

# An Evolution of Communication Modalities: Very Young Cochlear Implant Users who Transitioned from Sign to Speech During the First Years of Use

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**Abstract.** The communication modalities used, and the articulation and aural-only receptive vocabulary skills were investigated in 19 prelingually profoundly deaf infants who initially utilized Total Communication and who were implanted between the ages of 12 and 29m. Results revealed the children overwhelmingly tended to use *voice only* modality for an expressive task. Additionally articulation and receptive vocabulary skills approached those of normal hearing peers. Implications of these findings and suggestions for future studies are provided.

*Keywords:* communication mode; deaf, cochlear implants, infants

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## 1. Introduction

The decision to decrease the age of cochlear implantation (CI) eligibility to 12 months affects a host of topics, including the philosophy of communication parents and school systems utilize with their children. "Total Communication" (TC) is a philosophy utilized in educational settings and in the home employing themes that the children will use audition and vision as useful sources of information, and that any given child will make use of one or both sources (modalities) to fit individual needs and skills during a particular communication instance. TC uses flexibility and adaptability and allows for an evolution of communication modality used as skills develop.<sup>[1]</sup> Previous studies have found that older prelingually deaf children receiving CIs after the age of 3 educated within a TC philosophy continued to use both speech and sign in over 70% of their utterances.<sup>[2][3]</sup> The objective of this study is to characterize the change or consistency in communication mode used after cochlear implantation in a group of children who received CIs before the age of 27 months when the pre-implant communication philosophy was TC.

## 2. Methods

### 2.1 Participants

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Participants included 19 children with prelingual deafness who received cochlear implants. Mean age at surgery was 18.7 months  $\pm$  3.5 (mean  $\pm$  SD; range 12.8-27.0 m). All participants were followed for a minimum of 24m and a maximum of 60m.

## 2.2 Test Measures

A phoneme percent correct score was derived from a sentence repetition task. The modality used to produce each word was derived from a story retell task to yield the number of words produced by the *sign only*, *voice only*, and *voice and sign* modality. A standardized articulation test<sup>[4]</sup> was administered to yield a measure of articulation skills, and a receptive vocabulary measure was obtained using *voice only* modality.<sup>[5]</sup>

## 3. Results

### 3.1 Communication Mode

Table 1 presents data on the communication mode used during the story retell task. Fourteen of the 19 children were able to retell the stories. In this group, a striking pattern emerges. These children rarely produce their words in a *sign only* mode and instead utilized a *speech only* modality. Out of the total of 2096 words produced, none were produce in *sign only* modality. Conversely 1920 of the words were produced in *speech only* modality, while 76 words were produced in both *sign and speech* modality.

Table 1:

Number of Children at Each Post Operative Interval and the Mode of Communication they Used.

Interval	Sign Only	Speech Only	Sign and Speech
18 months	0/1	1/1	0/0
24 months	0/8	8/8	0/8
36 months	0/10	8/10	2/10
48 months	0/4	4/4	0/4
60 months	0/2	2/2	0/2

### 3.2 Speech Production

Figure 1A depicts individual growth over time for percent phonemes correct. Considerable amount of individual variability exists, yet a steep slope of growth for most children is seen. Figure 1B depicts the levels of phoneme production accuracy at each follow-up. By 36m post implantation, the average level of phoneme accuracy is 69.5 %  $\pm$  16.61 (mean  $\pm$  SD; range 47-98%). The number of participants fluctuates at each interval and is greatest at 36m, n=11. Figure 2A presents average scores achieved on articulation testing across time. The highest average standard score (ss) was 85 at both 12 and 18m post implantation. At 48m with just 4 data points, the average ss was 82.5. Children with normal hearing would be expected to achieve a ss of 100.

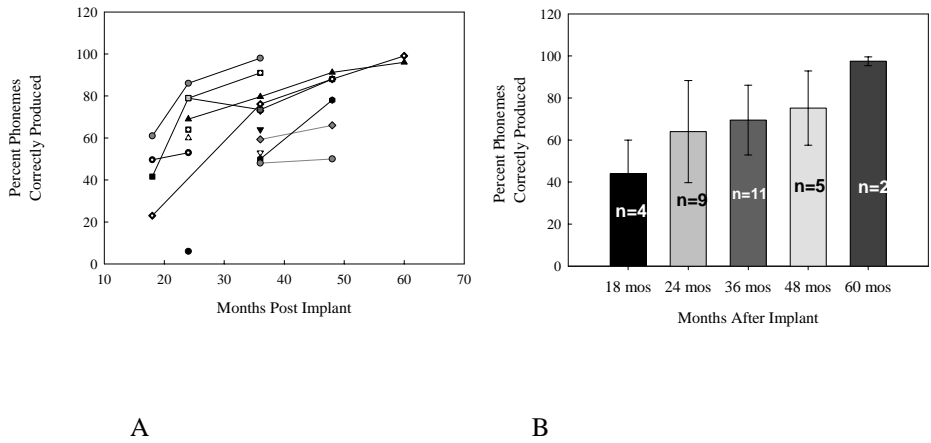


Fig 1. Individual growth over time for phonemes percent correct (A) and Group Means for each post-implant interval in percent phonemes correct (B)

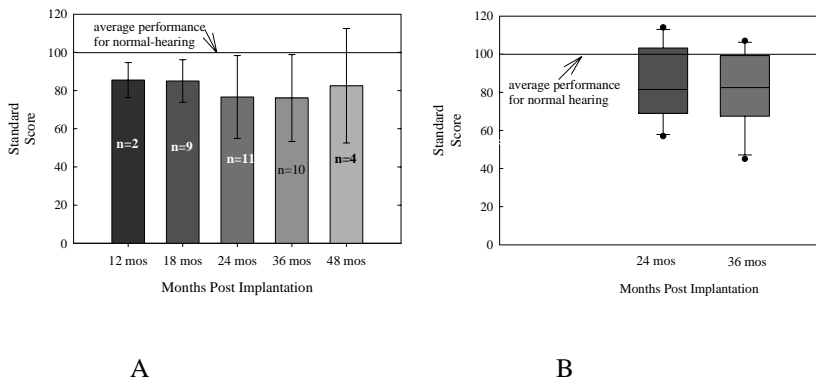


Fig 2. Standard scores for Vocabulary (A) and Receptive Vocabulary (B)

### 3.3 Receptive Vocabulary

Figure 2B depicts performance on a receptive *auditory-only* vocabulary test. Results indicate that at 24m post implantation, average ss was  $84.6 \pm sd = 18.62$  (mean  $\pm$  SD; range 66-114). At 36 months post implantation, average ss was  $81.3 \pm 17.52$  (mean  $\pm$  SD; range 42-102) A ss of 100 would be considered average for children with normal hearing.

## 4.0 Discussion

### 4.1 Communication Modality, Articulation and Vocabulary Skills

Profoundly deaf infants receiving a CI before 27m using aTC philosophy displayed a strong pattern of producing narratives using *voice only* modality. This could be attributed several things. First the children may have received inconsistent or non-fluent sign models, and began to quickly adopt a *voice only* communication mode, or parents and educational staff may have begun to implement a more auditory-oral approach to communicating with the children after they received a CI. Alternatively, results could reflect the natural evolution of the effect that increased auditory input has on speech production skills. This could be inferred from the findings that speech production skills gradually increase with CI experience. Children in this study were achieving articulation proficiencies consistent with much older CI participants with similar amounts of CI experience<sup>[6]</sup>, and their performance was within 1.5 SD of their normal hearing peers on standardized tests of articulation and receptive vocabulary.

#### 4.2 Implications for Future Research

Continued investigations are warranted, and this study highlights several issues. First it would be important to note how consistency of exposure to the modalities in question. In this clinical population it was informally noted that some parents became quite skilled at using Signed English, while others struggled to learn basic vocabulary. No formalized measure to evaluate parent skill was used, yet it would be helpful to know the range of parent sign proficiency levels in order to look for possible relationships between type of input and ultimate mode used. Identifying the mechanisms at work behind these outcomes is also important. Parents may find it easier to transition away from leaning sign language and implement a *voice only* modality. Alternatively sign language may be used as a “back-up” in times of communication breakdown. Finally, it is important to document what options the parents and children have with regard to educational programming.

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