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OUTCOME OF AUDITORY PERFORMANCE AND SPEECH INTELLIGIBILITY IN PAEDIATRIC COCHLEAR IMPLANT SURGERY IN A TERTIARY CENTRE.

ABSTRACT

Objective:

To analyse the relation between the age of implantation with the Category of Auditory Performance (CAP) and Speech Intelligibility Rating (SIR) rehabilitation score after one year of cochlear implantation surgery.

Materials and Method:

This is a retrospective study of the patients who had undergone cochlear implant surgery at a tertiary referral centre in the last six years. After the cochlear implantation all the patients had undergone compulsory Auditory Verbal Therapy (AVT) for one year. The postoperative evaluation tool used were CAP and SIR score for the audiological and speech outcomes. The patients were divided into two groups of age, one to four years (group A) and another group of four to eight years of age (group B). The CAP and SIR scores after one year of auditory verbal habilitation were recorded and compared in the two groups.

Results:

The outcome of total thirty-four patients within eight years of age who had undergone cochlear implant surgery were analysed. There were eighteen patients in group A and sixteen patients in group B. There were 64.7% males and 35.3% females among the patients analysed. In group A, the maximum number of patients reached CAP score of 5 and two patients reached a score of 7. Similarly, maximum number of patients reached SIR score of 3 followed by 4 in group A patients. Compared to this the CAP score in group B patients were between 3 to 5 with two patients reaching score 6. The SIR score reached in group B was 2 and 3. On comparison of the CAP and SIR scores between the two groups, the CAP score was not significant ($p=0.12$) but the SIR score was significant ($p=0.00$).

Conclusion:

The CAP score difference in the two groups was not significant but the SIR score showed significant difference on evaluating the outcomes after one year of AVT.

Keywords: Cochlear implantation, Implantees, CAP, SIR scores.

INTRODUCTION

Cochlear implantation is the surgery done for improving the auditory performance and then speech performance in patients with bilateral severe to profound sensorineural hearing loss. This specially holds true in prelingual children with bilateral severe to profound sensorineural hearing loss. The indications of cochlear implantation are expanding with time due to the positive outcomes of the surgery.^{1,2} Among the various attribution to the improving results of cochlear implantation like advanced technology and skills of the surgeon, there are others patient factors too like the age of the implantation, the

onset of deafness, associated comorbidities, family support and postoperative rehabilitation as well. The earlier the child is implanted better is their speech and language acquisition. The older the child is implanted, they may not have the optimal results owing to the neural plasticity.^{3,4}

The success of a cochlear implantation does not solely rely on the surgical outcomes only but also on the audiological and speech improvement in the patients postoperatively. The ultimate goal of implanting a prelingual pediatric patients is the hearing and good speech performance.^{5,6}

There are various tools to assess the post cochlear

implantation habilitation results and the one we have followed is the international standardized protocols like Category of Auditory Performance (CAP)⁷ scores and Speech Intelligibility Rating (SIR)⁸ by O’Donoghue et al. The scoring was done at or after 12 months at our institution and recorded. The score is a hierarchical score and can be easily recordable. This can be done on a regular interval to see the progress of the patients as well. The, CAP and SIR score can be used to compare the progress of the individual patients as well as to compare between different groups of patients.⁹

The aim of the present study is to analyse the speech and hearing outcomes of paediatric cochlear implant patients using Category of Auditory Performance (CAP) and Speech Intelligibility Rating (SIR) in relation to the age of implantation.

MATERIAL SAND METHOD

The study was done using the retrospective data collection of all the pediatric prelingual patients who had undergone cochlear implantation surgery in the department of ENT and Head Neck Surgery, TU Teaching hospital after obtaining ethical clearance-from institutional review committee. The implantation was done by different surgeons. All the prelingual paediatric cochlear implant surgery done with complete datas of one year of habilitation scores from February 2011 to January 2017 were included and analysed for the present study. The rehabilitation data of CAP and SIR score after at least one year of surgery was analysed. The children included had normal other milestones apart from hearing loss and delayed speech. The children with comorbidities and syndromes were excluded from the study. For the analytical purpose, the patients were divided into two groups: Group A (1-4 years of age) and Group B (5-8 years of age). The patients’ auditory outcomes were assessed using Category of Auditory Performance (CAP) score as described by O’Donoghue et al, as shown in Table 1. Similarly, Speech Intelligibility Rating (SIR) score by O’Donoghue et al, was used to measure the outcome of the cochlear implantation with respect to speech as shown in Table 2.

Table 1: Categories of Auditory performance (CAP) score (O’Donoghue et al 1999)

Category	Criteria
7	Uses telephone
6	Understands conversation
5	Understands phrases
4	Discrimination of sounds
3	Identifies environmental sounds
2	Responds to speech sounds
1	Awareness of environmental sounds

Table 2: Speech Intelligibility Ratio (SIR) score (O’Donoghue et al 1999)

Category	Criteria
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. Pre-recognizable words in spoken language; primary mode of communication may be manual.

The CAP and the SIR score of all the patients were tabulated in excel data sheet and analysed according to the age of the patients at the time of implantation. Both the CAP and SIR score in group A and B was compared and the statistical test was used for the overall difference in the CAP and SIR score between the two groups. Since the data was normally distributed the statistical test paired T test was applied and p value <0.05 was considered as significant difference.

RESULTS

Total of thirty-four prelingual pediatric patients with complete datas and follow-up habilitation records were analysed. Age distribution and the

number of patients in each group and the gender distribution are as shown in Table 3. There were (54.4%) males and (45.6%) females among the total patients. Thus, showing a male patient predominance in the access to surgery.

Table 3. Age and sex distribution of the patients (n=34)

Age Range (years)	Female	Male	Grand Total
1-4 years (Group A)	7	11	18
5-8 years (Group B)	5	11	16
Grand Total	12	22	34

Postoperatively, all of the patients had their switch on at the 3rd week after surgery and AVT scores after one year was recorded in all the patients. The CAP and SIR score results of the patients in different groups was tabulated and analysed.

Group A

The children of four years and below showed good progression and reached CAP score of maximum of 4 to 7 in twelve months period as shown in figure 1. The SIR score showed similar progression of improvement to score of 3 or 4 after one year as shown in figure 2.

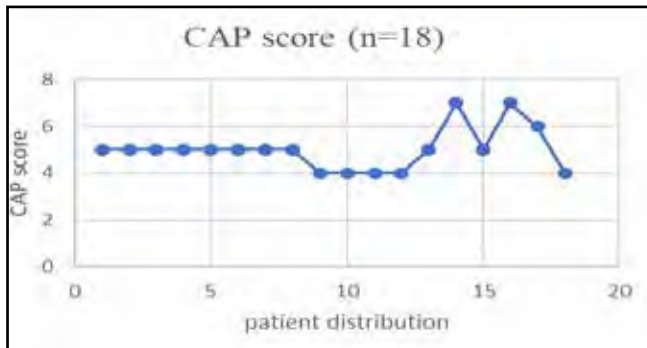


Fig 1. CAP score in group A patients

Group B

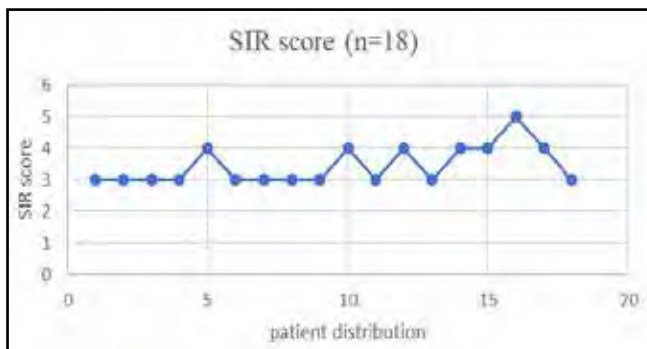


Fig 2. CAP score in group A patients

In children of 5 years and above, the CAP score ranged from 3 to 6 at the end of twelve months as shown in figure 3. Similarly, the SIR score showed progression to score 2 to 3 as shown in figure 4.

Thus, on analysing the results it was found that

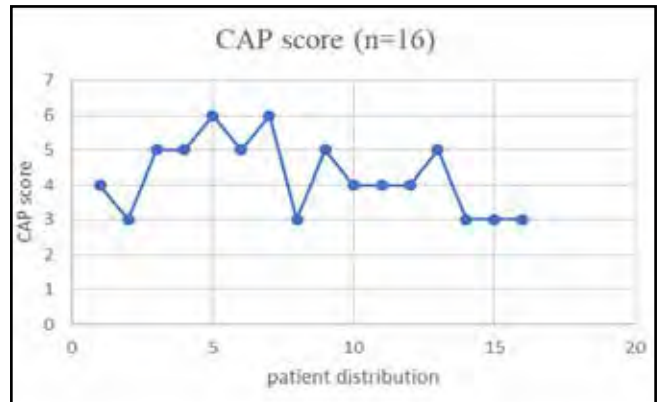


Fig 3: CAP score in group B patients

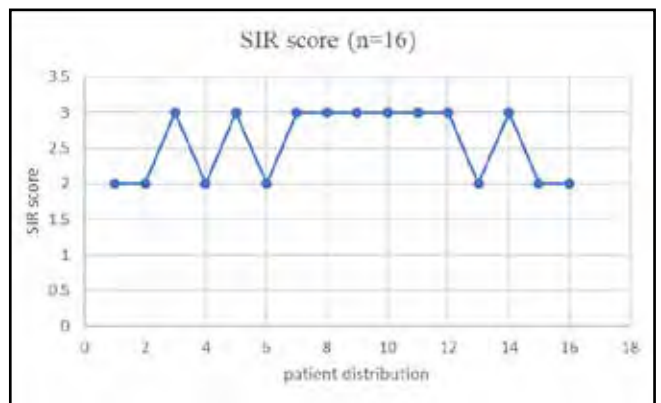


Fig 4. SIR score progression in group B patients

the CAP score in prelingual children implanted by four years of age showed CAP score ranging from 4 to 7 after one year as compared to children of five to eight years showing CAP score of 3 to 6.

Similarly, the SIR score in children implanted within four years of age ranged from 3 to 5 after one year as compared to children of five to eight years of age showing postoperative SIR score of 2 to 3 only. On further comparing the difference of CAP score in group A by paired T test was not significant (p=0.12). But the difference in the SIR score by paired T test was significant (p=0.00).

DISCUSSION

The present study analysed the retrospective data of the prelingual paediatric patients who had undergone cochlear implant surgery in a single tertiary care referral centre over a period of six

years. The ever-increasing good surgical results and availability of the better implants are leading to larger number of patients are being increasingly implanted every year.

Apart from the surgical skills, implant designs and better speech processor there are many factors too which are responsible for the good results after implantation. Patient factors like the age of implantation, duration of deafness, the postoperative habilitation, the family and the environmental factors.¹⁰ One of the most important factors being the age of the child during the implantation for the good audiological and speech outcomes. The age of the child for the implantation in prelingual deafness is decreasing and there are many reports of children being implanted before one years of age.¹¹ The surgeons opting for the early implantation stress the factor of brain neural plasticity.

All the implantation was done in a single centre but by multiple surgeons. The patients had undergone one year of auditory verbal habilitation done by two different habilitationists. There are many different tools developed to assess the outcomes of the postoperative audiological and speech outcomes available nowadays. In the present study we have used CAP and SIR score for assessing the audiological and speech outcomes. CAP and SIR scoring systems are accepted and practical tools to assess the outcomes after implantation surgery. It is a hierarchical scale of auditory perception ability, relates more to the real-life situations and closely relates to the observed clinical performance of the implantees.¹² Similarly, the speech intelligibility rating (SIR) scale was selected as its categories could be easily done by people involved in the rehabilitation team. It is particularly suitable for the age range of children in the present study and can be used over an extended period of time.¹³

The patients in our study were divided into two groups for the postoperative evaluation to assess the difference in the results of early and late implantation. Various literatures mention the importance of early implantation for the better outcome results. Age of implantation is the single most important factor for the success of spoken language development that the patient develops after implantation.¹⁴ O'Neill et al¹⁴ stresses on the better outcome of patients in early implanted age of the prelingual children. He observed a

greater gain in the CAP score in the younger implanted children.

Paul et al¹ also stresses the advantage of early implantation before 2 years of age. He mentions the CAP score reaching higher levels as early as three months after implantation. Comparing the highest average CAP score at the end of one year showed a higher score of 6 and 7 in younger children. This is comparable to other literatures by Karen et al¹¹ where eight of the ten children implanted reached CAP score of 5 or 6 at the end of the 1st year of habilitation.

Thawin et al¹⁵ in his follow up of patients post implantation showed that the CAP score gradually increased from 4 to 5 at yearly and eighteen months follow up. The article stresses on the need to follow up the patients after one year also. His follow-up of the patients till eighteen months improved the CAP score. This is advisable but technically difficult in a country like ours where the patients need to stay in the capital faraway from their house as good auditory verbal therapist are not available in the peripheral centres. Since the maximum number of the patients are small prelingual deaf children they need their parents also adding on to the monetary burden to the family. This might lead to stoppage of therapy by the children in between hampering on the good outcome. Given a provision of good surgery, family support and better habilitation gives the children the fare chance of getting the best advantage of cochlear implantation in children without comorbidities.

Gupta et al¹⁶ has studied on thirty cochlear implantee pediatric patients. He has used CAP, SIR and MAISS score for the evaluation of outcomes in his patients. The author unlike in our study has done progressive score maintenance at three, six and twelve months. This is a better way of studying the progression of the patients at a regular interval where we can critically analyse our auditory verbal therapy and intervene to change if needed. This will also give a better way of monitoring of the children.

Dettman et al¹⁷ have also stressed on the early implantation for not only acquiring hearing and better speech perception but also for the better development of the language at long term follow up. This was a multicentric study of 403 children less than six years of age. They have used various tools for assessment and their results

highlighted on implanting children below one year of age. Quittner et al¹⁸ mentioned the overall development of the children including the social and behavioural outcome too after implantation stressing on the cochlear implantation in prelingual hearing deprived children.

Our study showed better result in early implanted children but it is still advisable to undertake the larger sample size to make a more robust study. Similarly, it is also advisable to develop the scoring system in the local language for better assessment.

CONCLUSION AND LIMITATIONS

The score difference between group A (1-4years) and group B (5-8years) was statistically significant in SIR score evaluation while CAP score was better but not statistically significant. This stresses on the better outcome in earlier implantation of the patients.

But the study would be better if done in a larger sample size and progressive analysis of CAP and SIR score done at three, six, nine and twelve months.

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