The AllHear Cochlear Implant and Tinnitus

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Abstract: The authors have studied the effect of AllHear cochlear implants on tinnitus. We describe five cases of deaf patients with tinnitus and show that the implant device had a good effect on tinnitus in four. We also discuss one case in which the tinnitus was caused by electrical stimulation. The authors conclude that AllHear cochlear implants have a good effect on tinnitus in the majority of patients.

Keywords: cochlear implant, deafness, tinnitus

The effect of electrical stimulation on tinnitus gained new interest after House [1] reported that cochlear implants not only improve hearing in deaf patients but relieve their tinnitus. In several reports, a partial or complete suppression of tinnitus has been described in patients with cochlear implants. Some of them present a residual inhibition [2,3], and others relate an effect on the contralateral ear [4].

The majority of the reports are concerned with multichannel cochlear implant devices. The AllHear is a single-channel miniaturized cochlear implant device (Figs. 1, 2). Its active electrode is inserted only 5 mm through the round window into the scala tympani, therefore reducing the risk of damage to the inner ear structures, as compared with other active electrodes that are inserted approximately 20 mm.

Since 1994, we have used the AllHear cochlear implant in 27 totally deaf patients. Of a group of 14 patients, 5 had tinnitus before surgery, and 1 presented with tinnitus after surgery only when the device was turned on. The purpose of this study is to evaluate the action of the AllHear cochlear implant on tinnitus in six patients.

CASE REPORTS

Patient 1

A 17-year-old male patient had total deafness after an unknown viral infection that occurred 3 years before consultation. He complained of bilateral, high-fre-

Reprint requests: Y. Fukuda, Department of Otolaryngology, Universidade Federal de São Paulo, Rua Botucatu, 740 - 04023-900, São Paulo, Brazil. Phone: 5511 573 18 03; fax: 5511 570-6018; e-mail: Fukuda.otor@epm.br quency tinnitus of moderate intensity. After the cochlear implant was placed, tinnitus was relieved bilaterally. When the external unit is turned off, he has a residual inhibition of tinnitus for 10 minutes.

Patient 2

A 23-year-old male patient, with a history of a head injury occurring 10 months before the AllHear cochlear implant was placed, presented with bilateral deafness and a high-frequency disabling tinnitus in the head. After surgery, the tinnitus was relieved partially, with no residual inhibition.

Patient 3

A 64-year-old female patient presented with progressive, bilateral sensorineural hearing loss due to otosclerosis, with a hissing-type bilateral tinnitus of mild intensity. The tinnitus disappeared on both sides when



Figure 1. Internal receiver of the AllHear cochlear implant.



Figure 2. External processor of the AllHear cochlear implant: (1) battery; (2) adjustable magnet; (3) hook; (4) on/off switch and volume adjustment; (5) sensitivity adjustment.

the AllHear cochlear implant was turned on. She had residual inhibition of her tinnitus for 30 minutes.

Patient 4

A 39-year-old female patient presented with a history of meningitis at age 1. The infection caused bilateral deafness, with high-pitched tinnitus of mild intensity. The tinnitus was unchanged with the cochlear device.

Patient 5

A 41-year-old male patient presented with a progressive sensorineural hearing loss that started 10 years before surgery on the right side and 3 years before it on the left side. The disorder caused bilateral ringing tinnitus of moderate intensity.

Cochlear implant surgery was performed on the patient's left ear. The tinnitus disappeared in the ear in which the device was implanted, and a reduction of tinnitus was evident in the right side, presenting residual inhibition for 10 minutes.

Patient 6

A 52-year-old female patient presented with bilateral, profound hearing loss caused by meningitis that had occurred 18 years ago. She had no tinnitus before surgery. With the implanted device, she complained of shock, pain, and tinnitus as soon as the electrical device was turned on.

RESULTS

Table 1 displays the data for the six cases just presented: five patients with tinnitus before placement of the cochlear implant, showing the action of electrical stimulation on tinnitus, and one patient in whom tinnitus appeared with electrical stimulation after surgery.

DISCUSSION

Our data on tinnitus are based on the information supplied by the patients. The best results obtained in this group are related to the two cases of progressive hearing loss (patients 3 and 5). In patient 2, whose hearing loss was caused by head injury, the result may be considered good, as the tinnitus was as troublesome as the deafness. That patient felt relieved because the tinnitus was not as intense as it was before the cochlear implantation.

The only case in which the electrical stimulation had no effect on tinnitus is that of the patient who had contracted meningitis 38 years before the surgery (patient 4). However, her tinnitus was not intense, and the cochlear device has been useful for her hearing.

We could observe electrical stimulation as a cause of tinnitus in one patient (patient 6). The scala tympani was ossified, and a hole had to be burred in it to insert the electrode. In addition, owing to a small posterior

Table 1. Tinnitus in Six Patients Before and After Cochlear Implantation

					Tinnitus			
Case	Age	Gender	Onset	Etiology	Pitch	Intensity	Laterality	Result of cochlear implant
1	17	М	3 yr	Infection	High frequency	Moderate	Bilateral	Partial relief in both ears, residual inhibition for 10 min
2	23	М	10 mo	Head injury	High frequency	Disabling	Head	Partial relief, no residual inhibition
3	64	F	10 yr	Otosclerosis	Hissing	Mild	Bilateral	Supression of tinnitus bilaterally, residual inhibition for 30 min
4	39	F	38 yr	Infection	High frequency	Mild	Bilateral	Unchanged
5	41	Μ	3 yr	Unknown; progressive hearing loss	Ringing	Moderate	Bilateral	Suppression in the implanted ear and partial relief in contralateral ear, residual inhibition for a 10 minutes
6	52	F	18 yr	Infection				Pain, shock, and tinnitus with electrical stimulation after surgery

tympanotomy area, guiding the drill to the scala tympani was difficult, and possibly we drilled the modiolus and exposed the neurons in the spiral ganglion. The unusual fact is that tinnitus appears only with electrical stimulation, associated with a sensation of pain and electrical shock, disappearing 1 minute after the device is turned off.

Ito and Sakakihara [4] have described two cases in which the tinnitus was aggravated postoperatively. In reporting our results, we presented four cases (80%)in which the electrical device relieved or suppressed the tinnitus.

The risk of injury to cochlear structures (due to the insertion of an active electrode inside the scala tympani) is reduced using AllHear implants than it is with multichannel cochlear implant electrodes. This reduction in risk occurs because residual hearing has been shown to be maintained after the implantation. Therefore, the AllHear cochlear implant is useful in restoring hearing in deaf patients, and it has shown additional beneficial effects on tinnitus in the majority of them.

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