

## **Abstract EFAS/DGA 2007**

### **Children with Cochlear Implants: Bilateral Implantation**

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**Introduction:** Bilateral cochlear implantation (CIBIL) in post-lingual adults has proven to effectively resolve the head shadow problem, increase the ease of hearing and improve sound localisation and speech understanding, especially in noise. Literature data on paediatric patients is however scarce and the question arises concerning the ability for processing of the binaural information by congenitally and peri-lingually deaf children. Recent reports [1,2] show a possibility for existence of a critical period for CIBIL in children.

**Objectives:** 1.) To document the time course of development of the auditory and language skills of children bilaterally implanted at our clinic. 2.) To evaluate the influence of the age at implantation and the time interval between the implantations on the magnitude of improvement in auditory performance. 3.) To study the binaural cues that are effectively conveyed by the current cochlear implants (CI's).

**Material and Methods:** At our department 53 patients (including 37 children) have received bilateral CI's since 1997. 10 children have been chosen for this longitudinal study and followed for at least 2 years. All children have been implanted non-simultaneously with the Nucleus-Nucleus or the Laura-Nucleus CI combinations. Children included in the study were implanted at different ages (ranging from 15 to 129 months for the first implant, and from 51 to 157 months for the 2nd implant) and with different intervals between the first and the second implantations (range: from 28 to 106 months). At pre-defined time intervals extensive audiological evaluation was performed. The test battery comprised the speech understanding tests (CVC monosyllabic words, NVA-list in quiet and at +10dB S/N speech noise), localization tests, binaural summation tests, detection of binaural beats and binaural masking level difference for tones.

**Results:** 1.) The maximum speech discrimination with the first implant remained stable after implantation of the 2nd CI. 2.) The average maximal speech understanding results with the 2nd implant only, obtained at 3 months post-operatively, was 57% (monosyllabic CVC open-set identification task in quiet). 3.) The 2nd CI achieved performance at a level comparable to the first one after approximately 18 months. 4.) During the observation period there was continuous improvement of the speech understanding results measured in the CIBIL condition owing to the improvement of the results with the second CI. A ceiling effect is expected to occur. 5.) Multiple regression analysis showed that with only 2 independent parameters - the age at the first CI and the age at the second CI – we were able to predict 72% of the variability of the results after bilateral implantation. 6.) Additional benefit in speech discrimination evaluated in the second year after bilateral (2nd) implantation (measured as the improvement in the maximal phonemic score with both implants relative to the best mono-aural condition) disappeared in children who received the 2nd implant after the age of 10 to 12 years. 7.) The only binaural cues that are effectively used by CIBIL children are the intensity cues.

**Conclusions:** 1.) Contrary to what had been reported before, the results of speech understanding obtained with the 2nd CI do not differ significantly from the results obtained with the first one. The time needed for the 2nd CI to approach the results of the first one is approximately 18 months.

2.) The average maximal speech understanding results at 3 month post-operatively obtained



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in the mono-aural condition with the 2nd CI only were much better than the matched results obtained with the first CI. This indicates that the first CI primes the central auditory system in such a way that the subsequent input from the 2nd CI is integrated in a faster and a more efficient way.

3.) In our group there seems to exist a critical period for obtaining additional benefits in speech understanding with bilateral implantations as compared to unilateral implantations. Children implanted with the 2nd CI after the age of 10 to 12 years tend to show no additional benefits in speech understanding. Therefore bilateral cochlear implantation should be performed at the earliest possible age and with the shortest possible time interval.

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