

## Original Article

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# Outcomes of Cochlear Implantation: A Clinical Study

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### Abstract

*This retrospective study is based on the assessment of outcomes of Cochlear Implantation (CI) basing on various scoring systems like Category of Auditory Performance (CAP) and Speech Intelligibility Rating (SIR). 50 candidates, 45 of them who were implanted at CMH Dhaka, a tertiary referral center for cochlear implantation and 05 were implanted outside (home and Abroad) between June 2012- January 2015 included in the study. The results were analyzed using the above scoring systems to assess the performance levels of each implantee and to arrive at a cumulative result on the outcome of the implantation. Practical issues of concern to Cochlear Implantation in Bangladesh was also analyzed.*

**Key Words:** Cochlear implantation (CI), CAP score, SIR score, auditory verbal habilitation

### Objectives

To study the outcome of 50 patients, 45 of them underwent Cochlear Implantation at CMH Dhaka and 05 were outside (home and abroad) between June 2012- January 2015 by evaluating the quality of life after cochlear implantation with Category of Auditory Performance (CAP)<sup>1,2</sup> scores and Speech Intelligibility Rating (SIR)<sup>3</sup> scores (Tables 1 and 2). This study aims to analyze the results and derive a protocol to improve the outcome

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of the patients undergoing cochlear implantation in terms of speech intelligibility, auditory performance and rehabilitation.

### Study design

This is a retrospective study involving 50 patients who underwent cochlear implantation between June 2012- January 2015.

All of our candidates were prelingual. All patients received either Pulsar, Sonata or nucleus 24 and the electrode array was straight standard. The coding strategy used in the cochlear implant systems was CIS+ and ACE.

### Background

Cochlear Implant (CI) is an advanced micro ear surgery to regain hearing and development of speech and language in congenital and acquired deafness. It improves the quality of life associated with deafness by increasing

their listening and communication skills, their self sufficiency and ability to interact with others The success of a CI program is directly dependent on its ability to address the issue of patient expectations and balance it with the outcomes.<sup>1,3</sup> A multidisciplinary approach is required involving the CI surgeon, Audiologist, Speech therapist and Auditory verbal habilitationist . The patients and their family must also be highly motivated for the implant. Variables affecting the outcome of CI in children are the duration and etiology of deafness, age at onset of deafness, pre-implant amplification history, communication mode, age at implantation, type of speech processor used and duration of implant usage. In very young children, language acquisition is easier and hence the need for early implantation. Owing to the loss of neural plasticity in older pre-lingual deaf people, the response to implantation may not be optimal and extensive pre-op counseling regarding

realistic expectations is vital.<sup>4</sup> Factors influencing the overall outcomes are the transparency of the program, expertise of the team, patient motivation, family support and facilities for rehabilitation. Difficulties in Bangladesh perspective have been due to their prohibitive costs, the introduction of a radical technology in a developing country and its impact on deaf culture. The dilemma of balancing an advanced technology with the requirements of a developing country still remains.

Problems unique to the Bangladesh context are the lack of awareness, poor health policy, unavailability of NGO support, lack of skilled personnel and lack of family & social support. These can be overcome by having satellite centers, trained surgeons with adequate theatre facilities and a well equipped audiology unit with access to good schools for hearing challenged, which believe in an auditory verbal approach along with long term

**Table-I**  
*Categories of auditory performance<sup>2</sup> (O'donoghue et al 1999)*

Category	Criteria	Time after implantation				
		Before implant	0	6	12	24
7	Uses telephone					
6	Understands conversation					
5	Understands phrases					
4	Discrimination of sounds					
3	Identifies environmental sounds					
2	Response to speech sounds					
1	Awareness of environmental sounds					
0	No awareness to environmental sounds					
Total numbers						

**Table-II**  
*Speech intelligibility rating<sup>3</sup> (O'donoghue et al 1999)*

Category	Criteria	Before	Time after implantation (months)				
		implant	0	6	12	24	36
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 & lip reads.						
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.						

commitment to the implantees. A lingual map[5] needs to be charted for uniform rehabilitation of various implantees in their own mother tongue with the child's parents themselves forming an active and integral part of auditory verbal habilitation. Habilitation material has to be developed in regional languages<sup>5</sup> and bearing in mind the extreme paucity of qualified and trained auditory verbal therapists, the task seems to be daunting. Despite these very real hurdles, the cochlear implantation programs have grown exponentially.

The cochlear implant programme at Cochlear Implant Center, CMH Dhaka lays emphasis on after care and support with auditory verbal therapy as an integral part of the service.

### Methods

The study was done by collecting data through patient registers, fully completed clinical

records and information regarding the present performance levels of the implantees from health care professionals like Cochlear Implant surgeons, Audiologists, Auditory Verbal habilitationists. The communication strategy involved discussion with cochlear implantees and their guardians about the outcomes. Children belonging to the age group 1-4 years were majority (74%) and all our candidates were prelingual nonsyndromic children. Questionnaires were distributed to make a cumulative assessment of each implantee vis-a-vis the effectiveness of the implant. The discussion also included feedback from Auditory Verbal habilitationists about the performance of each cochlear implantee, the post-operative period after implantation at which the patients attained speech abilities and reached the respective categories of CAP scores and SIR scores. Wherever available, serial video recordings of

Auditory verbal therapy sessions of implantees were used to evaluate performance levels.

### Measuring level of performance

The outcome of cochlear implantation was measured using Category of Auditory Performance (CAP)<sup>1</sup> score described by O'Donoghue *et al*, 1999. The extent of auditory perception in terms of utility of auditory mechanisms to pursue day to day tasks from awareness of environmental sounds to making telephonic conversations were assessed. The ability to discriminate and understand speech with or without lip reading was also assessed and the results were categorized accordingly and a score was given, taking into account the number of months taken to achieve it.

Similarly, one more outcome measure, Speech Intelligibility Rating (SIR)<sup>2</sup> by O'Donoghue *et al*, 1999 was utilized to measure the outcome of cochlear implantation with respect to speech, measuring the intelligibility of speech and the quality, which might be recognizable by the listener. The analysis also included the extent to which speech is understood and discriminated by the listener. The results were assessed and categorized accordingly and a score was given taking into account the number of months taken to achieve it.

The study also laid emphasis on the comparison of the outcomes with respect to the protocols followed in the institution and the protocols given in the guideline of MERF (Madras ENT Research Foundation) & the Cochlear Implant Group of India (CIGI)<sup>1,7</sup>. The effectiveness of the protocols were assessed and the practical difficulties in implementing them were discussed highlighting the special issues which needs concern and introspection in the present Bangladesh scenario.

Cochlear implantation protocols at Cochlear Implant Center, CMH Dhaka.

Initially the patient was assessed by Cochlear Implant surgeon and audiologist and if he / she was found to be an ideal candidate a comprehensive audiological evaluation including BERA/ASSR/OAE/PTA/Speech Audiometry / BOA / middle ear analysis / aided audiogram and hearing aid trial was done.

The candidate also underwent Imaging study like CT / MRI scan to detect any congenital deformities of the cochlea and eighth nerve.

The importance of counseling was always acknowledged and each candidate was counseled for cochlear implantation explaining the surgical procedure, the types of implants, the working procedure switch on, mapping. The patient's speech, language and auditory skills were assessed. The candidates and parents were made to meet and interact with other cochlear implantees to have a perspective on the procedure and its outcome. After counseling and interaction with implantees, a questionnaire was given to the parents to assess their expectations after cochlear implantation.

Prior to implantation a basic workup including hematological, chest X-ray, ECG, TORCH screen, ECG, ECHO & HIV screening was conducted. The general physical condition was evaluated by the anesthetist. A specialist's opinion was sought in patients with syndromic etiology of deafness. In children pre-implant meningococcal vaccination was carried out. Cochlear implantation was done and the response of electrodes was confirmed using Auditory/Neural Response Telemetry (ART/NRT) and effectiveness was assessed in children.

The switch on and speech processor tuning was done 3 to 4 weeks after surgery. Mapping is done at periodic intervals till a stable map

is achieved. The rehabilitation programme was started out based on baseline skills of the patient, periodical assessments of outcome were done in terms of environmental sound, open set, closed set speech, speech discrimination and telephonic conversation. The recommended period for habilitation in our center is 1 year. The patient and guardians were asked to stay nearby Dhaka cantonment to attend the AV habilitation.

### Conclusions of comparatives study based on CI protocols

All our Implantees were prelingual congenital Deaf children. Out of the implantees 74% (37) were between 1-4 yrs of age and 26% (13) were between 4 to 7 years. Males were 60% and females 40%. The results of CAP score showed that 20% implantees achieved category 7 in 12 months in 1-4 yrs age group and 22% achieved category 6 in 12 months, whereas in 4 to 7 yrs 4% got category 7 in 12

months and 8% achieved category 6 (Table 3). Children responded better with very good outcomes with early cochlear implantation. This was also evident with SIR scoring system where in 1-4 yrs, 34% achieved category 5 in 12 months and got category 4 in 8%, whereas in age group 4-7 it was 8% who got both category 4 and 5 in 12 months and 6 months respectively (Table 4). Open set speech was performed by 76% cases and Closed set by 24%. 14 children were followed up for more than 1 year and 31 of 50 children joined normal school. With early CI in children between 1-4 yrs, the outcome was very gratifying. So we encourage very early implantation to facilitate a series of developmental processes occurring in the critical period of initial language acquisition. Early cochlear implantation<sup>7</sup> tends to yield normalization of audiophonologic parameters, which enables us to consider the performance of children implanted very early as being similar to that of their normally hearing peers.

**Table-III**  
*Age in years \*CAP score - category cross tabulation*

			CAP score - category							
			0	2	3	4	5	6	7	Total
Age in year	1-4	Count	3	2	3	3	5	11	10	37
		% of Total	6	4	6	6	10	22	20	74
	4-7	Count		1	1	2	3	4	2	13
		% of Total		2	2	4	6	8	4	26
Total	Count	3	3	4	5	8	15	12	50	
	% of Total	6.0	6.0	8.0	10.0	16.0	30.0	24.0	100.0	

**Table-IV**  
*Age in years \*SIR cross tabulation*

			SIR					Total
			0	2	3	4	5	
Age in year	1-4	Count	3	3	6	8	17	37
		% of Total	6.0	6.0	12.0	16.0	34.0	74.0
	4-7	Count		2	3	4	4	13
		% of Total		4.0	6.0	8.0	8.0	26.0
Total	Count	3	5	9	12	21	50	
	% of Total	6.0	10.0	18.0	24.0	42.0	100.0	

**Special issues like the following demands introspection with respect to Bangladesh**

- Cost factor of cochlear implants.
- No available audiology & habilitation institute
- lack of skilled trained personnel
- Social stigma
- poor health policy
- No hearing screening program nationwide.

**Table-V**  
Crosstabs age in years\* speech

		Speech		Total
		Open set	Closed set	
Age in 1-4	Count	29	8	37
Years	% of Total	58.0	16.0	74.0
4-7	Count	9	4	13
	% of Total	18.0	8.0	26.0
Total	Count	38	12	50
	% of Total	76.0	24.0	100.0

These special issues could be addressed based on the results of successful application of the following protocols.

1. These problems can be overcome by advocating the parents / guardians to stay nearby habilitation center to aid AV therapy at least for 6-12 months so that the continuous process of AV therapy is not disengaged.
2. Negativism of professionals needs to be alleviated by more hands on training and workshops. Satellite centers and interaction must bridge distance by video conferencing.
3. A lingual map needs to be charted for uniform rehabilitation of various implantees in their own mother tongue with the guardians forming an active and integral part of AV habilitation
4. The cost factor of implant- CI Center CMH Dhaka runs a charity scheme

where pre op assessment, selection of candidacy, surgical expenses & habilitation support is sponsored by the hospital itself. Such charity schemes and public awareness to help such charitable trusts, medical insurance, bank loans might help the financially incapable patients to meet at least part of their expenses.

So, in conclusion, the concept of solving the above mentioned issues could be done by analyzing the results of our study which shows beyond doubt that practical measures taken in view of these issues has given good outcomes statistically.

Only a comprehensive, coercive and integral team approach by all professionals, surgeons, audiologists, physicians, psychologists and AV units can yield a productive outcome.

**Summary**

The study included 50 cochlear implantees and measured their auditory and speech performance levels using scores like CAP and SIR. The emphasis is on early implantation with intensive auditory verbal habilitation after the procedure.

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