Research Paper

Volume : 4 | Issue : 1 | January 2015 • ISSN No 2277 - 8179

Medical Science

KEYWORDS :

Effect of Unilateral Versus Bilateral Cochlear Implantation on Language Development

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ABSTRACT

AIM & OBJECTIVE: The aim of the present study was to compare speech and language outcomes in children with unilateral and bilateral cochlear implant over a period of time.

Method: 10 children with unilateral cochlear implant and 5 children with bilateral cochlear implant participated in the study. All the children were implanted at Civil Hospital, Ahmedabad in the age range of 1 to 5 years. Longitudinal study was carried out. CAP, SIR and SECS scores were assessed at regular interval that is 6, 12, 18 and 24 months.

RESULTS: On the receptive language tests 5 children undergoing bilateral implantation performed significantly better than those 10 undergoing unilateral implantation. Children with bilateral simultaneous cochlear implantations performed better on the expressive language then children with bilateral sequential cochlear implantations.

CONCLUSION: The use of bilateral cochlear implants is associated with better spoken language learning compared with unilateral implantation.

Introduction:

Language is a key to participate in life. Delayed language development can have great impact on children's social life and education. Early learning through auditory stimulation is very important for speech development. An absence of or reduced auditory stimulation can cause delayed or inadequate speech development in many difficult-hearing children.[1] The application of hearing screening in new born and the increased use of bilateral cochlear implants have provided more and more children with severe to profound sensorineural deafness, access to bilateral auditory signals right throughout their initial months of life.

Now it's been an established fact that early unilateral implantation is beneficial for early language development in congenital or early acquired sensorineural deafness [2, 3]. We know the fact that despite of diseased bilaterality, if we treat it with unilateral use of Cochlear Implant that is against natural law. Although many children with CIs have been able to develop spoken language and other skills that would not have been possible with conventional hearing aids, it has been well-documented for many years through to the present time that many children with unilateral CIs show delays in the development of language [4], speech production [5], literacy [6], academic [7] and social skills [8]. Although a number of children with unilateral CIs have been able to achieve age-appropriate development in many of these areas [9], for a significant number of these children developmental delays have been maintained or increased through to adulthood [10]. For this reason, the efficacy of bilateral CIs is being investigated, and bilateral cochlear implantation is becoming the standard of care for children with severe to profound hearing loss in developed countries around the world [11].

For those who have delayed development of language [4], speech production [5], literacy [6], academic [7] and social skills [8] even with the use of unilateral cochlear implant, the benefits of bilateral cochlear implant can be suspected. Bilateral CIs offer additional benefits over a unilateral CI through the mechanisms of binaural redundancy (speech perception is improved with 2 ears, as the brain has 2 opportunities to process the signal), binaural summation (the signal when combined from 2 ears is slightly louder than from 1 ear), and the head-shadow effect (the head acts as a physical barrier to the sound, such that the signal will be softer at the ear that is farthest from the sound source). The benefits of bilateral CIs for speech perception in children have been evaluated in both noisy and quiet listening conditions. In noise, many studies have reported a significant improvement in children's abilities to perceive speech [12]. In quiet listening conditions, improved speech perception has also been reported [13]. Advantages of bilateral CIs for sound localization are not quite as clear, with some children reported to localize sound well [14], and others demonstrating more limited localization ability (i.e., left–right lateralization, rather than true localization [15]. Many other children, particularly older children, have shown no ability to localize sound. Further benefits have also been documented, with parents in some studies frequently reporting superior performance using bilateral CIs in everyday life, in situations such as group conversations, background noise,

and hearing at a distance [16]. There is also objective evidence that for some children with bilateral CIs, listening effort is reduced, suggesting that more attention can then be paid to the learning process. Despite the above-cited evidence of benefit for children from bilateral CIs, it is yet to be determined whether these perceptual benefits facilitate significantly better broader outcomes in children with bilateral CIs, and if so, to quantify the degree of benefit received by children based on factors such as age at second implant.

In prelingually deaf children, spoken language development and ease of communication are of paramount interest and that is the point for interest of using bilateral cochlear implants. The introduction of early bilateral cochlear implantation diminishes the likelihood of delayed language development in prelingually deaf children and thus contributes to an improved foundation for educational and social development.

AIM:

The main purpose of the current investigation was to analyze speech and language outcomes in children with unilateral and bilateral cochlear implant over a period of time. Further impact of age of implantation on language skills and rate of language development in unilateral and bilateral implant was also studied.

METHOD

Participants

15 participants were included in the study. Participants were divided in two group based on unilateral and bilateral cochlear implantation. Group 1, which included 10 children with unilateral implants and group 2, included 5 children with bilateral implants. Both groups were compared on the basis of prospective cross sectional study. Inclusion criteria for the study was bilateral profound congenital sensorineural hearing loss , with no other associated syndromes or complications and with the range of patient's age starting from 1 year to 5 years.

Test Materials

Test materials used were:

Scales of Early Communication Skills for Hearing-Impaired Children (SECS)

Speech intelligibility rating (SIR) (O'donoghue et al 1999)

Scales of Early Communication Skills for Hearing-Impaired Children (SECS)[17] was used to assesses speech and language development of children who participated in the study. In this information is gathered during structured lessons and in natural communication settings and used with children with hearing impairment. The instrument is divided into four scales: receptive language skills, expressive language skills, nonverbal receptive language skills and nonverbal expressive language skills. Further combined receptive language age (CRLA) and combined expressive language age (CELA) was calculated.

2. Speech intelligibility rating (SIR) (O'donoghue et al 1999): this is a rating scale ranging from 1 to 5 which is as follows:

5 : Connected speech intelligible to all listeners. Child understood everyday contexts.

4 : Connected speech is intelligible to a listener who has little experience of a deaf person's speech.

3 : Connected speech is intelligible to a listener who concentrates & lipreads.

2 : Connected speech is unintelligible. Intelligible speech is developing in single words when context & lip reading cues are available.

1 : Connected speech is unintelligible. Prerecognizable words in spoken language; primary mode of communication may be manual

Procedure

Data was collected using above mentioned test materials at regular interval of 3,6,9,12,18 and 24 months post implants at Civil Hospital, Ahmedabad.

Further data was subjected for analysis.

RESULTS

Scales of Early Communication Skills for Hearing-Impaired Children (SECS)

Findings of SECS revealed that in both groups there was a improvement in CRLS & CELS scores over a period of time. However the rate of improvement and overall scores at 24 month were higher for group 2 (children with bilateral cochlear implants) in comparison with group 1 (children with unilateral cochlear implants). These results are also showed in table 1, graph 1 and graph 2.

Table 1: CRLS and CELS at 3, 6, 9, 12, 18 & 24 months

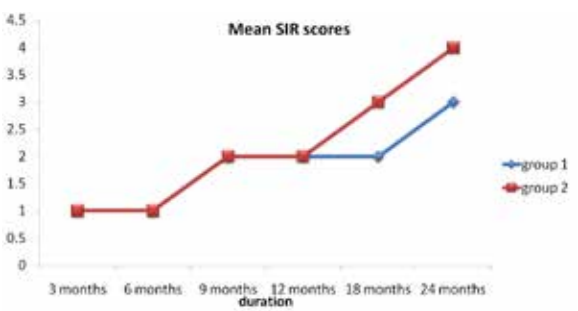
		3 months	6months	9months	12 months	18 months	24 months
CRLS raw score	Group 1	2 (2-2.11 years)	3(2-2.11 years)	5 (2-2.11 years)	6 (3-3.11 years)	6 (3-3.11 years)	7 (3-3.11 years)
	Group 2	2 (2-2.11 years)	3(2-2.11 years)	6 (2-2.11 years)	7 (3-3.11 years)	8 (3-3.11 years)	9.5(3-3.11 years)
CELS Raw Score	Group 1	2 (2-2.11 years)	3(2-2.11 years)	5 (2-2.11 years)	6 (3-3.11 years)	7 (3-3.11 years)	8 (3-3.11 years)
	Group 2	2 (2-2.11 years)	4(2-2.11 years)	6 (2-2.11 years)	7 (3-3.11 years)	8 (3-3.11 years)	9(3-3.11 years)

Volume : 4 | Issue : 1 | January 2015 • ISSN No 2277 - 8179

Graph 1: CRLS at 3,6,9,12,18 & 24 months

Speech intelligibility rating (SIR)
Graph 2: CELS at 3,6,9,12,18 & 24 months
2. Speech intelligibility rating (SIR)

SIR scores showed a significant improvement in both groups. At 3 months mean SIR score was 1 (i.e. Connected speech is unintelligible) for both groups. However, after one year children with bilateral cochlear implants progressed faster and at the end of 2nd year they reached the score of 4 (i.e. Connected speech is intelligible to a listener who has little experience of a deaf person's speech) while children with unilateral implants reached to the score of 3 (i.e. Connected speech is intelligible to a listener who concentrates & lipreads). These results are showed in graph 3.



Graph 3: Mean SIR score at different interval of 3,6,9,12,18 & 24 month

DISCUSSION

Children with unilateral implants were lagging behind in comparison to children with bilateral cochlear implant. Many other studies have also shown that children with unilateral Cochlear implants exhibit delays in the development of language[18][19] and speech production[20]. This could be due to difficulty understanding speech in noise and soft speech with one cochlear implant. There are also less chances of incidental learning due to limitation in hearing. There are many studies supporting that bilateral implantation has a greater positive impact on language development compared to unilateral implantation[21].

Conclusion:

Result of the present study shows that children with bilateral cochlear implantation have better outcome in terms of Language development compared to unilateral cochlear implantation.

However, the only disadvantage or limiting factor of bilateral cochlear implantation is cost especially in Indian scenario .

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