

OUTCOMES OF 1100 COCHLEAR IMPLANTS IN THE STATE OF U.P. UNDER GOVT. PROGRAM

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ABSTRACT

Introduction: This retrospective study is based on assessment of outcome of cochlear implantation at Late Dr. Shiv Nath Mehrotra Charitable ENT foundation between 2016 to march 2023 under ADIP (assistance to disable persons) scheme by taking into account various scoring systems like category of auditory performance (CAP), Speech intelligibility rating (SIR) and Glasgow children benefit inventory (GCBi).

MATERIALS AND METHODS

1100 children who were implanted between 2016 to march 2023 at Late. Dr. Shiv Nath Mehrotra Charitable ENT Foundation were included in the study. The results were analyzed using the above scoring system to assess the performance level and quality of life of each implanted children taking into consideration practical issues in Indian set up.

RESULTS

90% of total children implanted showed significant improved hearing, 80% with significant speech benefit and 90% with improved quality of life.

CONCLUSION

Outcome in terms of quality of life, auditory perception and rehabilitation was very good. The ADIP (assistance to disabled persons) scheme of central government has been a blessings for lower socio economic status children. Considerable improvement in hearing, speech and overall quality of life in almost 80% of

children.

Keywords

category of auditory performance, Speech intelligibility rating, Glasgow children benefit inventory

INTRODUCTION

Over the last few years cochlear implantation has become the most important treatment modality for children with severe to profound sensory neural hearing loss [1-4].

Multi channel cochlear implant was approved for marketing for children in the year 1990 by the FDA [5]. Since 2000, after FDA'S approval many children above 12 months have been implanted. In India, cochlear implant is done as a measure to treat deaf children screened under the national programme for prevention and control of deafness.

Earlier the implant age better the verbal language development. The ideal age for cochlear implant before 1 year after birth so that spoken language development is within 1 year of chronological age of the child [6].

Variables affecting outcome of implant [7,8] are duration of disease, aetiology of disease, age at onset of deafness, pre implant hearing aid use, communication mode, age at implantation [4], type of speech processor, duration of implant usage, family support and financial status, expertise provided, facilities for rehabilitation.

The cochlear implantation program at Late Dr. S N Mehrotra Charitable ENT, Foundation, Kanpur under the ADIP scheme lays emphasis on after care and the extensive rehabilitation with a dedicated team of ENT surgeons, Audiologist, speech therapist, auditory verbal habilitationist and other staffs under one roof. The ADIP scheme (Assistance to disabled persons) was launched by Government of India under the leadership of our PM Shri Narendra Modi ji in 2014. It brought implantation and hearing to the lowest section of society who would never had the chance of hearing otherwise due to high costs. Under the ADIP scheme implant was procured by ALIMCO (Artificial Limbs Manufacturing Corporation of India) Kanpur. Ali Yavar Jung institute of speech and hearing Mumbai became the nodal authority to distribute the implant.

In this paper, we focus on CI in relation to pre-lingual deafness. For these children who have never heard speech, CI provides a new entry point into language. Outcome measured by recording CAP (Categories of auditory perception) and SIR (Speech intelligibility rating) score and their GCBI(Glasgow Children Benefit Inventory)index.

MATERIAL AND METHOD

Study was carried out at late Dr S N Mehrotra Charitable ENT foundation from 2016 to March 2023, 1100 children implanted during this period were taken into consideration. Out of 1100 patients, 618 were male and 482 females. There were 27 Children in age group upto 1 year, 134 children in age group 2 year, 271 children in age group 3 years, 454 children in age group 4 years and 213 in age group 5 years. 771 patients received cochlear device, 144 patients received digisonic device and 185 were received Med El device.

Study was done by collecting data through fully completed clinical records and information regarding present performance of implantees from our team. The discussion also includes

feedback from rehabilitation team about performance of each implantee, the duration at which patients attained speech abilities and reach the respective categories of CAP and SIR score and their GCBI index.

INCLUSION CRITERIA

- a) Children with bilateral severe to profound sensory-neural hearing loss
- b) Hearing aid trial for minimum of 3 months
- c) Normal psychological assessment
- d) Normal cochlea on radiology

EXCLUSION CRITERIA

- a) Malformed cochlea
- b) Multiple disabilities
- c) Additional psychological issue

Evaluation protocol at Mehrotra ENT Hospital

- a) Informed written consent was taken from the parents for the study and follow-ups required during the study.
- b) A detailed history and thorough physical and ENT examination was carried out.

The subjects then underwent pediatric examination to rule out any neurological condition, which may hamper the child postoperative performance. Prior to implantation a basic workup including hematological, chest X-ray, ECG (electrocardiogram), TORCH (Toxoplasmosis, rubella, Cytomegalovirus, Herpes simplex, and HIV) screen (if require). The general physical condition will be evaluated by anaesthetics. A specialist opinion was sought in patients with syndromic aetiology of deafness. In children pre implant vaccination will be carried out.

- c) Behavioral observational audiometry, impedance, OAE (otoacoustic emissions), auditory brainstem response thresholds and auditory steady-state response was determined to evaluate the degree of hearing loss.

- d) Each child was subjected to a high resolution CT (computed tomography) scan and MRI (magnetic resonance imaging) scan of Temporal bones.
- e) Speech perception was also assessed by SIR score before implant
- f) The child was also evaluated by a child psychologist to determine the IQ (intelligent quotient).
- g) Counseling of parents was done regarding regular follow-ups and therapy/support to the child at home. They were also made to realize the realistic expectations about the cochlear implant. Also the parents were made to realize that they are an integral part of our rehabilitation team which requires consistent hard work and patience.

Cochlear implantation was done and the impedance checked. Neural Response Telemetry (NRT) was done in nucleus implants and effectiveness assessed in children. Post operatively x-ray was mandatory. The switch on and speech process or tuning done at 1-2 weeks after surgery. Mapping is done at periodic intervals till a stable map is achieved. The rehabilitation program was started on the basis of the child's baseline skills, with a periodical assessment of outcomes done in terms of environmental sound speech discrimination and telephonic conversation. The recommended period for rehabilitation under ADIP scheme is 2 years. All 1100 children are using the implant. There are no non-users.

OUTCOME MEASURES

- The subjects were followed up for a maximum period of 5 years after implantation.
- Outcome measures were recorded in March 2023 :
 - a) CAP SCORE (Categories of auditory performance)

b) SIR (Speech intelligibility ratings)

c) GCBI (Glasgow children benefit inventory)

(Table 1) [9] Scales: CAP is a global outcome measure applied to assess the auditory receptive abilities of hearing impaired children. The Shepherd Centre's revised version, based on Nottingham CI (cochlear implantation) Program, 1995.

Categories of auditory perception (CAP) are a reliable and valid tool to continuously assess these children [10, 11].

(Table 2) [12, 13] SIR is a five point hierarchical scale globally used to measure the speech intelligibility of cochlear implantees.

Table 1: Revised CAP [14] (Categories of Auditory Perception).

Level 0	Unaware of environmental sounds
Level 1	Detects some environmental sounds
Level 2	Responds to some speech sounds
Level 3	Can identify some environmental sounds
Level 4	Understands some spoken words additional performatives e.g. 'where is the duck that says quack quack',
Level 5	Understands common phrases e.g. pick it up; it's bath time.
Level 6	Understands some spoken words without performatives e.g. give me the duck' / 'go get the car'
Level 7	Responds appropriately to simple questions e.g. what is it?
Level 8	Understands conversations with familiar speakers
Level 9	Understands conversations with unfamiliar speakers
Level 10	Follows recorded stories
Level 11	Uses telephone with familiar speakers
Level 12	Uses telephone with unfamiliar speakers

Table 2: Speech intelligibility rating (SIR) [15,16].

GCBI (Glasgow Children Benefit Inventory)

This inventory was administered using the interview method. It consists of four domains with twenty-four items, which comprehensively assessed emotional, physical health, learning and vitality aspects of parents of children with a cochlear implant with five response levels, “much better”, “a little better”, “no changes”, “a little worse” and “much worse”. Scoring the GCBI each question has a range of response –much better score +2, A little better score +1, neither better or nor worse scores 0, A little worse scores -1 and much worse scores -2. Add-up all scores for the 24 questions and divided by 24 and multiply by 50. This should give the responses on a scale from -100 (greatest possible harm) and +100 (greatest possible benefit).

- 1) Has child operation made over all life better or worse?
- 2) Has operation affected the things child does?
- 3) Has operation made behavior better or worse?
- 4) Has operation affected progress and development?
- 5) Has operation affected how lively the child during the day?
- 6) Has operation affected how well child sleeps at night?
- 7) Has operation affected enjoyment of food?
- 8) Has operation affected how self-conscious with other people?
- 9) Has operation affected how well child gets on with the rest of the family?
- 10) Has operation affected the ability to spend time and have fun with friends?
- 11) Has operation affected how embarrassed child feel with other people?
- 12) Has operation affected how easily child gets distracted?

- 13) Has operation affected learning?
- 14) Has operation affected the amount of time had to be off nursery, playgroup, or school?
- 15) Has operation affected the ability to concentrate on the task?
- 16) Has operation affected how frustrated and irritable child is?
- 17) Has operation affected how child feels about himself/herself?
- 18) Has operation affected how happy and confident child is?
- 19) Has operation affected child confidence?
- 20) Has operation affected the child self-care ability, such as washing, dressing, and using the toilet?
- 21) Has operation affected the ability to enjoy leisure activities such as swimming, sports, and general play?
- 22) Has operation affected how prone a child is to catch a cold and infections?
- 23) Has operation affected how often child needs to visit a doctor?
- 24) Has operation affected child needs for taking medication?

RESULTS

Out of the 1100 patients, 618 were male and 482 female. There were 27 Children in the age group upto 1 year, 134 children in the age group 2 years, 271 children in the age group 3 years, 454 children in the age group 4 years, and 213 in the age group 5 years. 566 were Hindu and 134 Muslim. 588 patients were implanted right side and 122 were implanted left side. 771 patients received the cochlear device, 144 patients received digisonic devices and 185 were received Med El devices. In 9 patients various techniques of implantation were used and in 1091 patients were implanted by using the posterior tympanotomy technique. There was round window insertion in 1029 patients and cochleostomy site insertion in 71 patients.

Wearing hearing aid early helped the children to improve auditory skills

- 11.1% Children used hearing aids < 4 months.
- 24.4% Children used hearing aids 4-6 months.
- 10.8% Children used hearing aids 6-8 months.
- 53.6% Children used hearing aids > 8 months.

Age group wise results

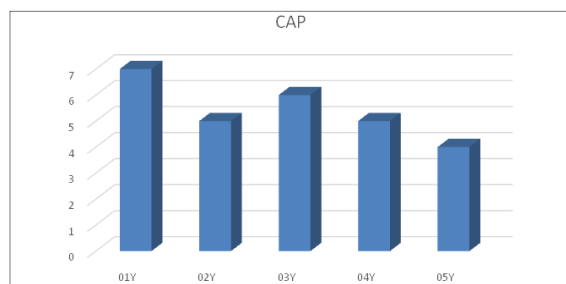
Children implanted before the age of 3 years of age performed significantly better than which are implanted after 3 years of age.

Age wise cap score (Table 3)

Average CAP score of children which are implanted at up to 1 year is 7, which is significantly better which are implanted at age of 4-5 years.

Age group	CAP score
0-1 Y	7
1-2 Y	5
2-3 Y	6
3-4 Y	5
4-5 Y	4

Figure 1

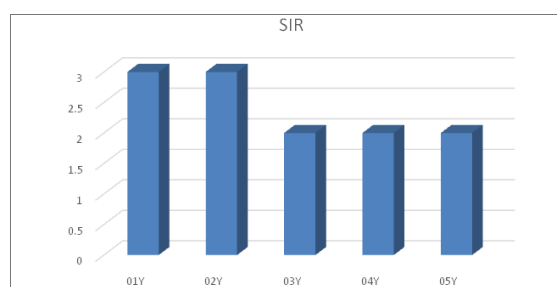


Age wise SIR score (table-4)

Average SIR score of children implanted at up to 1 year of age performing better than which are implanted at 4-5 years of age.

Table-4

Age group	SIR score
0-1 Y	3
1-2 Y	3
2-3 Y	2
3-4 Y	2
4-5 Y	2



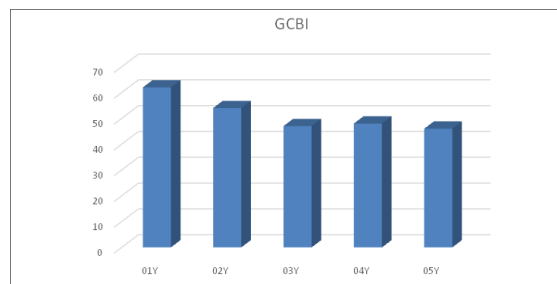
Age wise GCBI score (table-5)

GCBI score also showing that children which are implanted in lesser age are performing better.

Table-5 (Age wise GCBI score)

Age group	GCBI score
0-1 Y	62
1-2 Y	54
2-3 Y	47
3-4 Y	48
4-5 Y	46

Figure-3



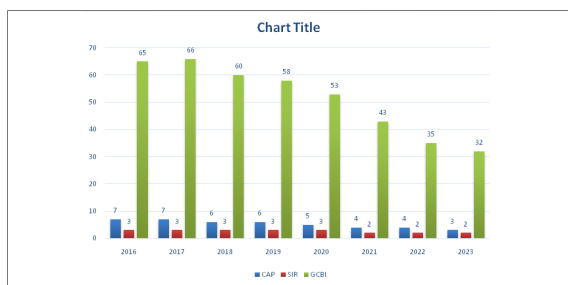
(Table 6) Age group of less than 3 year showed better CAP level, better SIR and better GCBI index when compared to greater than 3 years. GCBI at end of 1 year showed maximum benefit in almost all of children less than 3 years age.

Table 6: Comparison of Age with Mean Cap Score.

Age Group	Higher CAP Levels (9,10)	Mid CAP Levels (6,7,8)	Lower CAP Levels (1-5)
Age < 3 years	57	42	1
Age >3 years	2	48	50

Nearly 80% of children in age less than 3 had attained higher level of CAP (level 7,8,9,10) whereas in age group of 3-5 years only 13% had attained highest level of 9, 8 and 7) highlighting the need for early age implantation [14]. All of these 70% of children in age group less than 3 attaining level of 7-10 were prior hearing aid users which again emphasise on better outcome with prior hearing aid users.

Figure 4



(Figure 4) Outcome evaluation in March 2023. Communication skills continue to improve for several years post-implantation [13, 15] As shown in this figure children which are implanted earlier achieved higher scores for CAP, SIR, and GCBI, probably indicating that in the future they will master communication skills at higher levels [16,17].

POST OPERATIVE COMPLICATIONS

- Complications were more related to abnormal anatomy rather than related to surgical procedure.
- 5 children developed CSF gusher /leak during operation which was managed successfully

- 07 patients had facial paresis which recovered in 4-6 weeks
- 12 children had hematoma. 1 was aspirated and recovered. Rest recovered conservatively in 2 weeks.
- 05 had ear discharge which recovered in 01 week
- 01 keloid which was excised later.
- 1 had device failure which was replaced.
- 28 had redness, 5 had scab at implant site which improved on application of ointment, reducing the power of magnet and discontinuing use of implant for a week.

CONCLUSION

- Early age of less than 3 years or ideally less than 2 years showed better hearing, better speech and better quality of life. Spoken language performance results are best for those implanted prior to age 3.
- Prior hearing aid users performed better in all aspects. The greater the period of hearing aid use and shorter the period of time of hearing deprivation [4,18] better the outcome and easier development of spoken language.
- All children were using the implant. There were no non users.
- 90% of children showed significant improvement in hearing
- 80% of children showed significant speech improvement
- 64% had maximum benefit of quality life,
- 25% moderate benefit
- 11% had mild benefit.
- Religion plays no role.
- Regular follow up is the key to improve results
- Dedicated educated parents are as important as other factors for successful outcome.
- As the complications were minimal, surgery was safe [19]
- ADIP scheme changed the life of children with lower socio economic status.

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