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STUDY OF MAIS (MEANINGFUL AUDITORY INTEGRATION SCALE) SCORE POST UNILATERAL COCHLEAR IMPLANTATION IN PRELINGUAL DEAF PATIENTS

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ABSTRACT

Objective: To evaluate speech perception skills in everyday situations following Unilateral Cochlear Implantation in prelingual deaf patients in relation to the age of implantation.

Method: 45 prelingual deaf patients who underwent unilateral Cochlear Implantation under B.J. Medical College Cochlear and Hearing Implant Programme from April 2007 to August 2010 were included in the study.

Participants were divided into 5 groups on basis of age at which participants underwent implantation: ≤3 years, 3 to 6 years, 6 to 9 years, 9 to 12 years, 12 to 15 years. The MAIS Questionnaire was administered before implantation unaided and at three post-implant switch-on time periods 6 months, 1 year and 2 years with Cochlear Implant alone. The study was retrospective and prospective comparative interventional type. Significance of difference between individual preoperative and postoperative scores was evaluated using the post hoc test of repeated measure analysis.

Results: Pre-op average MAIS Questionnaire score was ≤8/40 in all implanted age groups with score increasing over time to attain average score ranging from 34 to 37.44/40 in all implanted age groups after two years of implantation.

The score increased significantly ($p<0.05$) in all implanted age groups from pre- to post-CI. Improved ratings were found for those implanted at younger age (≤3 years) than those implanted later.

Discussion: There is significant improvement in speech perception skills in everyday situations after cochlear implantation which continues to improve over time. Better results were seen in those implanted at younger age.

Introduction:

In the past thirty years, Cochlear Implants have evolved from a single-channel device, providing little or no speech understanding, to multi-channel implants using advanced signal processing strategies. Cochlear Implantation is a well-established intervention for both adults and children with severe to profound bilateral sensorineural hearing loss, who receive no useful benefit from hearing aids (HAs)[1,2]. As of December 2010, approximately 219,000 people worldwide have received Cochlear Implants; in the United States, roughly 42,600 adults and 28,400 children are recipients3. Hearing loss interferes with a person's ability to communicate effectively. Profound or severe hearing impairments in young children often result in poor speech perception skills. Multichannel Cochlear Implantation of profoundly hearing impaired children unable to benefit from hearing aids results in significant improvements in speech perception following implantation [4-8].

Method:

A total of 45 prelingual deaf patients (satisfying the inclusion criteria) who underwent unilateral Cochlear Implantation under B.J. Medical College Cochlear Implant Programme from April 2007 to August 2010 were included in the study. All participants underwent Cochlear Implantation by Transcanal "Veria" Technique.

Full insertion of the active electrode array was accomplished in all subjects. Tempo+ speech processor was used in these subjects. All participants used the CIS speech processing strategy with a stimulation rate of 1500 pulses per second. All participants underwent Auditory-Verbal training and had strong family support systems.

Study Design:

The study was retrospective and prospective comparative interventional type. In this study a quantitative approach was used to collect, analyze and interpret the data. The quantitative approach allows the researcher to describe and objectively assess the outcomes[9].

Inclusion criteria:

- Prelingually deafened CI recipients.
- Patients with severe to profound bilateral congenital sensorineural hearing loss with preop average pure-tone thresholds worse than 70 dB HL.
- Patients who received no useful benefit from hearing aids (HAs).
- Patients ≤ 15 years age.
- Patients who underwent unilateral Cochlear Implantation.
- Patients implanted with the MED-EL Combi 40+ implant (standard electrode) (MED-EL medical electronics, Innsbruck, Austria).

- Patients having normal cochlea, vestibulo-cochlear nerve with normal Broca'sarea.
- Patients without external and middle ear infections.
- Patients with normal IQ.
- Patients without additional syndromes/ illness that could affect the child's development.
- Patients having access to post-Cochlear Implant rehabilitation (through auditory verba training).
- Patients having high motivation from family and family willing to work toward speech and language skills with therapy.

Exclusion criteria:

Exclusion criteria for the study were:

- Patients with cochlear malformation, obliteration, absence of the cochlea (Michel deformity), and a small internal auditory canal (associated with cochlear nerve atresia).
- Patients with Labyrinthitis ossificans.
- Patients with mental retardation, psychosis, organic brain dysfunction.
- Patients implanted with Cochlear Implant other than MED-EL Combi C40+ implant.

Study Groups:

As shown in table 1, whole of participants were divided into five groups on the basis of age at which participants underwent implantation: ≤ 3 years, 3 to 6 years, 6 to 9 years, 9 to 12 years, 12 to 15 years. This was done to enable evaluation in each group.

Groups	Age of implantation
Group 1	≤ 3 years
Group 2	3 to 6 years
Group 3	6 to 9 years
Group 4	9 to 12 years
Group 5	12 to 15 years

Table 1 Study Groups

Materials:

MAIS Questionnaire

The Meaningful Auditory Integration Scale (MAIS) Questionnaire developed at the Indiana University School of Medicine, is parent report scale which allows the examiner to evaluate a child's use of auditory information in meaningful, real-world situation. The MAIS questionnaire assesses the child speech perception skills and the child's reliance on the hearing aid or on the implant[10]. It gathers auditory behavioral information and provides information about the child's use of auditory information in everyday situations. It is designed to identify the meaning of hearing loss for a child that uses sound in daily life[10].

Procedure:

The MAIS Questionnaire was used for evaluation of speech perception in everyday situations. The MAIS questionnaire was administered before implantation unaided and at three post-implant switch-on time periods 6 months, 1 year and 2 years with Cochlear Implant alone. The MAIS lists ten (10) areas to be probed and gives the specific questions that are to be asked by the clinician. Unstructured probes were presented to the parent so that a description is given by them about the child's spontaneous listening in natural situations. Based on this information, further questions were asked and specific examples were requested to support the response. Hence, the MAIS was scored on the basis of parent report and clinician observation. All the patients were observed by one and the same clinician pre-op and post-op. This method was adopted to prevent the type of bias that may occur with direct questionnaires and obtain more accurate results.

Statistical analysis:

All the patients were assessed and data obtained both preoperatively and postoperatively at appropriate intervals according to the follow up protocol. Scores for MAIS Questionnaire data were averaged and plotted for each group. The study was based on individual children evaluated with repeated measures, each child serving as his own control. The significance of the difference between the individual preoperative and postoperative scores for the MAIS Questionnaire data was evaluated using the post hoc test of repeated measure analysis. The statistical software used for analysis of the results of this study was SPSS version 17. A 'p' value of < 0.05 was regarded as statistically significant.

Results and discussion:

As shown in table 2, 9 participants were in group 1, 19 participants were in group 2, 13 participants were in group 3, 2 participants were in group 4 and 2 participants in group 5.

Groups	No. of Male (M)	No. of Female (F)	Total	Percentage
Group 1	5	4	9	20%
Group 2	11	8	19	42.22%
Group 3	9	4	13	28.89%
Group 4	0	2	2	4.44%
Group 5	0	2	2	4.44%
Total	**25**	**20**	**n=45**	

Table 2 demographic data

As shown in table 3, improved pre- to post-CI speech perception skills in everyday situations was observed from the results of MAIS Questionnaire data. As shown in table 4 and fig. 1, Pre-op average MAIS Questionnaire score was ≤ 8/40 in all implanted age groups with scores increasing over time to attain average score ranging from 34 to 37.44/40 in all implanted age groups after two years of implantation.

The score increased significantly ($p<0.05$) in all implanted age groups from pre- to post- CI. There was positive effect of time with scores increasing on every follow-up.

In a study by Zakirullah et al[11] it was shown that Cochlear Implanted children develop speech recognition soon after implantation and these skills develop over long period of time, highlighting the need for continued therapy to maximize listening and learning. Results in that study showed that prelingual participants after 12 months of switch-on had MAIS score 34 compared to pre-op score which was around 8 to 10. In the EARS study[12] also MAIS scores reached to around 36 after 2 years and reaching 40 after 3.5 years.

In the current study it was observed that those implanted at younger age ≤ 3 years showed better results than those implanted at later age. Wong-Kein Low et al[13] also concluded that more rapid development of speech perceptive skills was achieved in children who were implanted early. This informs us about the developmental plasticity of the auditory system. This might be because of possible atrophy of the auditory tract on account of non-stimulation as they are born with the insult. Sensory activity leads to neural development, and the sustained effects of sensory inactivity can lead to a loss of responsiveness. These effects may be reversed by the subsequent provision of sensory stimulation, such as that delivered by Cochlear Implants14. Early implantation therefore, enables children to develop good core listening skills and to potentially develop spoken language at a young age and to integrate into mainstream education.

Conclusion:

Cochlear Implant is a recognized treatment option for patients suffering with profound sensorineural hearing loss. A team approach including experts from various fields concerned is mandatory for a successful outcome. These patients need to be continuously rehabilitated and monitored following implantation. This study aimed to obtain information regarding pre- to post- CI changes in speech perception skills in everyday situations. Results showed that there is significant improvement in speech perception skills over time. This study highlights the importance of age of implantation. Improved ratings were found for those implanted at younger age (≤ 3 years) than those implanted later. Significant effect of age at implantation was also demonstrated. As technology continues to improve, the future of CIs is even more promising.

SUBJECTS ENROLLED IN STUDY	AGE OF IMPLANTATION (IN YEARS)	MAIS SCORE (/40)			
		PRE-OP	POST-OP		
			6 MONTHS	1 YEAR	2 YEARS
Subject 1	1	0	24	33	38
Subject 2	1.5	0	27	33	38
Subject 3	1.6	0	26	33	38
Subject 4	2.5	6	27	32	37
Subject 5	2.5	0	27	32	37
Subject 6	2.6	0	27	32	37
Subject 7	3	0	27	32	37
Subject 8	3	6	27	32	37
Subject 9	3	0	27	31	38
Subject 10	3.5	6	27	33	37
Subject 11	3.5	7	27	33	37
Subject 12	3.5	0	27	32	36
Subject 13	4	0	27	31	36
Subject 14	4	0	26	32	36
Subject 15	4	6	26	31	36
Subject 16	4	6	27	31	35
Subject 17	3	6	26	31	36
Subject 18	4.6	6	27	32	37
Subject 19	5	6	25	31	36
Subject 20	5	6	26	31	36
Subject 21	5	6	26	30	35
Subject 22	5	0	27	29	36
Subject 23	5	6	27	30	36
Subject 24	5	6	26	31	36
Subject 25	5	0	26	31	35
Subject 26	5	6	26	30	35
Subject 27	6	6	25	30	34

Subject 28	6	8	25	29	36
Subject 29	6.5	6	25	31	36
Subject 30	6.5	8	25	29	36
Subject 31	7	6	26	30	36
Subject 32	7	7	27	30	35
Subject 33	7	6	26	31	35
Subject 34	7	7	27	30	36
Subject 35	8	7	25	30	35
Subject 36	8	7	26	31	35
Subject 37	8	6	27	30	35
Subject 38	8	8	26	31	35
Subject 39	8	8	27	31	36
Subject 40	8	6	26	31	36

Subject 41	9	8	26	31	35
Subject 42	10	7	25	31	35
Subject 43	12	9	25	30	35
Subject 44	13	7	25	29	33
Subject 45	13	7	25	31	35

Table 4: Descriptive statistics for MAIS Score

MAIS SCORE					
Study groups	**Mean (/40)**				**p-value**
	PRE-OP	POST-OP			
		6 MONTHS	1 YEAR	2 YEARS	
Group 1	1.33 (SD 3.65)	26.56 (SD 1.01)	32.22 (SD 0.67)	37.44 (SD 0.53)	< 0.05 Significant
Group 2	4.58 (SD 2.85)	26.26 (SD 0.73)	30.95 (SD 1.13)	35.54 (SD 0.76)	< 0.05 Significant
Group 3	6.92 (SD 0.86)	26.08 (SD 0.76)	30.46 (SD 0.66)	35.46 (SD 0.51)	< 0.05 Significant
Group 4	8 (SD 1.41)	25 (SD 0)	30.5 (SD 0.71)	35 (SD 0)	< 0.05 Significant
Group 5	7 (SD 0)	25 (SD 0)	30 (SD 1.41)	34 (SD 1.41)	< 0.05 Significant

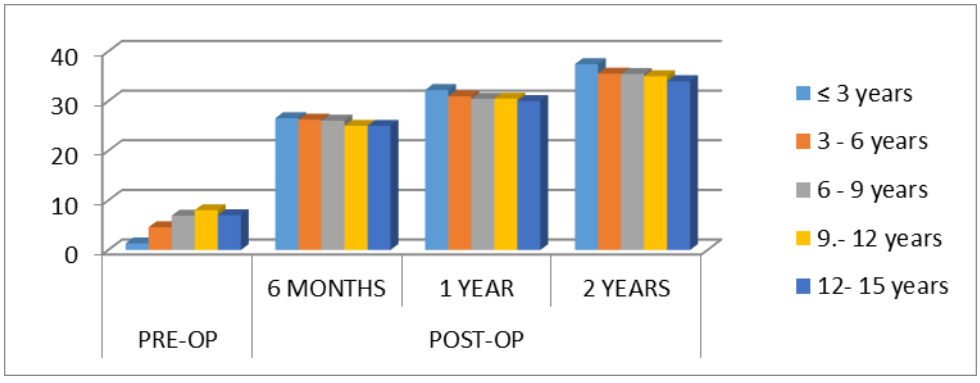

Fig. 1: Mean MAIS Score (/40)

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