SPEECH UNDERSTANDING IN POST-LINGUAL ADULTS WITH COCHLEAR IMPLANTS

C. MORERA¹, M. SAINZ², L. CAVALLE¹, A. DE LA TORRE²,
¹HOSPITAL UNIVERSITARIO LA FE. VALENCIA. ²HOSPITAL UNIVERSITARIO SAN CECILIO. GRANADA
COLABORADORES: I. ANDERSON, P. D’HAESE. MED-EL, INNSBRUCK, AUSTRIA.

ABSTRACT

It is well recognised that multi-channel cochlear implants are highly effective in gaining or regaining auditory perceptual skills of severe to profound hearing-impaired people. Research shows that adults rapidly improve in speech understanding after cochlear implantation. This study reports on speech understanding from two Spanish Clinics. 32 post-lingually deafened adults were fitted with either a MED-EL COMBI 40 or COMBI 40+ cochlear implant at the Hospital Universitario San Cecilio, at the Granada or Hospital Universitario La Fe, Valencia Clinic, Spain. Subjects were assessed at 1, 3, 6 and 12 months post-fitting on a number of speech perception tests. Results showed a highly significant improvement on all speech perception tests over the time. These ratify other studies in saying that cochlear implantation is a viable and successful treatment in post-lingually deafened adults.

KEY WORDS: Cochlear implant. MED-EL. Adults. Speech understanding. Post-lingually deafened.
INTRODUCTION

It is well known that cochlear implants are an effective method of rehabilitation in post-lingual deafness in adults. Many authors have published results that show that the perception of speech in children and adults with severe-profound deafness improves with a multi-canal cochlear implant\(^1\)\(^-\)\(^8\). Studies in different countries have obtained satisfactory results using tests of perception of speech adapted to the language of the country\(^1\)\(^\)\(^-\)\(^4\). Some studies have been carried out in Spanish, however no publication exists regarding the results of the MED-EL cochlear implant in the Spanish-speaking adults with post-lingual deafness\(^9\)\(^,\)\(^10\).

The MED-EL COMBI 40 and COMBI 40+ cochlear implant use the “Continuous Interleaved Sampling” (CIS) as a strategy of stimulation, which allows a high rate of stimulation. The COMBI 40 implant has 8 channels with a rate of stimulation of 12120 pulses per second (pps), and the COMBI 40+ implant has 12 channels and a rate of stimulation of 18180 pps. Both implants can be adapted to the corporal speech processors CIS PRO+ or to the retroauricular TEMPO+.

Studies carried out with both implants and processors have showed that perception of speech improves with time\(^7\)\(^,\)\(^12\). Other authors have observed that results in post-lingual patients improved rapidly within the first year after the implant and especially within the first six months\(^1\)\(^,\)\(^4\)\(^,\)\(^7\)\(^,\)\(^13\). The aim of our study is to show the evolution of the speech perception in the Spanish-speaking patients with post-lingual deafness. The results of two Spanish hospitals are presented.

The first hospital started its programme of cochlear implants in adults in 1991 and in children in 1994 and until now has performed 186 cochlear implants in both adults and children. The second hospital carried out its first cochlear implant in 1990 and has currently performed over 135 cochlear implants.

MATERIALS AND METHODS

We present the results of 32 post-lingual adults with MED-EL COMBI 40 and COMBI 40+ cochlear implants. 15 males and 17 females aged between 18 and 72 years inclusively, with a mean age of 45 years and 6 months. The length of deafness was 18 years and 5 months on average. The causes of their deafness are shown in Fig. 1.

All patients had logopedic rehabilitation, by means of two weekly sessions during a period of 6-12 months after the activation of the cochlear implant. In the rehabilitation process, the phases of detection, discrimination, recognition and comprehension of spoken language were followed up.

The results were evaluated throughout the first year following the implant, by means of tests of perception of speech that were carried out at one month, 3 months, 6 months and 12 months. The tests used were: the consonant test, the monosyllable test, the bisyllable test and the test of phrases in open context\(^14\). The test of phrases in noise, with a relation signal-noise of 10dB, was carried out on those patients that obtained more than 40% of comprehension in the test in silence. The tests were carried out in a soundproofed cabin, with a speaker at a metre distance from the patient. Randomized registers of viva voice at an intensity of 70 dB SPL were done. The tests were performed with only a

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Figure 1. Etiology of hypoacusis
cochlear implant and without the help of lip-reading. In addition, audiometries with warble tone and in free field with the cochlear implant were obtained.

For the statistical analysis of the results, an analysis of variance with a factor of variation in repeated samples was used to evaluate the progress over time.

**RESULTS**

The results of the consonant test (fig. 2) varied between 0% and 65% in the first month and up to 16% and 88% in the sixth month. The average in the interval of the twentieth month was 52.44% and the median 54%. The improvement over time is statistically more significant ($p = 0.000$). In figure 3 the results of the bisyllable test over time are shown. There are large individual variations in the results of this test at one month (range: 0% - 66%) and at 12 months (range: 14% - 90%). In the statistical study of the average values we saw an improvement that was statistically more significant ($p < 0.001$) during the study period, with an average of 28% at one month and 64% at 12 months. In the monosyllable test (fig. 4) an average of 27.5% success at one month (range: 0% - 60%) and 64.6% of success at 12 months (range: 45% - 86%) after the implant are achieved. This improvement is statistically very significant ($p < 0.006$) between the first month and the twentieth month post-implant. Similar results are obtained in the test of phrases in pen lists (fig. 5), with significant individual variations at one month (range: 0% - 93%) and at 12 months (range: 0% - 100%). The study of the average values at one month and 12 months post-implant show very significant statistical differences ($p = 0.000$). The test of phrases in noise (fig. 6) was carried out on the 10 patients that obtained more than 40% of success in the test of phrases in silence. These patients obtained an average comprehension of phrases in noise of 25% at one month (range: 5% - 63%) and 73.5% at one year (range: 50% - 85%) with a significant improvement between one month and one year post-implant. ($p < 0.012$).

A free field tonal audiometry with cochlear implant shows some average values similar to those of mild deafness, with a range that varies between mild and moderate.

**DISCUSSION**

The aim of this study is to document the improvement in various tests of speech perception over time in patients who carry a MED-EL COMBI 40 and COMBI 40+ cochlear implant. The results of the Spanish-speaking adults with post-lingual deafness show a highly significant improvement in tests of speech perception over time.
Like previous studies\textsuperscript{1,2,4,6,7,15} our results reflect a fast improvement within the first six months of using the cochlear implant, but it does not end after this period. It would be interesting to carry out a further follow up in order to study long-term hearing with a cochlear implant. There is discussion in the literature about whether there is an improvement between the first and the second year after the implant \textsuperscript{1} or even up to 30 months \textsuperscript{6}, or if the change is only up to the first year. However, our results indicate that rehabilitation during the first months of use of the cochlear implant is of great importance in our population, optimising the post-implant results.

The results vary between the different tests used, the best results being obtained in the test of phrases. As in other published studies\textsuperscript{1}, this can be due to the differences in the difficulty of the tests presented and this demonstrates the need for modifying the tests to evaluate the results of the adults implanted in Spanish language, creating a battery of methodical tests of greater or lesser difficulty. In this way, we avoid obtaining negative or positive impressions of the auditory capacity of the patient and create a realistic impression of the evolution of the patient implanted.

The comprehension of phrases in noise improves significantly over time (p < 0.012). Initial studies suggest that the improvement of speech comprehension in a noisy environment requires a greater experience with the cochlear implant, and it is achieved after a longer period of time. This has been demonstrated in a study where the comprehension of phrases in noise was studied during a period of three years post-implant. This study demonstrates the existence of a significant improvement in comprehension in noise in the implanted patients compared to a group of patients with profound deafness and conventional hearing aids. The benefit or advantage of the cochlear implant could be due to the fact that it can be adjusted for better comprehension of the words in a noisy environment. The parameters such as the sensitivity of the microphone, the compression of the signal, the volume and the individual adjustment of the processor CIS PRO+ and TEMPO+ could influence this ability.

Finally, the results in the free field audiometry (warble tone) with a cochlear implant show auditory thresholds with a range that varies between mild and moderate losses. This data coincides with previous papers\textsuperscript{1}. The results in the speech perception obtained in this study show that the implanted patients have a relative hearing loss when using a cochlear implant. This can be observed especially in the more difficult tests such as in the presence of background noise. The patients show a greater difficulty with comprehension in
noise, which is consistent with the experience that we have in patients with different grades of hearing loss.

CONCLUSIONS

The speech perception in post-lingual adults that have a cochlear implant in Spanish language was studied over a period of time. The results show a highly significant improvement in all tests of speech perception, in both silence and noise. The audiometric thresholds are established within a range of mild to moderate losses. Despite the heterogeneity of the studied group, the results suggest that patients with post-lingual deafness can improve in a significant way over time when having a cochlear implant, even in a noisy environment, with an adequate post-implant training and rehabilitation.

REFERENCES