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Original Research Article

Convenience and short comings among paediatric cochlear implant candidates

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ABSTRACT

Background: Cochlear implants have revolutionized the treatment of severe-to-profound sensorineural hearing loss in children. However, the convenience and shortcomings experienced by pediatric cochlear implant candidates in various settings remain understudied. This study aimed to assess the convenience and shortcomings among pediatric cochlear implant candidates in home, school, and other social settings.
Methods: This was a prospective clinical study that was conducted in the Cochlear Implant (CI) Center, Combined Military Hospital (CMH), Dhaka and Chattogram, Bangladesh from July 2015 to December 2022. A total of 200 parents of pediatric cochlear-implanted children were enrolled in this study as the study subjects. A simple random sampling technique was used in sample selection. All data were processed, analyzed, and disseminated by using MS Excel and SPSS version 22.0 program as per necessity.
Results: The study analyzed information collected during the study period, focusing on the convenience and shortcomings reported by the parents of cochlear implant recipients. The findings revealed that the highest level of convenience was reported in some other social settings (82.84%), followed by home (75.67%) and school (64.4%). In contrast, shortcomings were reported primarily in the home environment (63.6%), followed by school (34.6%) and other social settings (31.45%).
Conclusions: In the majority of cochlear implant children, convenience is observed in some other social settings than home or school. In the majority of cochlear implant children, shortcomings are observed in their homes.

Keywords: Convenience, Cochlear implant, Hearing loss, Paediatric, Shortcoming

INTRODUCTION

Approximately two centuries ago, Count Alessandro Volta of Italy pioneered the concept of auditory perception through electrical stimulation. Volta's groundbreaking experiment involved inserting metal rods into his ear canals and connecting them to an electrical circuit, leading to what he described as "a boom among the head." This seminal work laid the foundation for the development of cochlear implants, devices designed to facilitate auditory perception through electrical stimulation of the sensory system's peripheral components.[1] A cochlear implant comprises both internal and external components. The internal assembly includes electrodes, a receiver-stimulator, an antenna, and a magnet, all of which are surgically implanted within the

head. The external assembly consists of a microphone, speech processor, external transmitter, and cords, typically worn around the ear or in a specialized body pack. These external components can be easily replaced and upgraded as technology advances.[2] In recent years, the government of Bangladesh has initiated programs offering free cochlear implantation to children from low-income families suffering from severe to profound deafness. The U.S. Food and Drug Administration approved the Nucleus 22-channel cochlear prosthesis for pediatric implantation in children as young as two years old in 1990. This decision sparked debates in both the hearing and deaf communities regarding the ethical implications of implanting young children. Advocates argue that the "critical period" for language development occurs between the ages of two and six, making early implantation beneficial.[3] The cochlear implant operates on the principle of converting sound into electrical impulses. The human ear is most sensitive to sound pressures of 20 µPa in the frequency range of 2000-4000 Hz.[4] The device consists of an external sound processor and an internal implant, which includes a receiver-stimulator and an electrode array. Sound is captured by microphones on the sound processor and, after processing, is transmitted through the skin to the implant via a frequency modulation (FM) signal. This signal is then converted into electrical impulses that are sent to an array positioned in the cochlea.[5] The cochlear implant system divides sound frequencies into channels 12, 16, or 22, depending on the manufacturer and directs each channel to a specific electrode on the array. This allows for tonotopic intracochlear electrical stimulation. The electrodes stimulate the neurons of the spiral ganglion in the modiolus according to the sound frequencies.6 Historically, cochlear malformations were first described by Carl Mondini in 1791 as a deformity of the labyrinth.[7] However, the term "Mondini malformation" is often inaccurately used to describe various types of cochlear abnormalities. A more precise classification was suggested by Jackler and associates in 1987.[8] The primary objective of this study was to evaluate the convenience and challenges faced by pediatric candidates for cochlear implantation.

METHODS

This was a prospective clinical study that was conducted in the Cochlear Implant (CI) center, Combined Military Hospital (CMH), Dhaka and Chattogram, Dhaka, Bangladesh from July 2015 to December 2022. A total of 200 parents of pediatric cochlear-implanted children were enrolled in this study as the study subjects. The study was approved by the ethical committee of the mentioned hospital. Properly written consent was taken from all the participants before data collection. The whole intervention was conducted following the principles of human research specified in the Helsinki Declaration and executed in compliance with currently applicable regulations and the provisions of the General Data Protection Regulation (GDPR).[9,10] A simple random sampling technic was used in sample selection. As per the inclusion criteria of this study parents of cochlear implanted pediatric children, cochlear implant more than 2 years ago who agreed to interview were included. On the other hand, according to the exclusion criteria of this study, parents of adolescent or adult cochlear implanted cases and cochlear implanted cases of fewer than 6 months were rejected. In data collection, face to face interviews were conducted by using a close-ended questionnaire which was converted into Bengali and verified by audiology and speech-language pathologist professionals. Socio-demographic parameters and relevant information on cochlear implanted child adoption in different kinds of situations such as home, school and other social settings situation were recorded. Data were processed, analyzed and disseminated by using the MS Office program.

RESULTS

In this study, the total population was 200 cochlear-implanted child's parents. The respondents were asked a set of questions regarding the convenience and shortcomings of their cochlear-implanted children in adopting in different social settings like home, school and some other places. Regarding convenience in several settings, most of the affirmative responses were found in convenience at other social settings than home or school, which was 82.34%. Then in the second position, convenience at home, which was 75.67% and lastly, convenience at school which was 64.4% (Table 1).

Table 1: Convenience at several settings (n=200).

Variables	Yes (%)	No (%)
At home	75.67	24.33
At school	64.4	35.6
In other social settings	82.34	17.66

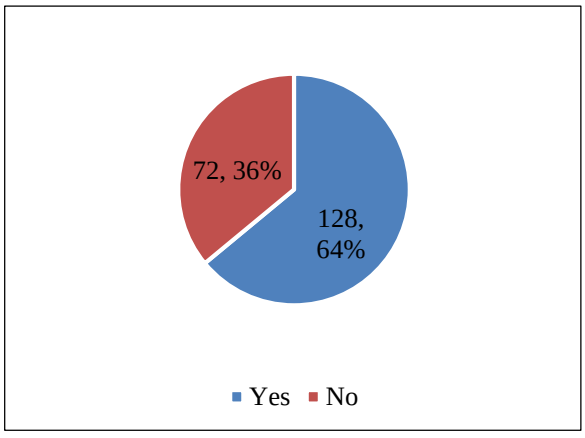

Figure 1: Shortcomings at home (n=200).

On the other hand, regarding the shortcomings in several settings, most of the affirmative response was found at home, which was 63.6%. Then in the second position, it was at school, which was 34.6% (Figure 2 and Figure).

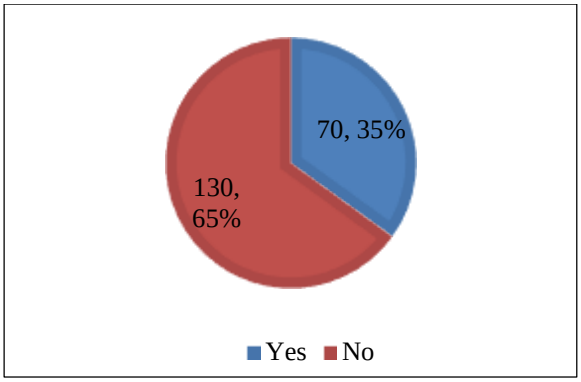

Figure 2: Shortcomings at school (n=200).

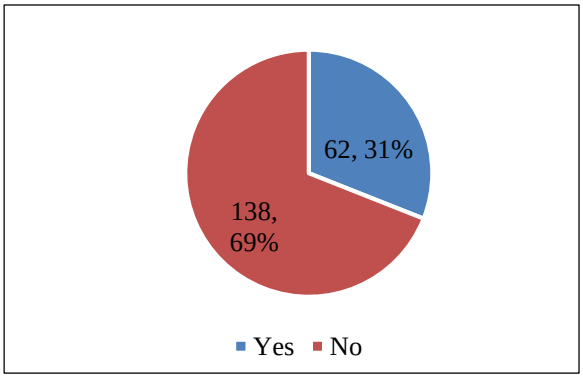

Figure 3: Shortcomings in other social settings (n=200).

Lastly, in other social settings, it was 31.45% (Figure 3). Regarding the convenience at home at first, the respondents reported their children's positive benefits in environmental sound and affirmative responses. Secondly, they reported that their children could hear, speak and interact with families normally. Regarding convenience at school, the maximum number of affirmative responses was found from the respondents. Secondly, they reported about extra activities, socializing with friends and better improvement than home, and lastly about interaction with friends of their children. Regarding convenience in other social settings, the maximum number of respondents reported their children's positive responses in public places at first. Secondly, they mentioned their children's improved socialization, then confidence in other social settings, improved interaction, understanding of background noise and then enjoying the conversation. Among the convenience at several settings as the most benefitted setting 'other social settings' were mentioned by the respondents; then in second position convenience at home and then convenience at school. In shortcomings at home, the maximum number of affirmative responses were reported in any problems at home, then in second position, limitation of hearing, then care and maintenance issues, more time to family adjustment and lastly worried about damage to the implant. In shortcomings at other social settings, the respondents were worried about the damaged processor, then in the second position it was, noticing no sound when the device stop working then worried about visibility, facing problems in a noisy place and lastly care and maintenance issue. In shortcomings at school, the maximum number of respondents mentioned breaking processors, then in second position problems in background noise, care and maintenance issue, problems in understanding the teacher and lastly worried about damage to the processor. In shortcomings at several settings, the maximum number of respondents reported shortcomings at home as the first position, then in the second position, it was shortcomings at school and lastly, it was shortcomings at other social settings.

DISCUSSION

This study aimed to assess the convenience and shortcomings among paediatric cochlear implant candidates. It was reported that more than 70% of subjects reflected traits of speech and hearing that was similar to normal hearing individuals. We found that 76% understood 'speech and voice' commands. Among the total of the children, 77% understood speech while 74% could interact with other family members without difficulty. Environmental sounds were the highlight of home conveniences and topped the results at 80% affirmative, 76% responded well to their home tutor's instruction as opposed to their pre-implant days. It must be kept in mind that these responses were taken solely from parents and as seen in usual circumstances, parents always find it easy to understand their child even in situations where they hardly speak. Srikanth Chundu (2013) in their study had found that the majority of the parents reported a definite improvement in overall hearing (70%).[11]

Therefore, we must be aware that these results have been recorded from a group of parents who are seeing their child interact in a manner that resembles regular kids for the very first time in their lives and is therefore very impressed at even the slightest of changes, thereby overestimating their child's performance. If in another situation these values were to be taken from peers or other slightly distant family members, the results would have varied. The entirety of the study participants fell in the pre-lingual deaf population before implantation, we must mention how these children have all shown significant improvement, not only in academics but also in most formats of peer-to-peer communication. Most evidently, participation in extracurricular activities was seen in 67% of subjects while the very idea of enjoying school, mentioned as "Like to go school" has been reported as affirmative by 74%; 61% of participants socialized better with friends and 59% showed to have true meaningful interaction with friends. About 61% of children performed better at school than at homeschooling. Srikanth Chundu (2013) also demonstrated that they found benefits in education/schooling.[11] School performance improved and also able to go to mainstream school which results also similar to this study.[12] Most of the parents reported kinds

of particular benefits in above mentioned field. On average, significant progress was seen in almost all types of social settings with a staggering 85% showing improved socialization and 82% showing improved interaction. We observed that 79% fulfilled the audition in background noise and enjoyed the conversation. Apart from these proper responses in public situations have been seen in an impressive 86 % of subjects' post-implantation. Srikanth Chundu (2013) also found benefits in improved confidence, improved interaction with other normally hearing children, improved socialization, improved family interaction and confidence in speaking to strangers.[11] These results are also similar to this study. In our study, 75.67% of the subjects answered affirmatively about having convenience at home, 64.40% were positive about school convenience and 82.54% participants found convenience in other varied social settings. In this study, at home, the highest number of shortcomings came in the form of frivolous everyday problems as reported by 67% of the subjects, 64% of the participants reported facing trouble in the area of proper care and maintenance and taking a little too by their family to adjust to the new device. Besides, 64 % subjects faced a limitation of hearing while a meager 58% participants worried about damage to the implant. Chundu (2013) also found shortcomings in high maintenance and care costs, the processor is sensitive, not able to hear music normally hearing children.[11] In analyzing the shortcomings at school and shortcomings in other social settings we found comparable results with the findings of the study conducted by Chundu (2013).[11] The combined analysis of the convenience of use in several settings yielded an affirmative answer from 75.67% of home settled participants, 64.40% of school-going participants, and also 82.34% of subjects in varied social settings. Earlier implantation would cause increased rates of language acquisition because the children were still within the crucial period for their development. Results incontestable that cochlear implantation is also performed safely in very young youngsters with glorious language outcomes. The mean rates of receptive and communicative language growth for kids receiving implants before the age of 12 months in a study shown.[5] Interestingly, being attentive to music was reported as each a profit and a defect. Being attentive to music could be a complex task and, in people with cochlear implants, music listening skills vary considerably.[12] In relevance listening to music, a study examined the changes in self-rated quality of life obtained following cochlear implantation in relevance changes within the individual's complaints in post-lingually deaf patients.[13] They found that patients appreciated hearing music soon after implantation but later dis- likable it due to distortions. For this reason, it'd be helpful to watch the advantages and shortcomings over time. Only 1 parent-reported 'average quality of hearing' with the implant which can be attributed to the upper expectations of the parents and the fact that outcomes of the cochlear implants vary from person to person due to a variety of different factors. The benefits reported by parents during this current study are according to the results that showed the foremost common advantages reported by parents included improvements in hearing, raised awareness of environmental sounds, and improved localization and recognition.[14] The most shortcomings reported in our study are associated with the prices and repairs, which contrasts with the sooner study. The foremost common advantages reported by adult users are within the areas of improved speech, awareness of the sounds, and the skill to use the telephone and listen to music and television.

This study has some limitations. Comparison of the hearing healthcare systems was done mainly considering financial aspects; however, the survey did not probe deep into financial support a parent received towards their children's implantation. For this reason, the results should be treated as preliminary and care must be taken while generalizing these findings. This was a single-centered study with small-sized samples. Moreover, the study was conducted in a very short period. So, the findings of this study may not reflect the exact scenario of the whole country.

CONCLUSION

The study suggests that when assessing the convenience or shortcomings of cochlear implantation among cochlear implanted children, the opinions of their respective parents are a valuable and reliable source of information. The majority of cochlear implant children in this study reported experiencing convenience in social settings outside of their home or school environments. However, it is noteworthy that shortcomings were predominantly observed within their homes.

Recommendations

Supportive home environments: It is recommended that efforts be made to create more supportive home environments for cochlear implanted children. This may involve providing resources and guidance to parents to better accommodate the needs of these children within their households.

Enhancing social integration: Given that convenience was often reported in social settings outside of home and school, it is advisable to encourage and facilitate the participation of cochlear implanted children in various social activities. This can aid in their overall development and well-being.

Further research: To gain a more comprehensive understanding of the factors contributing to convenience and shortcomings in cochlear implantation, further research is needed. This may include exploring the specific challenges faced by parents and children at home and identifying strategies to address them effectively.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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