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REMOTE CHECK: ASSESSMENT OF AUDITORY PERFORMANCE OF COCHLEAR IMPLANT USERS

Fayez Bahmad Jr[1] - fayezbjr@gmail.com,
Francisco Wallison Lucena da Silva[1] - fwlucenads@gmail.com ,
Fernanda Ferreira Caldas[1] - fernandaffc@gmail.com,
Carolina Cardoso[1] - costacardosoc@gmail.com
[1]University of Brasília

Introduction

Individual performance for good speech recognition and understanding with Cochlear Implant may be the result of factors such as age, shorter hearing deprivation time, greater residual hearing and use of a hearing aid before implantation may be favorable for a good result with CI (SKIDMORE ET. AL, 2020).

Auditory training also plays a positive role in achieving good performance after implantation through targeted auditory activities performed both in the clinic by a speech-language pathologist and in their own home (DORNHOFFER ET AL, 2024).

In addition to speech therapy, it is essential to periodically program the Cochlear Implant, which is a procedure performed through psychoacoustic measurement of the lowest level of perception of the auditory stimulus (level T) and the highest level of sound intensity tolerated comfortably (level C) by the individual, while the Evoked Compound Action Potential (ECAP) is objectively measured (MARTINS; GOFFI-GOMEZ, 2021).

Furthermore, remote monitoring of Cochlear Implant can also help in cases where the patient lives hours away from the clinical center or has difficulties due to their work routine (CULLINGTON et al, 2022).

Remote Check was developed by Australian CI company Cochlear® and is a tool that is part of the Nucleus Smart App. It consists of a set of tests designed to be performed by a CI user alone or by their parents/caregivers at home. The tool is made available by the speech-language pathologist who routinely follows patients (MARUTHURKKARA; CASE; ROTTIER, 2022).

Thus, the main goal of this study is to describe CI users profile and auditory performance through Remote Check based on datalogging and speech in noise situations.

Methods

A prospective cross-sectional observational study was carried out. It included 31 individuals, both sexes, over 15 years old, unilateral or bilateral users with over 6 months experience with CI. All individuals answered the Remote Check tasks through Nucleus Smart App in order to obtain data of usage and hearing performance.

Data were analyzed using JASP software (JASP Team, 2025) to obtain descriptive statistics to identify the sample profile, in addition to the analysis of normality of the distribution, investigated using the Shapiro-Wilk test (Miot, 2017), in which significant results indicate a significant deviation from normality ($p < 0.05$).

For inferential analyses, t-tests for independent samples were used, while for asymmetric data, Mann-Whitney tests were used.

Results

Thirty-one subjects participated, 11 with bilateral implants (35.48%) and 20 with unilateral implants (64.52%). Among patients with unilateral implants, 11 had implants on the left side (55.00%) and 9 on the right side (45.00%). In addition, it was observed that most of the sample was female (61.29%), a pattern that is confirmed for people with bilateral implants (63.64%), unilateral (63.16%) and unilateral on the right side (77.78%), while for people with unilateral implants on the left side, there were more males (55.55%). Regarding hearing loss, it was observed that most types of loss were Post-lingual (64.52%), unilateral on the left side (63.64%) and right (88.89%), while for people with bilateral implants, most participants presented Pre-lingual hearing loss (54.55%). The results can be seen in Table 1.

Table 1: Descriptive statistics of categorical variables

Variables		Bilateral	Right	Left	Total
Sex					
	Female	7 (63,64)	7 (77,78)	5 (45,45)	19 (61,29)
	Male	4 (36,36)	2 (22,22)	6 (55,55)	12 (38,71)
Hearing Loss					
	Pre-lingual	6 (54,55)	1 (11,11)	4 (36,36)	11 (35,48)
	Post-lingual	5 (45,45)	8 (88,89)	7 (63,64)	20 (64,52)

Subsequently, descriptive statistics of numerical variables were investigated, which can be seen in Table 2. Results indicated significant asymmetry in the distribution of the variables Pure tone (PT) 1k Right ear (RE) (bilateral and unilateral), PT 2k RE (unilateral), PT 3k RE (unilateral), PT 4k RE (bilateral), PT 6k RE (unilateral and bilateral), PT 500 LE (unilateral), PT 1k LE (unilateral and bilateral), PT 4k LE (unilateral) and PT 6k LE (unilateral and bilateral).

Table 2. Profile of numerical variables

		M	DP	Q1	Q2	Q3	Min	Max	*p*
Datalogging (RE)	Bi	9,350	5,064	6,275	10,550	13,475	1,200	14,700	0,153
	Uni	11,717	3,712	10,200	11,350	14,225	6,100	16,500	0,908
Datalogging (LE)	Bi	10,310	4,462	8,175	11,400	13,900	1,200	15,000	0,246
	Uni	9,667	4,834	6,000	10,900	12,300	0,300	15,000	0,355
Speech in Noise (RE)	Bi	2,280	1,306	1,300	2,450	3,175	0,400	4,400	0,794
	Uni	2,729	0,881	2,200	2,600	2,900	1,800	4,500	0,177
Speech in Noise (LE)	Bi	2,630	1,222	1,875	2,850	3,300	0,500	4,600	0,912
	Uni	2,862	1,612	1,500	2,750	4,225	0,900	5,000	0,347
PT 250 RE	Bi	19,033	6,046	14,915	17,665	21,085	12,830	33,500	0,058
	Uni	21,667	5,125	20,582	20,830	21,085	15,500	31,170	0,061
PT 500 RE	Bi	18,634	5,698	16,253	18,335	18,747	11,170	30,500	0,206
	Uni	18,986	5,357	16,670	18,170	20,165	11,380	28,830	0,552
PT 1K RE	Bi	17,100	5,286	14,252	15,500	17,497	11,500	27,170	**0,029**
	Uni	16,169	4,281	14,418	14,830	15,830	12,860	26,500	**< ,001**
PT 2K RE	Bi	18,422	5,578	14,170	18,000	21,665	10,330	26,210	0,184
	Uni	19,061	6,161	14,335	17,500	21,500	13,500	33,000	**0,045**
PT 3K RE	Bi	18,759	4,287	15,500	17,500	19,500	14,500	26,830	0,125
	Uni	17,519	3,885	15,252	17,015	18,207	13,500	27,500	**0,008**
PT 4K RE	Bi	17,641	6,705	15,170	16,170	16,830	12,100	34,500	**0,001**
	Uni	15,500	4,295	13,830	15,500	16,500	10,500	25,500	0,052
PT 6K RE	Bi	17,278	6,250	14,500	15,500	17,170	12,500	32,830	**0,002**
	Uni	17,334	6,232	14,418	15,500	16,498	12,500	32,170	**0,001**
PT 250 LE	Bi	18,860	2,741	16,652	19,830	21,332	14,500	21,500	0,065
	Uni	20,537	1,859	20,500	21,170	21,500	17,500	22,830	0,067
PT 500 LE	Bi	17,733	2,304	16,165	18,500	18,500	13,500	21,500	0,709
	Uni	17,467	2,394	16,250	18,500	18,747	12,170	19,500	**0,008**
PT 1K LE	Bi	15,982	2,518	14,500	15,500	16,170	13,500	22,170	**0,008**
	Uni	16,500	2,824	15,418	15,665	16,500	13,830	23,170	**0,002**
PT 2K LE	Bi	14,034	1,502	14,170	14,500	14,500	11,500	15,500	0,141
	Uni	14,787	2,698	13,335	14,500	16,000	11,170	19,170	0,864
PT 3K LE	Bi	15,634	1,192	15,500	15,500	15,500	14,170	17,500	0,238
	Uni	15,786	3,187	14,000	15,500	16,665	12,170	21,500	0,365
PT 4K LE	Bi	15,432	1,571	15,500	15,500	16,500	12,830	16,830	0,200
	Uni	16,394	7,330	11,500	15,500	16,500	11,170	32,090	**0,006**
PT 6K LE	Bi	14,434	1,479	13,170	15,500	15,500	12,500	15,500	**0,028**
	Uni	19,429	13,517	13,835	14,830	15,335	12,830	50,000	**< ,001**

Note: Uni: Unilateral; Bi: Bilateral; RE: Right ear; LE: Left Ear; PT: Pure tone; DP = Standard Deviation; Q1-Q3: Quartiles; Min: Minimum value; Max: Maximum value; p: Significance level of the Shapiro-Wilk test.

Discussion

The number of Cochlear Implant users is increasing all over the world. Recent studies have focused on characterizing the profile of CI users and their auditory performance.

In our study, our patients had an average usage time of 9,35 hours for CI in the right ear and 10,31 hours for CI in the left ear for those who are bilateral users. Unilateral users had 11,71 usage time for the right ear and 9,66 for the left ear. Busch et al. (2017) analyzed data logging information of 1501 patients and found that their average usage of CI is 10,7 hours, which is similar to our findings, showing that it is recommended daily CI processor user for at least 12 hours per day ir order to get better results.

For aided-threshold test (ATT), it was possible to measure Pure Tone Audiometry (PTA) through Remote Check. The range for all frequencies went from 1 dB to 50 dB, showing differents thresholds according to each patient. Even though, PTA through RC can be reliable, according the study of Sorrentino et al. (2024), it is important to compare the stimuli between acoustic and electric situations, since the microphone can’t be tested via Remote Check.

Conclusion

The study demonstrated that Remote Check is a valid instrument for characterizing the profile of Cochlear Implant users, as well as monitoring usage time, speech performance in noise and access to sound through hearing thresholds.

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