Babbling in early implanted CI children

Karen Schauwers a,b, Steven Gillis a,* , Paul J Govaerts b

a CNTS, Department of Linguistics, University of Antwerp, Belgium
b The Eargroup, Antwerp, Belgium

Abstract. The aim of this study was to investigate the onset of prelexical babbling (production of reduplicated CV syllables) of 10 deaf children who received a Nucleus-24 multichannel cochlear implant (CI) between 5 and 20 months of age. They were followed longitudinally by means of monthly video recordings consisting of spontaneous parent-child interactions. The results showed that the age at onset of babbling of the CI children implanted in the second half of their first year of life, was within the normal range as established for normally hearing children. Children needed 1-4 months of exposure to sound in order to start babbling. In conclusion, early cochlear implantation appeared to be beneficial as measured by children’s prelinguistic sound production. The earlier the implant was given, the smaller the delay was in comparison with normally hearing children with regard to the onset of prelexical babbling.

Keywords: Babbling, Children, Paediatric cochlear implant.

1. Introduction

When and how well do CI children learn to speak? This is an important question: as an outcome measure, productive language development is an index for the beneficial effect of CI. Numerous reports in the literature show that children implanted after age four have a language acquisition delay that apparently can never be bridged [1,2]. But the question remains unanswered if that is also the case for two-year-olds or even children implanted in their first year of life?

Cochlear implantation in the first year of life necessitates the assessment of speech production at a stage when a child does not yet produce meaningful words, viz. the prelexical period. In normally hearing children prelexical development follows a regular sequence of stages from birth to the emergence of words. The babbling stage is considered to be a major landmark in prelexical vocal development. Babbling is critical because it represents the production of adult-like CV syllables, the building blocks of words [3]. Normally hearing children attain the babbling stage between 6 and 10 months of age [4-7].

Do young hearing-impaired infants start babbling at the same age as normally hearing children? Profoundly hearing-impaired children start babbling much later than normally
hearing children. Most profoundly hearing-impaired children do not reach the babbling stage before 18 months of age [3, 8]. This suggests that auditory perception and feedback at least partly determine the onset of this prelexical milestone.

The aim of this paper is to report on the onset of babbling as a major landmark in productive speech development in a group of deaf children who received a CI in their first or second year of life as compared to the babbling stage attainment in a group of normally hearing children.

2. Subjects and methods

The methodology has been described in detail elsewhere [9]. Briefly, ten congenitally deaf children of hearing parents were selected. The children had an unaided pure-tone average (PTA) of more than 90 dBHL hearing loss in the best ear, which was detected in a neonatal screening test. Fitted with bilateral hearing aids within 1 to 4 months after detection of the hearing loss, the thresholds stayed below 60 dBHL. Only one child reached a PTA of 45 dBHL with his hearing aids. Five children received a multichannel Nucleus-24 cochlear implant (Cochlear Corp., Sydney, Australia) in their first year of life (5 – 10 months), and the other five in their second year of life (13 – 20 months). The PTA’s with CI fell between 32 and 47 dBHL.

A control group of 10 normally hearing children of hearing parents was followed from chronological age 6 months onwards.

In order to monitor these children’s prelexical development, we relied on monthly video-recordings. Each of these lasted approximately 80 minutes, and were made starting from the first month after activation of the implant. Selected video-segments of 20 minutes were transcribed in a very detailed manner. The prelexical utterances were coded for phonation and articulation according to the sensori-motor description model for early infant vocalizations developed by Koopmans-van Beinum and Van der Stelt [4].

Babbling was defined as the occurrence of multiple articulatory movements in one breath unit combined with continuous or interrupted phonation [4]. The onset of babbling was defined as 1) the first appearance of at least two babbled utterances in one observation session, and 2) the occurrence of babbled utterances in three consecutive sessions. For the CI children, the onset of babbling was computed in two ways; in terms of their chronological age (in months) as well as in terms of the number of months after activation of the implant.

3. Results

Figure 1A shows the chronological age (in months) at which the CI children started to babble relative to their chronological age (in months) at activation of the cochlear implant. The expected age at onset of babbling is 30.8 weeks (95% confidence interval, 18 – 43 weeks) [4]. The 10 normally hearing children in this study fell within this range, viz. they started babbling between the ages of 6 and 8 months. Similarly, the two earliest implanted CI children fell within the normal range, viz. their onset of babbling appeared at 8 and 10 months of age. Another two early implanted children started babbling at 11 months of age. The linear correlation coefficient R² was .92 (p < .05).
The onset of babbling relative to the number of months after the activation of the implant, as displayed in Figure 1B, revealed no statistically significant linear correlation ($R^2 = .30, p > .05$). Thus, the delay between activation of the CI and the onset of babbling was constant with a median value of 1 month and a mean value of 1.6 months (standard deviation of 1.3 months). For further details we refer to Schauwers et al. [9].

4. Discussion

In this study we analyzed young CI children’s sound production. We especially focused on their production of prelexical vocalizations and in particular on babbling. Based on these analyses, we can address the issue whether babbling is merely driven by motor maturation or whether audition plays a role in reaching the babbling milestone. If the former were the case, then we would expect all children to start babbling at a particular chronological age, irrespective of their auditory abilities. This was not the case: an analysis of the normally hearing and the CI children’s onset of babbling revealed that only the youngest CI infants started babbling at an age comparable to that of the normally hearing infants. From the perspective of age at implantation, our analyses revealed that the CI children did not need the 6 to 10 months that normally hearing needed to attain the babbling milestones. In fact, the CI children needed only up to four months of exposure to sound to start babbling. Age at implantation is not a critical factor in this respect: the children implanted around the age of six months as well as those implanted in their second year of life needed approximately the same amount of time to start babbling. In this respect, we can assume that the CI children were physiologically ready to babble at an age of 7 months, but because of the lack of auditory exposure and feedback the actual onset of babbling was delayed. But as soon as auditory stimulation was given, the CI children started babbling almost immediately after activation of the implant. Thus maybe this “physiological readiness” was put on hold and by simply providing sufficient auditory input, the system could proceed to the stage of babbling. In other words, the onset of babbling appears to be triggered by the cochlear implant.
In conclusion, the present results indicate that, even in this age group (5-20 months), the earlier the implant was given, the smaller the delay was in onset of babbling in comparison with normally hearing children.

References


