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Tinnitus Impact on Quality of Life: Can Cochlear Implantation Decrease Tinnitus Perception?

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Application dissertation for the Master's degree in Medicine, submitted to the Universidade do Porto – Instituto de Ciências Biomédicas Abel Salazar

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Tinnitus Impact on Quality of Life:

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Submission of an article based on the present research, titled "Impacto da Implantação Coclear na Avaliação Subjetiva do Acufeno" to the journal *"Revista Portuguesa de Otorrinolaringologia e Cirurgia de Cabeça e Pescoço"*, according to the journal's manuscript rules.

Resumo

Introdução: O acufeno é definido como uma sensação de audição de som ou ruído sem estimulação acústica externa. É uma manifestação amplamente encontrada entre os candidatos à implantação coclear, identificada em 85% dos casos. O dano coclear na surdez neurossensorial pode ser um fator desencadeante para o surgimento do acufeno. Os efeitos da implantação coclear estão bem estabelecidos em indivíduos com perda auditiva neurossensorial irreversível severa a profunda, e o seu impacto na redução subjetiva do acufeno foi relatado.

Objetivos: Este estudo visou avaliar o impacto da implantação coclear na supressão do acufeno.

Métodos: Este estudo retrospetivo incluiu 35 doentes com antecedentes de hipoacusia neurossensorial bilateral severa ou profunda e queixas de acufeno, submetidos à colocação de implante coclear unilateral entre janeiro e setembro de 2022. O Tinnitus Handicap Inventory (THI), validado e traduzido para português, foi utilizado para avaliar o impacto e a perceção do acufeno no período pré-operatório e três meses após a implantação coclear. Com base na pontuação do THI, a gravidade do acufeno foi também determinada.

Resultados: A média do resultado total do THI no pré-operatório foi de 40,2 ± 32,2 pontos. Os resultados três meses após a implantação coclear mostraram uma diminuição da média do resultado total de THI, com valores de 12,06±23,5 pontos, e uma redução em todas as subcategorias, funcional, emocional e catastrófica. A diferença na média do THI foi estatisticamente significativa entre o período pré-operatório e pós-operatório ($p < 0,05$). De salientar que 16 dos 35 doentes obtiveram uma resolução completa do acufeno, pontuando 0 no THI, e apenas um doente teve um agravamento no período pós-operatório.

Conclusão: Este estudo mostrou uma melhoria do acufeno na maioria dos doentes submetidos a colocação unilateral de implante coclear, sendo que quase metade conseguiu uma resolução completa. O presente estudo contribui para a literatura com resultados semelhantes a investigações anteriores, incluindo a redução do acufeno após IC. No futuro, os estudos devem considerar a avaliação de fatores que potencialmente influenciam o sucesso do implante coclear na supressão do acufeno.

Palavras-chave: Implantação Coclear; Surdez; Hipoacusia; Acufeno; THI.

Abstract

Introduction: Tinnitus is defined as a sensation of hearing a sound or noise without external acoustic stimulation. It is a widely experienced occurrence among cochlear implantation (CI) candidates, as it can be found in 85% of cases. The cochlear damage in sensorineural hearing loss (SNHL) may be a triggering factor for the appearance of tinnitus. The effects of CI for those with irreversible, severe to profound SNHL have been well established, and its impact on the subjective reduction of tinnitus has been reported.

Objectives: This study aimed to evaluate the potential effectiveness of cochlear implantation for tinnitus suppression.

Methods: This retrospective research included 35 patients with a history of bilateral severe or profound SNHL and tinnitus, who underwent unilateral cochlear implantation between January and September 2022. The Tinnitus Handicap Inventory (THI), validated and translated into Portuguese, was used to evaluate the impact and perception of tinnitus in the individual's life preoperatively and three months after CI placement. Based on the THI score, the severity of tinnitus was also determined.

Results: The mean total THI score preoperatively was 40.2 ± 32.2 points. The results three months after CI showed a decrease in the mean total THI score, with values of 12.06±23.5 points, and a reduction in all subcategories, functional, emotional, and catastrophic. There was a statistically significant difference between the total mean scores and each subcategory in the preoperative and postoperative periods ($p < 0.05$). It should be noted that 16 out of 35 patients achieved a complete resolution of tinnitus, scoring 0 in the THI, and only one patient had a worsening in the postoperative period.

Conclusion: This study showed an improvement in tinnitus in most patients who underwent unilateral CI placement, and nearly half of them achieved complete remission. The current study contributes to the literature with similar results to previous investigations, including a reduction in tinnitus following CI. In the future, studies should consider the evaluation of factors that potentially influence the cochlear implantation success in suppressing tinnitus.

Keywords: Cochlear implantation; hearing loss; deafness; tinnitus; THI

Abbreviations

CI – Cochlear Implant or cochlear implantation
SNHL - Sensorineural hearing loss
THI - Tinnitus Handicap Inventory
CHUdSA – Centro Hospitalar Universitário de Santo António
ICBAS – Instituto de Ciências Biomédicas Abel Salazar
SD - Standard Deviation
SPSS - Statistical Package for the Social Sciences software

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Introduction

In Latin, the word tinnitus means “to ring”. Tinnitus is defined as a sensation of hearing a sound or noise without external acoustic stimulation.[1] It is often described as a buzzing or ringing, but it may also sound like a clicking, hissing, pulsations, or other noises referred by patients. [2] Tinnitus can be unilateral or bilateral, and sometimes experienced as emerging inside the head, pulsatile or non-pulsatile, intermittent or constant, bothersome or non-bothersome. [3]

Tinnitus has a prevalence ranging from 10% to 15% worldwide, and can occasionally be a debilitating medical condition, with 1-2% of individuals reporting severely bothersome tinnitus. [4] [4][4] In Portugal, the prevalence is similar, with 16.2% of the Portuguese reporting tinnitus, of which 7.9% were debilitating and 1.5% severe. [5] These statistics increase with age, especially among males, in individuals with a history of exposure to loud sounds (occupational, professional or leisure activities, as well as the use of weapons), or those with a diagnosis of hearing impairment. It is anticipated that the occurrence of tinnitus will increase as a result of demographic evolution and higher levels of noise exposure in recreational and professional environments. [6]

There are numerous classifications of tinnitus, and one of the most important divides it into objective (somatosound) or subjective forms. The majority correspond to subjective tinnitus, which is only perceived by the patient and is often associated with hearing loss. In contrast, objective tinnitus is rare and represents less than 1% of cases. It refers to the creation of sound close to the ear due to vascular, neurological disorders, or Eustachian tube dysfunction that the examiner can also hear. [1]

From the outer ear to the auditory cortex, any area along the hearing pathway can be the origin of the symptom. A quarter of the cases of tinnitus correspond to cochlear or peripheral tinnitus due to damage of the outer or inner hair cells caused by presbycusis, acoustic trauma, ototoxicity, endolymphatic changes, and inner ear infections. If the damage is in the auditory cortex, it is called central tinnitus (35% originate in the acoustic pathways and 41% in the supratentorial structures), due to, for example, meningioma, schwannoma, trauma, multiple sclerosis, intracranial hypertension or stroke. [7, 8]

There is scarce knowledge of the pathophysiologic process that causes tinnitus. According to the most recent theory, the central nervous system is primarily responsible for tinnitus, which originates from a neuroplastic response to hearing loss. In other words, a peripheral insult may induce tinnitus, but the subsequent cascade of neuronal changes in the central auditory system is

the tinnitus generator. [8] Additionally, there is also a loss of suppression of neuronal feedback, which leads to a disinhibition of normal synapses and the creation of alternative neuronal synapses, culminating in an abnormal perception of sound. A decrease in inhibition and/or an increase in excitation can lead to neuronal hyperexcitability. Therefore, a decrease in peripheral nerve activity due to hearing loss leads to hyperexcitability in central nervous system structures, causing an increase in spontaneous stimulation in the central auditory system. [4,9]

However, not everyone with hypoacusis will develop tinnitus, nor will everyone who reports tinnitus have audiometric changes. In these cases, they frequently have “dead” cochlear regions or damaged outer hair cells compared to people without tinnitus. This theory involves auditory, sensorial, memory, and emotional systems, which are consistent with the multifactorial nature of tinnitus. [10]

Although the association between tinnitus and sensorineural hearing loss is not direct, the proposed pathophysiology explains the main correlation with otologic causes. These include cochlear dysfunction, such as sudden deafness, noise trauma, presbycusis, otosclerosis, Meniere’s disease, or the administration of ototoxic medication. Compression of the auditory nerve, either caused by microvascular conditions or a vestibular schwannoma, can lead to auditory neuropathy and the consequent perception of the symptom. Since it is a nonspecific and multifactorial symptom, it has various other causes, including temporomandibular joint disorders, head and neck trauma and emotional factors such as anxiety or stress. However, in most cases, no underlying physical cause is identifiable. Objective tinnitus, typically a heartbeat synchronous pulsatile tinnitus, has a different cause - vascular abnormalities (for example, arteriovenous malformation or carotid stenosis). [11]

A thorough case history, an auditory evaluation, and the quantification of tinnitus severity (using the Tinnitus Handicap Index) are the important steps for the general evaluation of the patient with tinnitus.

The doctor should ask the patient about the duration of the clinical history, in order to classify tinnitus into acute, when the duration is less than three months, chronic, when it lasts over six months, and subacute, when it lasts between three and six months. Other important information for tinnitus assessment is intensity, laterality, quality, and persistence (constant or intermittent). Associated symptoms include vertigo, headache, hypoacusis, otalgia and otorrhoea, ear fullness and autophony. Predisposing factors to consider are trauma, noise exposure, otologic diseases and infections in the past, ototoxic agents and otologic surgical and family history.

Comorbidities such as stroke, vascular malformations, hypertension, thyroid disorders, anxiety, and depression are also valuable information, as tinnitus is occasionally related to medical illness.

A complete tinnitus assessment requires an examination of the head and neck, a thorough otoscopic examination, acumetry with Weber and Rinne tests, a neurological examination with a focus on cranial nerve assessment, and vestibular testing when appropriate. There is not any audiometric exam that makes the diagnosis, but all patients with unilateral, chronic, or associated hearing difficulties should undergo audiometric assessment: Tonal and vocal audiometry, tympanometry, and stapedius reflex testing. Typically, imaging is not required for the investigation of subjective tinnitus. The exceptions correspond to unilateral tinnitus or tinnitus associated with asymmetrical or unilateral hearing loss, or if retrocochlear pathology is suspected. In these cases, additional examinations and targeted imaging should be performed. [1]

The complexity of this symptom does not allow the definition of a uniform diagnostic approach. Therefore, the management of subjective tinnitus is based on its severity and aimed at improving the quality of life for patients, and questionnaires seem to be a useful tool for that evaluation, allowing to determine the degree of severity and its effect on health, social and psychological aspects. [12] The impact of tinnitus on the quality of life should not be underestimated, since a significant proportion of patients suffer from anxiety, depression, insomnia and concentration difficulties. Patients with severe anxiety or depression must be detected and treated promptly since there is a documented higher risk of suicide in patients with tinnitus and an associated psychiatric disorder. [2] Consequently, questionnaires such as the Tinnitus Handicap Inventory (THI) can be crucial to prioritise patients with persistent and bothersome tinnitus, plan rehabilitation strategies, and assess their effectiveness.

There is still no established cure for tinnitus, and its therapy remains a challenge. However, based on a better insight into the pathophysiology, multiple innovative therapeutic strategies have been developed and are presently being clinically evaluated. Tinnitus management should always include personalised and empathic psychotherapy, as well as cognitive-behavioural and sound therapy. Other treatment options being explored are pharmacotherapy, hearing aids, cochlear implants and brain stimulation. [13-17] The multidimensional nature of tinnitus, the challenges in evaluating the symptom and the low methodological quality of many treatment trials result in low evidence levels for the majority of treatment strategies. [18]

Psychological treatment aims to help patients cope with the impact of tinnitus at a behavioural and emotional level, as well as to develop techniques to restructure negative thoughts,

and consequently reduce the undesirable responses to tinnitus. [13,19] Reducing the perception of this symptom can be achieved by psychotherapy (tinnitus retraining therapy) and/or sound-based therapy (producing white noise in masking devices). As the association between hearing loss and tinnitus is significant, hearing aids are frequently useful in its treatment, as they amplify the environmental sound, they have the same effect of masking the tinnitus. [14,19] Regarding pharmacotherapy, the FDA currently does not approve any medication for primary tinnitus, as most of the pharmacological therapies tested are not effective and many have undesired collateral effects. [17,19]

Currently, it is consensual in the scientific community that cochlear implantation is an effective method in auditory rehabilitation in adults with proven irreversible sensorineural hearing loss, of severe to profound degree, without benefit from hearing aids. Cochlear implantation involves surgically implanting a bundle of electrodes into the cochlea to stimulate the cells of the organ of Corti to transmit auditory information. [20] In simpler terms, cochlear implants can bypass the damaged areas of the inner ear and directly activate the auditory nerve. The electrode's intra-cochlear location allows for differential stimulation of the auditory nerves thereby resulting in the transmission of distinct pitch perceptions.[21]

It is reported in the literature that the prevalence of tinnitus in cochlear implant (CI) candidates can reach up to 66% to 86%. [22] In recent years, patients have resorted to cochlear implantation as an “off-label” treatment for tinnitus when other treatments were found to be ineffective. [23] The theory underlying CI as an effective treatment for tinnitus suppression is that the electrical stimulation of the auditory nerve can "mask" tinnitus perception by competing or interfering with the neuronal activity involved in tinnitus perception. When the CI stimulation is deactivated, the temporary reduction or suppression of tinnitus perception is denominated as residual inhibition. One hypothesis is that electrical signals sent to the cochlear nucleus and superior olivary nucleus can directly suppress the inner ear hair cells through the cochlear efferent nerves. The period of residual inhibition can range from seconds to minutes or even hours after stimulation has stopped.[24]

Therefore, since tinnitus is mostly associated with cochlear alterations, combined with the lack of scientific evidence for most tinnitus therapeutic strategies, the aims of this study include the analysis and description of the adult population of patients with CHUP submitted to cochlear implantation, the evaluation of the impact of tinnitus on their quality of life before implantation and the evaluation of the subjective improvement of tinnitus after cochlear implantation.

Methods

This research retrospectively analysed the adult population of Centro Hospitalar Universitário de Santo António (CHUdSA) undergoing cochlear implantation surgeries between January and September 2022. *Sclinico* and SECTRA were used to elaborate the database of all 35 patients. The descriptive statistics of the sample include the demographic and clinical information of the patients. The Ethics Committee of CHUdSA/ICBAS, the Administrative Board of CHUdSA, and the Department for Teaching, Education and Research (DEFI) approved this study [N/ REF.ª 2022.240(187-DEFI/202-CE)]. Informed consent was obtained, and the ethical principles of the Helsinki Declaration were respected for all participants.

Eligible participants were adults (18 years and older) with i) bilateral severe or profound sensorineural hearing loss and ii) tinnitus perception of any degree. Patients without tinnitus before cochlear implantation surgery were excluded from this study. The selection of the ear for implantation was based on audiological, vestibular, and anatomical findings. Surgery was performed with the same surgical technique in all patients, the round window procedure, conducted by the same surgeon.

To evaluate the impact and perception of tinnitus in the individual's life, the Tinnitus Handicap Inventory (THI) was used. The Portuguese version of THI was validated by Oliveira et al. in 2011.[25] It is a 25-item questionnaire, with a three answer options - Yes, Sometimes and No - corresponding to a score of 4, 2 and 0, respectively. Higher scores represent a greater impact on the individual's life. It comprises three sections called the emotional (nine questions, with a value ranging from 0 to 36), functional (eleven questions, with a maximum value of 44), and catastrophic subcategories (five questions with a value ranging between 0 and 20), which allow us to see which aspect is most affected and what type of intervention should be used. [26] According to the THI score, McCombe et al. created a scale to determine the severity of tinnitus, that classifies it as slight (0-16), mild (18-36), moderate (38-56), severe (58-76) and catastrophic (78-100). [27]

After cochlear implantation, complete resolution of tinnitus was defined as a THI score of 0; partial resolution when there was an improvement of at least one degree in the severity of tinnitus and worsening of tinnitus when there was worsening of at least one degree.

All patients included in the study answered the Tinnitus Handicap Inventory (THI) during the preoperative visit and three months after the CI placement.

Statistical Analysis

Continuous variables were described with the mean and standard deviation (SD), and categorical variables with the absolute and relative frequencies. The association between variables was then analysed using the Paired Samples T-test, with a value of $p<0.05$ being considered statistically significant. Data were analysed using the SPSS software (version 26, IBM® SPSS® Statistics, NY, USA).

Results

The sample consisted of 35 individuals, of which 57.14% were female (n=20) and 42.86% were male (n=15), with a mean age of 52.1 (SD=13.2) years. All patients underwent unilateral CI, with the right ear being implanted in 54.29% (n=19) of cases, while the left ear was implanted in 45.71% (n=16). Table 1 shows the characteristics of the study population regarding age, sex, and laterality of the implanted ear.

Table 2 presents the total THI scores for each patient preoperatively and postoperatively. The mean total THI preoperative score was 40.2 ± 32.2 points. A comparison to the results three months after CI found a decrease in the mean final THI score, with values of 11.54±23.5. Concerning the subscales of THI, before the CI, it was verified that the functional subcategory obtained an average of 17.8 points (SD=14.5), while the emotional subcategory presents an average of 14.6 points (SD=12.2), and lastly, the catastrophic subscale obtained an average of 7.9 points (SD=6.7). A reduction in all subcategories, functional, emotional, and catastrophic occurred after the surgery (Table 3). There was a statistically significant difference between the total mean scores and each subcategory in the preoperative and postoperative periods ($p < 0.05$).

It should be noted that 16 out of 35 patients had a complete resolution of tinnitus (45.7%), scoring 0 in the THI, and the percentage of patients with complete and partial resolution was approximately 74% (n=26) (Table 4). Only one patient had a higher score in the postoperative period, with slight preoperative tinnitus and moderate tinnitus postoperatively. Eight patients did not experience any reduction in tinnitus following implantation, considering that five of them had already slight or mild preoperative tinnitus and three had severe or catastrophic tinnitus prior to surgery (Table 4).

The patients were classified according to the severity of their tinnitus: 28.6% had slight, 20% mild, 20% moderate, 17.1% severe, and 14.3% catastrophic tinnitus before CI placement. Postoperatively, the percentage of reduced tinnitus increased to 82.9% (n = 29) and catastrophic tinnitus decreased to 5.7% (n=2) (Table 5).

Discussion

Patients with profound and/or severe sensorineural hearing loss have frequently associated tinnitus, increasing their communication impairment and causing a significant decrease in their quality of life. Cochlear implantation is an effective method in auditory rehabilitation in adults with proven irreversible sensorineural hearing loss, when hearing aids are no longer beneficial, and its positive impact on the severity of tinnitus has been reported. [28, 29] This study aimed to describe the results of cochlear implantation in patients with severe to profound bilateral sensorineural hearing loss with complaints of tinnitus.

Regarding gender, the participation of individuals had a predominance of females (20 females to 15 males). This did not correspond to the expected higher prevalence of hearing loss in men, as described in the introduction. However, there has not yet been found a link between genre and better CI outcomes, which makes this a detail of lesser prominence.

In order to evaluate the impact of tinnitus on the quality of life and to verify the effectiveness of CI as a treatment, the THI was used, this scale being a reliable measure to assess the tinnitus severity. The mean total THI preoperative score was 40.2 ± 32.2 points. According to the tinnitus severity scale, this score is considered as moderate. More than half of the sample was classified as moderate, severe, or catastrophic severity. In addition to the impact of hypoacusis on the quality of life of these patients, it is critical not to undervalue tinnitus, as evidenced by the previously stated values.

The impact of CI on tinnitus is controversial, and highly variable results have been described in prior studies. [30] In this study, of the 35 patients who experienced bilateral tinnitus before surgery, 16 (45.7%) had complete resolution. These values are below those reported in the literature, particularly by *Pan et al.* and *Hsieh et al.*, who reported 61 and 62% complete resolution of tinnitus, respectively. [31] In 2017, *Ahmed et al.* documented total tinnitus suppression in 54% of patients, which is similar to the result observed in this study. [32] *Kim et al.* reported identical outcomes, with a resolution of tinnitus in 45.5% of patients. [33] Table 4 shows that almost two thirds (74.3%) of the 35 patients had an improvement in their tinnitus complaints after cochlear implantation (n= 16+10 =26). When compared to the nineteen studies reviewed by *Baguley and Atlas*, 67.9% of the 832 participants showed an improvement in tinnitus. [34]

In some studies, cochlear implantation has revealed an adverse effect on tinnitus, with the subjects experiencing a worsening of their tinnitus or even developing the symptom. [28,30] In this research, only one patient had a deterioration of tinnitus (2,85%), which is below what is reported

in previous studies, with a range of 4 to 26%. [34] Additionally, in contrast to what has been described in other studies, no patient developed newly induced tinnitus after cochlear implantation.

Despite a general improvement of the symptom, 54.3% of the patients remained with complaints of tinnitus after implantation. There are some factors that appear to influence the cochlear implantation success in suppressing tinnitus, such as the surgical approach, the duration, persistence, and severity of tinnitus preoperatively.

The surgical approach seems to influence the effect of CI on tinnitus. Patients operated through the round window have better results in complaints of tinnitus compared to patients who undergo cochleostomy. In the round-window procedure, the electrode is inserted into the opening of the round window. In cochleostomy, the electrodes' placement in the tympanic ramp of the cochlea is performed through a surgical opening made by a drill. The first technique is thought to be responsible for less damage to the cochlea. *Kloostra et al.* discovered a 75% resolution of tinnitus operated via round window vs 25% via cochleostomy. [28] In this study, the surgical approach was similar in all patients, through the round window procedure, so this variable was not relevant to the results obtained.

Tinnitus duration appears to be a key determinant in postoperative outcomes. It is believed that in tinnitus present for a longer period, the alterations in the central nervous system are more difficult to revert. [35] *Kloostra et al.* verified that patients with a longer duration of tinnitus were associated with the absence of improvement in the postoperative period, compared to those who showed improvement (32.2 years versus 5.2 years).[28] It should be noted that the non-evaluation of the tinnitus duration in this study is a limitation for the interpretation of the results.

Other than the duration of the tinnitus, its daily persistence is thought to be a factor affecting cochlear implantation outcomes. Patients with complete resolution of the tinnitus in the postoperative period are thought to have more fluctuating symptoms, for a shorter period during the day. While patients in whom the tinnitus remains in the postoperative period, it would be continuous. This could mean that treatment efficacy is higher in patients with fluctuating tinnitus, perhaps because changes in the central nervous system may be minor. [28]

Other variable that was not evaluated in this study was the correlation between the effectiveness of CI and the severity of tinnitus. Previous findings revealed that patients who experienced tinnitus cessation also had a higher preoperative THI score than participants who still had the symptom after surgery. This suggests that the severity of tinnitus before surgery increases

the likelihood of tinnitus cessation after cochlear implantation. [29,31,33] In this study, due to the small sample size, it was not possible to draw any conclusions.

In our study, patients with bilateral hearing loss were implanted unilaterally, and therefore, the persistence of tinnitus in some cases may correspond to the tinnitus of the non-implanted ear. A previous review of subjective variations in unilateral tinnitus in 27 implanted patients with normal hearing in the contralateral ear revealed that 96% improved. [36] It would be interesting to carry out a similar study to assess tinnitus in patients with unilateral deafness, a situation in which tinnitus resolution has a higher success rate.

Additionally, placebo effects and recall bias can occur in tinnitus treatment trials, with the patients recalling how they felt prior to the surgery and three months after it, and such effects could have partly influenced the results observed in the present study.

Conclusion

The conduct and findings of this study support what has been advocated: cochlear implantation, although being a therapeutic option in severe to profound sensorineural hearing loss, can also be an important tool to improve the impact of tinnitus in patients proposed for cochlear implant placement. Finally, it validates the following question: is cochlear implantation a treatment option in tinnitus suppression?

Despite the fact that other studies with identical methods have been published, the current study provides additional data to the literature with similar outcomes, including a decrease in tinnitus following CI. In the future, studies should consider a larger sample size and the evaluation of factors that potentially influence the cochlear implantation success in suppressing tinnitus. In addition, evidence on the long-term effectiveness of tinnitus suppression with CI will be beneficial to develop strategies for treatment and improve patient care.

Tables

Table I - Characteristics of the studied population.

Features	***n* = 35**
Age	52.1±13.2
Gender (Female: Male)	20:15 (57.14%: 42.86%)
Laterality (Right: Left)	19:16 (54.29%: 45.71%)

Table II – THI total results in the pre- and postoperative periods.

***n*= 35**	**THI pre**	**THI post**
1	6	2
2	8	0
3	10	0
4	100	2
5	92	86
6	100	82
7	20	18
8	2	46
9	74	8
10	36	24
11	34	0
12	12	12
13	6	0
14	78	0
15	70	6
16	8	0
17	32	0
18	68	0
19	54	0
20	6	0
21	10	10
22	80	4
23	44	0
24	38	10
25	8	0
26	72	58
27	54	2
28	68	0
29	10	0
30	78	4
31	6	0
32	72	8
33	6	0
34	38	10
35	32	12

Table III - THI subcategories result in the pre- and postoperative periods.

THI Subcategories	Preoperative (total±SD)	Postoperative (total±SD)	p value
Functional	17,8±14,5	6,4±12,3	p=0,01
Emotional	14,6±12,2	3,6±8,2	p=0,01
Catastrophic	7,9±6,7	3,2±5,2	p=0,001
Total	40,2 ± 32,2	11,54±23,5	p=0,01

Table IV - Differences in pre- and post-cochlear implantation in the severity of the tinnitus.

	n = 35	*%*
Total resolution	16	45,7
Partial resolution	10	28,6
Unchanged	8	22,8
Worsening of tinnitus	1	2,9

Table V - Severity scale results in the pre- and postoperative periods.

Severity	Preoperative (%/n)	Postoperative (%/n)
Slight	28,6/10	82,9/29
Mild	20/7	5,7/2
Moderate	20/7	2,85/1
Severe	17,1/6	2,85/1
Catastrophic	14,3/5	5,7/2

QUESTIONÁRIO DE AVALIAÇÃO DOS ZUMBIDOS

NOME:
IDADE:
DATA: PROCESSO:

Instruções: Este questionário pretende ajudar a identificar o grau de problemas que os zumbidos lhe possam causar. Assinale as suas respostas ao lado de cada questão. Não deixe nenhuma por responder.

		Sempre	Por vezes	Nunca
F-01	Tem dificuldades em concentrar-se por causa dos seus zumbidos?			
F-02	A intensidade dos zumbidos torna-lhe difícil ouvir as outras pessoas?			
E-03	Os seus zumbidos fazem com que fique irritado/a?			
F-04	Os zumbidos fazem com que fique confuso/a?			
C-05	Sente-se desesperado/a por causa dos seus zumbidos?			
E-06	Queixa-se muito dos seus zumbidos?			
F-07	Tem dificuldade em adormecer à noite por causa dos seus zumbidos?			
C-08	Sente que não pode escapar aos seus zumbidos?			
F-09	Os seus zumbidos perturbam o prazer que retira das atividades sociais (como jantar fora, ir ao cinema,...)?			
E-10	Sente-se frustrado/a por causa dos seus zumbidos?			
C-11	Acha que tem uma doença muito grave por causa dos seus zumbidos?			
F-12	Os seus zumbidos impedem-no/a de gozar a vida?			
F-13	Os zumbidos interferem com o trabalho e com as atividades domésticas?			
E-14	Acha que está muitas vezes irritável por causa dos seus zumbidos?			
F-15	Tem dificuldade em ler por causa dos seus zumbidos?			
E-16	Fica preocupado/a por causa dos seus zumbidos?			
E-17	Acha que há stress nas relações com familiares/amigos por causa dos seus zumbidos?			
F-18	É difícil deixar de pensar nos seus zumbidos e concentrar-se noutras coisas?			
C-19	Acha que não consegue controlar os seus zumbidos?			
F-20	Devido aos seus zumbidos sente-se muitas vezes cansado/a?			
E-21	Sente-se deprimido/a por causa dos seus zumbidos?			
E-22	Fica ansioso/a por causa dos seus zumbidos?			
C-23	Acha que já não consegue lidar com os seus zumbidos?			
F-24	Os seus zumbidos pioram quando está sob stress?			
E-25	Sente-se inseguro/a por causa dos seus zumbidos?			

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