The drill-out technique was safe and effective to remove dense obliterative footplate, even in cases of far-advanced otosclerosis. There was no statistically significant difference in hearing results between small fenestra stapedotomy and stapedectomy in this series.

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References

Amedee, R. G., Lewis, M. L. (1987) Obliterative otosclerosis. *Laryngoscope* **97:** 922–924.

Gherini, S. G., Horn, K. L., Bowman, C. A., Griffin, G. (1990) Small fenestra stapedotomy using a fiberoptic hand-held argon laser in obliterative otosclerosis. *Laryngoscope* **100:** 1276–1282.

Gristwood, R. E., Venables, W. N. (1984) Otosclerosis in South Australia. *Clinical Otolaryngology* **9:** 221–228.

House, H. P. (1962) Footplate surgery in otosclerosis. *Journal of Laryngology and Otology* **76:** 73–86.

McGee, T. M. (1983) The argon laser in surgery for chronic ear disease and otosclerosis. *Laryngoscope* **93:** 1177–1182.

Raman, R., Mathew, J., Idikula, J. (1991) Obliterative otosclerosis. *Journal of Laryngology and Otology* **105:** 899–900.

Roulleau, P., Martin, C. (1994) L'otospongiose - otosclérose. Arnette, Paris (France), p. 240.

Sooy, F. A., Owens, E., Theurer, D. (1964) Stapedectomy in obliterative otosclerosis. *Annals of Otology, Rhinology and Laryngology* **73:** 679–694.

Vincent, R., Gratacap, B., Causse, J. B. (1997) Laser argon et sonde Gherini-Causse en chirurgie otologique. *Journal Français d'ORL* **46:** 56–63.

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