Assessment of benefit after bilateral cochlear implantation in children

A. Obrycka, H. Skarżyński, A. Lorens, A. Piotrowska, M. Zgoda
International Center of Hearing and Speech of the Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland

Corresponding author: Anita Obrycka ; email: a.obrycka@ifps.org.pl

INTRODUCTION

Numerous studies have shown that after bilateral cochlear implantation, a patient receives additional channels of information, which makes sound localization possible and improves speech understanding in noisy conditions (Laszig et al. 2004, Litovsky et al. 2004, Müller et al. 2002). The binaural benefit results from three binaural effects, the head shadow effect, the squelch effect, and binaural summation effects. It is confirmed that bilateral cochlear implant users can benefit from all of these (Schleich et al. 2004). Most of the studies on bilateral cochlear implantation have concerned adult patients, who showed significant improvement in speech perception in noise compared to unilateral implanted subjects. The above mentioned benefit makes communication in everyday situations easier and, in consequence, leads to improvement of quality of life.

In case of young bilaterally implanted children, the auditory system is more plastic than that of adults. Stimulation of both auditory pathways allows activation of both sides of the brain. Potentially the left and right auditory cortices can develop in a similar way to normally hearing children. Presumably very young children can benefit from two implants more than adults. The aim of this work is to assess the benefit after bilateral cochlear implantation in children.

MATERIAL

From the group of bilaterally implanted patients in the Institute of Physiology and Pathology of Hearing, 10 children with the same cochlear implant system in both ears were chosen. Age at first implantation ranged from 2,5 to 7,5 years, age at second implantation - from 3,5 to 8 years. Age at examination ranged from 5 to 9 years. The children have been using both speech processors for no less than one year. All children from the group were implanted in a sequential procedure; the time interval between operations ranged from 5 to 17 months; in all cases the first implanted ear was the right ear.

METHOD

To assess the benefit, the Polish version of the Adaptive Auditory Speech Test (AAST) was used. The AASR was designed especially for children 3-4 years of age and older. It was elaborated in the German language by Professor Frans Coninx (iFAP, Sölingen, Germany) and adapted to Polish as a part of the European Grant “Hearing Treat”. The AAST test has been validated in Polish in a group of 84 normally hearing children.

AAST is an adaptive test procedure. The test consists of 6 words. The child chooses its answer from six pictures. If the child’s answer is correct, the level of the signal decreases by 5 dB, whereas in case of an incorrect answer, it increases by 10 dB. This up-down method adjusts the presented stimuli to the Speech Recognition Threshold (SRT).

All children from the group were examined by the Adaptive Auditory Speech Test. The test was performed in quiet and in noise in monaural and binaural conditions. All conditions were tested during one visit at the Institute. The words were presented in free field in front of the patient.

RESULTS

Figure 1 presents average speech recognition thresholds in quiet in all three conditions: right ear, left ear, and both ears. Figure 2 shows the average speech recognition thresholds in noise. The difference between right and left ear is not statistically significant, either in quiet or in noise. The difference between one implant and two implants is statistically significant for the right ear as well as for left ear when compared to both ears, with $p < 0,05$ in quiet and with $p < 0,01$ in noise. Figure 3 shows the results in quiet plotted on AAST Polish norm data. The results in bilateral listening conditions are closer to the norm for normal hearing Polish children. In this evaluation, the results foractual, rather than hearing age were compared. Future plans include estimation of hearing age calculated as duration of cochlear implant use, and a comparison of the results with normative data in quiet as well as in noise in a larger group of bilaterally implanted children.

CONCLUSION

Significant speech discrimination improvement in bilateral conditions compared to unilateral conditions was observed, especially in noise. All 10 children from the group regularly use both speech processors all day.

REFERENCES

Laszig R et al. (2004) Benefits of bilateral electrical stimulation with the Nucleus cochlear implant in adults: 6-month postoperative results. Otology and Neurotology 25: 958-968.

Litovsky R. Y, Parkinson A, Arcaroli J, Peters R, Lake J, Johnstone P, Gonqiang Y (2004) Bilateral cochlear implants in adults and children. Arch Otolaryngol Head Neck Surg 130: 648-655.

Müller J, Schön F, Helms J (2002) Speech understanding in quiet and in noise in bilateral users of the Med-el Combi 40/40+ cochlear implant system. Ear and Hearing 23: 198-206.

Schleich P, Nopp P, D'Haese P (2004) Head shadow, squelch, and summation effects in bilateral users of the Med-el Combi 40/40+ cochlear implant. Ear and Hearing 25: 197-204

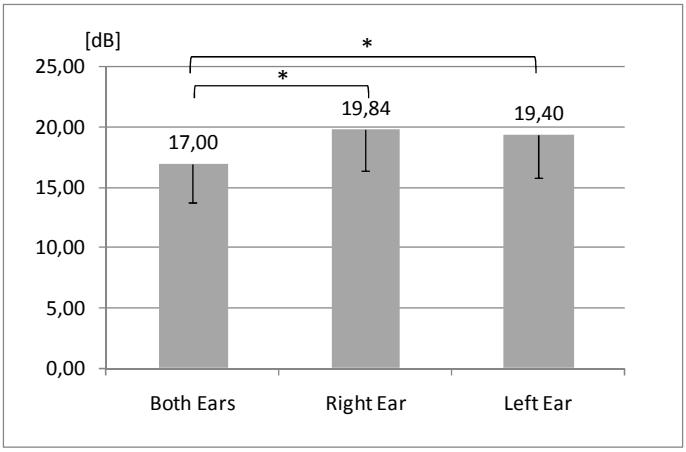

Figure 1. Average speech recognition threshold in quiet, $p < 0,05$.

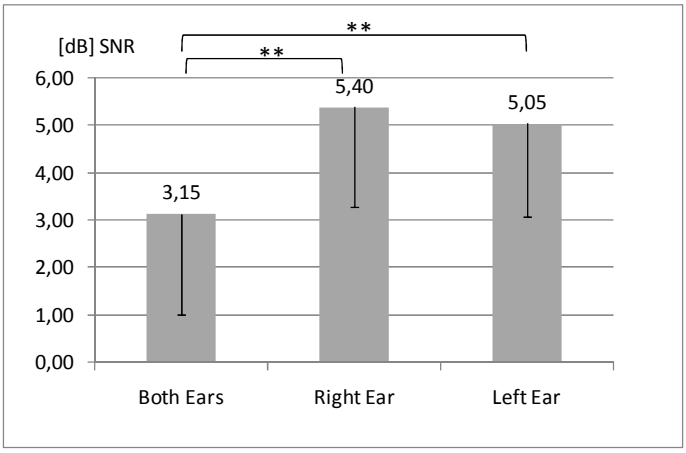

Figure 2. Average speech recognition threshold in noise, $p < 0,01$.

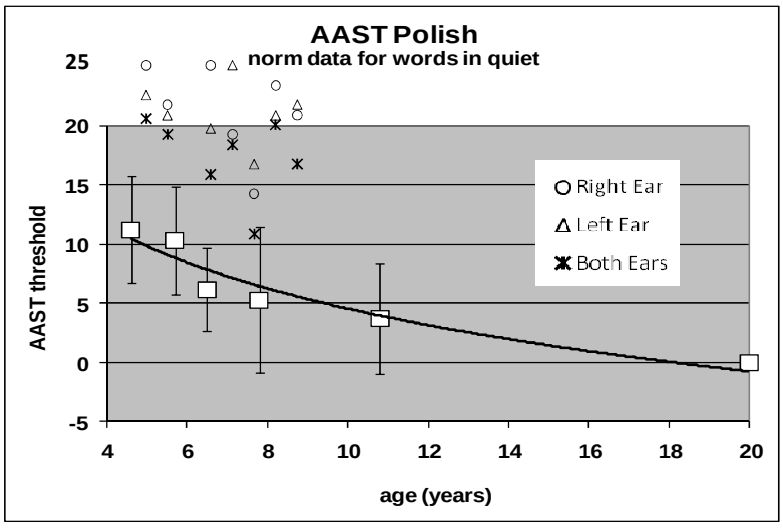

Figure 3. Results in quiet of tested group plotted on AAST Polish norm data.