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Research Article

Restoration of Deafferentation Reduces Tinnitus, Anxiety, and Depression: A Retrospective Study on Cochlear Implant Patients

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Patients with profound bilateral deafness (BD) are prone to su□ering from tinnitus, which further leads to psychological comorbidities and makes it more di□cult for patients to communicate with people. This study was aimed at investigating the e□ect of cochlear implants (CIs) on tinnitus distress and psychological comorbidities in patients with profound BD. This multicenter retrospective study reviewed 51 patients with severe postlingual BD who underwent cochlear implantation; 49 patients underwent unilateral cochlear implantation, and 2 patients underwent bilateral cochlear implantation. The patients were asked to complete all the questionnaires, including the tinnitus handicap inventory (THI), the visual analog scale (VAS) score, the Hospital Anxiety and Depression Scale Questionnaire (HADS), the Categories of Auditory Performance (CAP), and the Speech Intelligibility Rating (SIR), at least 4 months after implantation when the CI was on or o□, in approximately May-June 2019. In our study, 94% (48/51) of BD patients su□ered from tinnitus before CI, and 77% (37/48) of them su□ered from bilateral tinnitus. In addition, 50.9% (26/51) of the CI patients were su□ering from anxiety, 52.9% (27/51) of them were su□ering from depression (score ≥ 8), and 66.7% (34/51) (27/51) of them were su□ering from anxiety or depression. Cochlear implantation could reduce tinnitus more obviously when the CI was on than when the CI was o□. Cochlear implantation also reduced anxiety/depression severity. There were significantly positive correlations between tinnitus severity and anxiety/depression severity before and after surgery. Moreover, hearing improvement is positively correlated with reduction level of tinnitus, the better hearing, and the lesser severity of tinnitus. Thus, along with e□ective restoration of dea□erentation, cochlear implantation shows positive therapeutic e□ects on tinnitus and psychological comorbidities, providing a reference for future clinical and research work.

1. Introduction

Tinnitus, which literally means "ringing in the ears," is defined by the perception of sound or noise in the absence of an external physical sound source. The prevalence of tinnitus in adults is 10-15%. In the a□ected subgroup of patients, it causes extreme distress with far-reaching consequences for daily activities and quality of life [1]. In addition, tinnitus can cause an overall perceived handicap that can include hearing di□culties, anxiety, depression, inability to relax, and sleep di□culties [2]. In sensorineural hearing-impaired patients, tinnitus has a higher prevalence, but this association is not simple or straightforward because some people with troublesome tinnitus have audiometrically normal hearing;

conversely, many people with hearing loss do not report tinnitus [1, 3].

Cochlear damage is a trigger factor for tinnitus. Tinnitus is generated by a series of changes in central auditory pathways, such as the cochlear nucleus (CN), inferior colliculus (IC), the medial geniculate body (MGB), and auditory cortex (AC) to compensate for the loss of this input when the electrical input of the cochlea decreases or disappears [4]. Based

developed by the University of Nottingham for the assessment of children'

To obtain more details, further comparisons among patients were conducted according to di□erent levels of tinni-
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when the CI device was o and 5:3 ± 3:3 when the CI device was on. There were significant di erences between the CI-o group and the preoperative group ($p = 0{:}02$) and between the CI-on group and the preoperative group ($p = 0{:}002$). There was no significant di erence between the CI-on group and the CI-o group ($p = 0{:}33$) (see Table 4).

3.6. The Degree of Hearing Improvement after CI Is Correlated with the Degree of Tinnitus Reduction when the CI Device Is On but Is Not Correlated with Anxiety or Depression. According to the results summarized in Table 5, the CAP scores were 1:3 ± 1:3 before CI and 4:3 ± 1:3 after CI. There was a significant di erence ($p < 0{:}01$), meaning that hearing was significantlA36.1n0.1(CAPu46547.2(Oence)I)-54du.82TJ/g dip

to be necessary, but not su□cient, to produce tinnitus [5, 24, 25]. Dea□

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