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Benefits of Cochlear Implantation in Deafened Adults

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Key Words

Elderly · Hearing loss · Deafness · Hearing aid · Cochlear implant · Audiometry · Speech perception

Abstract

Aim: The objective was to retrospectively analyze the benefits of cochlear implantation in deafened elderly (>65 years old). **Method:** Data from 30 elderly patients with a unilateral cochlear implant were included and analyzed. Audiometric threshold and speech data in aided and unaided conditions were examined at pre- and postimplant intervals at 3, 6, and 12 months after activation of the sound processor and compared. **Results:** All patients demonstrated hearing benefits after implant and over time with results ranging from very good, good, to limited performance in a few cases. The mean postimplantation follow-up time was 2.74 years (minimum 1 year). Our study cohort demonstrates that cochlear implantation is a successful treatment method for improving speech perception in the auditory alone or auditory-visual mode for the majority of elderly patients. No correlations were observed between postimplant outcomes and age, or preimplant hearing thresholds and speech audiometry. **Conclusion:** Age is not a determining or limiting factor for post-CI outcome performance in deafened elderly patients. Counselling should consider the patient as a whole and include explanation of the risk for a minority of elderly patients who may demonstrate poor outcomes after implant, despite presenting as good candidates before implantation.

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Introduction

In cases of bilateral severe-to-profound hearing loss, even the most powerful hearing aids are no longer sufficient and the patient experiences difficulties associated with residual hearing. It manifests itself mainly as significant problems with speech understanding even in quiet environment and situations where only one person speaks. One of the reasons for this phenomenon is significantly narrowed dynamics of hearing that leads to distorted sound perception. Although hearing aid technology has evolved signifi-

cantly in recent years, unfortunately, in these patients, even the most modern hearing aids are not able to provide adequate benefits when it comes to speech understanding. In these patients, the method of choice is cochlear implantation.

In elderly patients with severe-to-profound bilateral sensorineural hearing loss, hearing aids usually provide little benefit and elderly patients isolate themselves from other people, leading to loneliness and sometimes depression. In activities such as going out for shopping or doctor's appointments, they become dependent on others. These factors negatively affect their quality of life [Dalton et al., 2003; Hallam et al., 2006; Knutson et al., 2006; Poissant et al., 2008; Scherer and Frisina, 1998]. Cochlear implants are more and more frequently being used in these patients [Eshragi et al., 2009; Lachowska et al., 2013; Leung et al., 2005; Francis et al., 2002; Migirov et al., 2010; Poissant et al., 2008; Sterkers et al., 2004; Yeagle et al., 2010].

Subjects and Methods

The data of 30 elderly patients (13 females, 17 males) with postlingual bilateral severe-to-profound hearing loss were analyzed. Mean patients' age at the time of implantation was 76 years old (SD = 6.0; min = 66 years; max = 87 years). All were implanted unilaterally (16 right, 14 left) with a multichannel cochlear implant. In all cases, the speech processors were activated 1 month after the surgery. For this study purpose, the data were analyzed for the following time intervals: before cochlear implantation and at 3, 6, and 12 months after activation of the speech processor. The mean follow-up time was 2.74 years (range 12 months – 7.34 years). Audiological evaluation before implantation included pure tone audiometry, speech audiometry, and free-field audiometry. Evaluation after implantation included free-field audiometry and speech perception tests (Ling's six-sound test, syllable discrimination, monosyllabic and multisyllabic word recognition in open set). Speech perception tests were conducted using live voice at the presentation level of about 65–70 dB SPL. Results from speech perception tests performed routinely assist in the sound processor mapping procedure (fitting) and ensure the best possible performance outcomes for the individual during the fitting sessions. In addition, patients were asked (via interview) about their everyday activities and the influence of cochlear implantation on their everyday lives, i.e. communication with a familiar and unfamiliar person, necessity of lipreading, using the phone, interactions with household members, relatives and friends, independence in everyday activities, and speech perception in noisy environments. The patients' responses to those issues were very helpful in evaluating benefits of cochlear implantation in everyday life.

Data were tested for normality, parametric and nonparametric criteria. The t test, repeated-measures ANOVA and correlation analysis were used for statistical analysis; p values < 0.05 were considered statistically significant. Statistics software STATISTICA (StatSoft Inc. 2011, version 10) was used.

Fig. 1. Free-field pure-tone audiometry mean results in elderly patients (n = 30) before and 3, 6, and 12 months after cochlear implantation. The results present improvement with time.

Fig. 2. Speech perception test mean results (Ling's six-sound test, syllable discrimination, monosyllabic and multisyllabic word recognition tests) before and 3, 6, and 12 months after cochlear implantation for all 30 analyzed patients. The results present improvement with time.

Results

All patients showed hearing improvement over time. Aided thresholds improved significantly ($p < 0.01$) from a mean of 62.3 dB HL with the preimplant hearing aid to a mean of 39.2 dB HL at 3 months after implantation and 36.3 dB HL at 12 months after implantation (fig. 1). Speech perception tests also presented highly significant improvements ($p < 0.01$) over time (fig. 2).

Looking at individual results, we observed a range of outcomes with some patients showing very good benefits, some showing good results and a few with very poor results using their CI. Using speech perception as a main criterion, we distinguished three sub-

groups of patients based on the level of benefit for speech perception with their CI (fig. 3, 4). To group the patients, we used the criteria presented in table 1.

The first subgroup of implanted elderly (6 patients, 20%) – showing very good benefits – also displayed very good perception of spoken language through the auditory-sensory modality with familiar and unfamiliar speakers without assistance from lipreading, and with a little help from lipreading in noisy environments. Most of them were able to have a conversation over the phone. After implantation, these elderly became more active in everyday life, often met with neighbors and friends, and were

Fig. 3. Mean results of free-field pure-tone audiometry in elderly patients before and after cochlear implantation with regard to the three groups of patients (according to implantation benefits): very good (6 patients), good (20 patients) and poor (4 patients) performers.

Table 1. Criteria used to classify patients into one of the three groups: very good, good, and poor results of cochlear implantation

	Very good results	Good results	Poor results
Speech perception benefits	good perception of spoken language through the auditory-sensory modality, no lipreading	perception of spoken language through the auditory-sensory modality, a little help from lipreading	only detection of sounds, no auditory-verbal communication, only lipreading
Free-field audiometry result	PTA $\leq$ 30 dB HL	30 dB HL < PTA < 50 dB HL	PTA $\geq$ 50 dB HL

open to meet new people. The mean implant-aided free-field audiometric threshold was <30 dB HL. The oldest patient was 87 years old.

The second subgroup of implanted elderly (20 patients, 67%) showing good benefits – also demonstrated good perception of spoken language through the auditory-sensory modality with a little help from lipreading. The cochlear implant provided better communication and enabled improved contact with other people leading to increased independence in everyday life. Their mean implant-aided free-field audiometric threshold was between 30 and 50 dB HL. The oldest patient was 87 years old.

The third subgroup of implanted elderly (4 patients, 13%) – showing poor benefits – represented the minority. These patients presented no auditory-verbal communication ability. The cochlear implant provided sensations of sounds which did not lead to improved communication skills. They were still dependent on others in their everyday life activities; their social life activities remained relatively reduced to minimum interactions. Those patients presented some symptoms of dementia that started to develop. Their mean implant-aided free-field audiometric threshold was >50 dB HL. The oldest patient was 81 years old.

No correlation was shown between age and postoperative performance for speech recognition tasks or aided thresholds ($p > 0.05$). There were no perisurgical complications and no major postsurgical complications.

Discussion

Our study demonstrates that age is not a determining and limiting factor for outcome performance with the cochlear implant in deafened elderly patients. The vast majority of our patients achieved good and very good benefits following implantation. This is consistent with subjective statements made by some such as 'they could not imagine living without a cochlear implant'. The aided audiological results and speech perception improved significantly after cochlear implantation. Adaptation to hearing through the cochlear implant took them relatively little time, the majority reported notable difference after 2–3 months of implant use with further progressive improvement over time. Our studies and the studies of other authors show that recently there has been a growing interest in cochlear implantation in deafened elderly [Eshragi et al., 2009; Francis et al., 2002; Lachowska et al., 2013; Leung et al., 2005;

Fig. 4. Speech perception test mean results of Ling's six-sound test, syllable discrimination, monosyllable and multisyllabic word recognition tests before and 3, 6, and 12 months after implantation for the three subgroups of patients (according to implantation benefits): very good (6 patients; **a**); good (20 patients; **b**), and poor (4 patients; **c**) performers.

Migirov et al., 2010; Poissant et al., 2008; Sterkers et al., 2004; Yeagle et al., 2010]. A review of the literature provides supporting evidence of improved hearing and speech perception ability in elderly cochlear implant recipients as shown in our study cohort.

In our study, the majority of our patients achieved very good and good results. Through examination of individual patient outcomes, patients could be assigned to three different subgroups based on their postoperative performance on speech perception measures in the auditory-alone modality and auditory-visual mode (lipreading assistance): very good, good and poor benefits. Even though the poor results group was in the minority, the potential for only limited benefits exists and should be discussed with patients and their families prior to surgery during counselling. A possible contributing factor in obtaining poor benefits might be a certain degree of dementia progressing with time and/or eventual neural degeneration aspects and/or inefficient central auditory processing. Consultation before implantation should therefore address the range of potential real-life benefits of implantation ranging from very good to very limited results. In any case, as shown in our study, age alone is not an excluding factor when selecting candidates for cochlear implantation.

Conclusion

Our study demonstrated that cochlear implants are an effective aid in speech perception and communication for the majority of older people with severe-to-profound bilateral sensorineural hearing loss. Without an implant, an older person may still be dependent on others in even simple activities of daily life. However, there is a minority group that presents poor results, even if they were good candidates before implantation. In the future, we plan to investigate the postimplant speech perception results from extended numbers of elderly patients in each subgroup using the same evaluation protocol, and to determine evidence of correlations between outcomes and patient-specific characteristics, including preimplant hearing threshold levels. Future research involving larger implanted elderly populations is needed to better understand the differences in outcomes resulting from cochlear implant treatment in this group and, in turn, support counselling and patient management.

Disclosure Statement

The authors state that there is no conflict of interest including any financial interest or financial support to be disclosed.

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