

## Comparing language progress in cochlear implantation hearing impaired children before and after four years' age

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### Abstract

**Introduction:** A child with hearing loss is facing certain problems arising from deficits in spoken language abilities. Deficient language commonly leads to reading problems, limits academic performance. Many studies have demonstrated that children with severe-to-profound hearing loss understand and produce spoken language better when they have a cochlear implant at younger age, rather than hearing aids.

**Aim of the work:** To compare the outcomes of auditory and language rehabilitation in hearing-impaired children who have received cochlear implant before age of 4 years to those who have been implanted after age of 4 years.

**Patients and Methods:** Comparative study, include 30 hearing Impaired children underwent cochlear implantation. Ten children (Group I) underwent CI before age of 4 years, mean age ( $\pm$ SD) was 3.02 ( $\pm$ 0.91) and twenty children (Group II) were implanted after age of 4 years, mean age ( $\pm$ SD) was 4.58 ( $\pm$ 0.62). All implants used by the children in this study were programmed and mapped in Audiology unit, Sohag university hospitals. Both groups have received post-cochlear auditory and language rehabilitation in Phoniatics unit, Sohag university hospitals. Assessment was done for four language parameters (receptive language, expressive language, vocabulary size and word class) pre-therapy and after 3, 6 and 9 months.

**Results:** There is no significant differences between both groups on language development.

**Keywords:** Hearing impairment, Cochlear implantation.

### Introduction

A child with hearing loss is facing certain problems arising from deficits in spoken language abilities. Deficient language commonly leads to reading problems and limits academic performance. Many studies have demonstrated that children with severe-to-profound hearing loss understand and produce spoken language better when they have a cochlear implant at younger age, rather than hearing aids (Geers, 1997; Svirsky, et al., 2000).

A cochlear implant (CI) is a hearing device that is appropriate for children who have severe to profound SNHL and who gained little or no benefit from conventional hearing aids (Clark et al., 1997). Improved speech production, auditory language development and speech perception ability is the desired outcome for children using the cochlear implants (Cowan and Dowell, 1995). Cochlear implants have dramatically

changed the outcomes for patients with profound sensorineural hearing loss and allow hearing impaired children to be successfully re-integrated into the hearing world (Svirsky, et al., 2000).

The purpose of this study is to compare the outcomes of auditory and language rehabilitation in hearing-impaired children who have received cochlear implant before age of 4 years to those who have been implanted after age of 4 years.

### Patients and Methods:

This study is a comparative study conducted on a series of 30 hearing impaired children with severe to profound sensorineural hearing loss (SNHL), mean age was  $4.6 \pm 1.07$ . All were implanted with the MEDEL SONATA device and received post-implant rehabilitation in Phoniatics unit, Sohag university hospitals. Ten children (Group I) underwent CI before

age of 4 years, mean age ( $\pm$ SD) was 3.02 ( $\pm$ 0.91). The rest of children (Group II) were implanted after age of 4 years, mean age ( $\pm$ SD) was 4.58 ( $\pm$ 0.62). All implants used by the children in this study were programmed and mapped in Audiology unit, Sohag university hospitals. The exclusion criteria were implantation after age of 6 years, any degree of mental retardation and/or any major health condition other than hearing loss that could delay language, cognitive, or motor development. This study included hearing impaired children whose parents have normal hearing and speak only Arabic with good motivation to work with their children at home.

Assessment was done for four language parameters pre-therapy and after 3, 6 and 9 months.

- Receptive language: a measure of how well children comprehend the language that they hear by asking the child to respond to a verbal stimulus by pointing to the picture in question. number of correct answers are reported. Total score is 60.
- Expressive language: The examiner shows to the child and ask him/her

(by pointing and/or asking him/her directly) to give name to one picture in question. Correct responses are reported here to total score (60).

- Vocabulary size: the mean number of vocabs uttered by child.
- Word class that the child begins to utter. It provides a measure of early grammatical competency. It was assessed by six score system: Score 1: nouns, Score 2: nouns and few verbs, Score 3: nouns and many verbs, Score 4: nouns, verbs and questions, Score 5: nouns, verbs, questions and pronouns, Score 6: nouns, verbs, questions, pronouns, adjective and negation.

#### Statistics:

Data of each group were compared using unpaired T test (two-tailed) in parameteric data and Mann Whitney test in non-parameteric data. Statistical analysis was done by using a statistics software package (graph-pad prism 7 for Windows). The p value 0.05 was considered a cut point where below it, the test was considered significant. Above this value the test was considered non-significant.

## Results

The differences between group I (CI before age of 4yrs.) and group II (CI after age of 4yrs.) were insignificant. Table (1)

**Table (1):** Comparison between group I & II as regard language parameters:

		Mean $\pm$ SD		p
		Group I	Group II	
Receptive semantics	Pre-therapy	0.3 $\pm$ 0.3	1.05 $\pm$ 0.55	0.25
	3m	4.2 $\pm$ 1.7	8.95 $\pm$ 1.72	0.06
	6m	10.8 $\pm$ 3.99	+19.8 $\pm$ 3.1	0.09
	9m	19.3 $\pm$ 4.6	26.7 $\pm$ 3.37	0.21
Expressive semantics	Pre-therapy	0.3 $\pm$ 0.3	0.65 $\pm$ 0.51	0.56
	3m	1.6 $\pm$ 1.28	4.55 $\pm$ 1.8	0.19
	6m	4 $\pm$ 2.65	8.8 $\pm$ 2.7	0.22

		Mean ± SD		p
		Group I	Group I	
Vocabulary size	Pre-therapy	0.7 ± 0.52	1.95 ± 0.81	0.20
	3m	4.5 ± 2.92	11.4 ± 3.79	0.16
	6m	14.9 ± 9.6	22.85 ± 6.69	0.51
	9m	39.4 ± 23.79	48.4 ± 13.91	0.75
Word class	Pre-therapy	1 ± 0	1 ± 0	>0.99
	3m	1 ± 0	1.41 ± 0.19	0.54
	6m	1.5 ± 0.34	1.42 ± 0.16	>0.99
	9m	1.5 ± 0.31	2 ± 0.35	0.35

\* = Significant, \*\* = Highly significant

## Discussion

The present analyses demonstrate that cochlear implants have a significant beneficial effect on the development of language in severe to profoundly deaf children. The mean rate of language development in the deaf children after implantation exceeded the development rate expected from unimplanted deaf children. Although CI children not reach the level of normal hearing children. Ching et al., (2014) stated there was better language outcomes associated with cochlear implant. Sarant et al., (2014) was found that CI use predict faster rates of receptive and expressive language development than non CI use when controlling other factors. Robbins, (2003) stated that the average child who receives a CI in the first 2 years of life learns approximately 1 year of language in 1 years' time. While children implanted at 3 or 4 years show slower rate of language growth due to the significant delays that already exist in children's language at the time they receive their implants. This may be an explanation for insignificant differences between both groups as all of them were implanted a little bit late. Ten children implanted from 2-4 year and 20 children after age of 4. Children of this study had a language age not matching their chronological age.

Dettman, et al. (2007) conducted a retrospective review for 19 infants (mean age at implantation, 0.88 yr.;

range, 0.61–1.07, SD 0.15) and 87 toddlers (mean age at implantation, 1.60 yr.; range, 1.13–2.00, SD 0.24) who received CI. Post-implantation language assessments were reported. They concluded that cochlear implantation may be performed safely in very young children with excellent language outcomes. The rates of receptive and expressive language growth for children receiving implants before the age of 12 months were significantly greater than the rates achieved by children receiving implants between 12 and 24 months, and matched growth rates achieved by normally hearing peers.

## Conclusion and recommendation:

Children underwent CI show better language outcomes than hearing aid use. Our recommendation is to use CI in children with severe to profound SNHL at younger age of life (before 2 years old) for better language outcomes.

## References:

1. Ching, T. Y., Day, J., Van Buynder, P., Hou, S., Zhang, V., Seeto, M., Burns, L & Flynn, C. (2014). Language and speech perception of young children with bimodal fitting or bilateral cochlear implants. *Cochlear implants international*, 15(sup1), S43-S46.

2. Clark, G., Cowan, R. and Dowell, R. (1997). Cochlear implantation for infants and children. Singular Publishing Group, INC. San Diego, London.
3. Cowan, R. and Dowell, R. (1995). Speech perception in children using the advanced speak speech-processing strategy. In: Clark, G. and Cowan, R. (eds.). International cochlear implant, Speech Hearing Symposium 1994. Annals of Otology, Rhinology and Laryngology vol (104) 318-321.
4. Dettman, S. J., Pinder, D., Briggs, R. J., Dowell, R. C., & Leigh, J. R. (2007). Communication development in children who receive the cochlear implant younger than 12 months: risks versus benefits. Ear and hearing, 28(2), 11S-18S.
5. Geers, A. E. (1997). Comparing implants with hearing aids in profoundly deaf children. Otolaryngology–Head and Neck Surgery, 117, 150-154.
6. Robbins, A. (2003). Language development in children with cochlear implants. In: Cochlear Implant Research: Present and Future. Proceedings from the tenth annual NIH research symposium, SHHH convention, June 29, 2003, Atlanta, Georgia.
7. Sarant, J., Harris, D., Bennet, L., & Bant, S. (2014). Bilateral versus unilateral cochlear implants in children: a study of spoken language outcomes. Ear and hearing, 35(4), 396.
8. Svirsky, M. A., Robbins, A. M., Kirk, K. I., Pisoni, D. B., & Miyamoto, R. T. (2000). Language development in profoundly deaf children with cochlear implants. Psychological Science, 11, 153-158.