

Rehabilitation of Adult CI-Users: Outcome of Speech Understanding Determined of Age and Duration of the Deafness

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Background

Cochlear implants (CI) have proven to be a highly effective treatment for severe hearing loss or deafness. Inpatient rehabilitation therapy is frequently discussed as a means to increase the speech perception abilities achieved by CI. However, thus far there exists no quantitative evaluation of the effect of these therapies. The aim of this study [1] was to measure patients' benefits from an inpatient rehabilitation program in dependency of duration of deafness, CI experience and age. Regrettably there exists no comparable study regarding benefits of an outpatient rehabilitation program in Germany.

Methods

For this purpose, we retrospectively analyzed data from 1355 CI users who had been treated in the MEDIAN Klinik am Kaiserberg, a rehabilitation clinic specializing in the treatment of hearing impairments, vertigo, tinnitus and cochlear implants, in Bad Nauheim, Germany, between 2007 and 2013. The therapy concept comprises admission and discharge hearing tests, fine tuning of speech processors, individual audio therapy, group therapy, individual computer-based training of hearing abilities, communication skills group training, technical counseling as well as a sports and relaxation program. The MEDIAN Klinik am Kaiserberg solely offers inpatient rehabilitation programs. The typical duration of inpatient rehabilitation is 3-5 weeks, with an average of 31.8 days. To measure the patients' benefit, standardized and qualitative speech perception tests conducted at two time points (admission to and discharge from inpatient hearing therapy) were compared. The test battery consisted of examination of vowel and consonant identification, the Freiburg numbers and monosyllabic test (65 and 80 dB sound pressure level, SPL, free-field sound level), the Hochmair-Schulz-Moser (HSM) sentence test in quiet and in noise (65 dB SPL speech level; 15 dB signal-to-noise ratio, SNR) and a speech tracking test with and without lip-reading. Particular attention was given to the following questions:

- Does inpatient rehabilitation significantly improve hearing abilities as well as speech perception?
- How do duration of deafness, CI experience and patient age affect the outcome of the treatment?
- Do older patients (>80 years) also profit?
- How does a long duration of deafness (>10 years) affect the outcome?
- Is it still possible to improve hearing abilities after a long CI experience (>24 months)?

Our sample consisted of 1355 postlingually deaf patients, including 313 bilaterally fitted with CI. We excluded patients with single sided

deafness (SSD), all prelingually deaf patients (regardless of whether they used sign language or speech), psychologically and/or cognitively impaired patients, non-native German speakers and patients with a known injury of the acoustic nerve. The youngest patient was 13, the oldest 95 years old. There was a substantial sample of patients (75) older than 80 (five of them even being older than 90), given the need for research regarding the adaptation of rehabilitation concepts to this target group [2,3]. Patients were categorized based on their age (each group comprising one decade; patients younger than 40 and older than 80 years each formed a separate group), duration of deafness of the ear fitted with CI (<5 years; 5-10 years; 10-20 years; 20-30 years; >30 years) and CI experience (ranging from several days to more than 22 years). 25 % of CI users had an experience of up to 3 months, 75% up to 13 months. All four CI manufacturers were represented. Most patients were fitted with CI on one ear and hearing-aid on the other (48.3%), some were fitted bilaterally with CI (37.5%) and only a minority was fitted exclusively with one CI (14.1%).

Results

The outcome of the inpatient rehabilitation program was defined as the difference in test scores (hearing abilities as well as speech perception) between admission and discharge. Hearing abilities: Patients displayed significantly better hearing abilities at discharge than at admission. For example, they were able to improve their identification of consonants by 22.3 % on average. Speech perception: Patients considerably improved their speech perception, which probably can be attributed to training as well as fine-tuning of the audio processors. Most importantly, they became less dependent on visual cues (lip-reading). Duration of deafness: In general, patients with a long duration of deafness (>10 years) displayed significantly poorer performance on all admission and discharge hearing tests. This is in accordance with the findings of Blamey et al. [4] who also observed better hearing in patients with a short duration of deafness. Nonetheless, they, too, were able to considerably improve their hearing abilities (discrimination of vowels and consonants). Patients with a long duration of deafness even showed a significantly greater improvement of speech perception than those who only recently had acquired deafness (<5 years). On the other hand, patients with a long duration of deafness remained more dependent on visual cues. On average, all patients displayed an improvement of 20 percentage points in test scores. There were no significant differences in rehabilitation efficacy between the groups, which means that patients with a long duration of deafness profited just as much as those only recently deafened. CI experience: In general and in line with expectations, patients with longer CI experience achieved better test scores. However, patients with short CI experience (<4 months) were able to considerably improve their hearing abilities, quite often even

significantly more so than experienced CI users. Also those with long CI experience (>60 months) could still improve their vowel and consonant identification scores (by 14.4 and 20% respectively) as well as their speech perception (by 17%). At the end of the stay, patients with short CI experience achieved test scores comparable to very experienced CI users. Also, the training had rendered especially the relatively unexperienced CI users less dependent on lip-reading.

All outcomes taken together, while samples differed in absolute test scores, all patients had the same benefit from the rehabilitation. The success of inpatient rehabilitation proved to be independent of age, duration of deafness and CI experience.

Conclusion

The present results support the efficacy of inpatient rehabilitation for CI recipients. The presented rehabilitative training program significantly improved hearing abilities and speech perception in all CI users, independent of their age, duration of deafness, or CI experience. Patients who had been wearing their CI for a long time still had a great benefit. The same applied to patients older than 80 who, although scoring lower on tests, were able to considerably improve their hearing abilities. CI implantation and high quality rehabilitation can prevent the elderly from social exclusion [5]. As hearing abilities and speech

perception are clue to professional success as well as a fulfilled private life, a rehabilitative training is able to not only promote the professional and social inclusion of CI users but also their quality of life.

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