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Outcomes and Measures of Children with Bilateral Cochlear Implants: A Single-center Experience in Bangladesh

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Abstract **Original Research Article**

Children dealing with hearing impairment encounter challenges associated with speech and language delays, significantly impacting their quality of life. Recent data from the World Health Organization indicate that 466 million people worldwide experience disabling hearing loss, with 34 million being children. Cochlear implantation (CI) is a novel approach for severe to profound sensorineural hearing loss. In pediatric CI, the main objective is to enable hearing-impaired children to perceive sound promptly, facilitating speech and language development. This study investigated the outcomes of bilateral pediatric cochlear implant (CI) users in Bangladesh, applying the Speech, Spatial, and Qualities of Hearing questionnaire and the Classification of Auditory Performance-II (CAP-II). Conducted at the Combined Military Hospital in Bangladesh, the study involved 10 children with bilateral cochlear implants. The results revealed commendable scores in speech understanding, spatial hearing, and qualities of hearing, underscoring the effectiveness of cochlear implant interventions. Deeply examining the implications is the topic of discussion of these findings, emphasizing the positive impact of early implantation and the adaptability of assessment tools in diverse cultural contexts.

Keywords: Hearing impairment, Cochlear implantation, Pediatric, Auditory Performance-II, Speech, Spatial and Qualities of Hearing, Bangladesh.

1. INTRODUCTION

Children facing hearing impairment often confront challenges associated with delays in speech and understanding, significantly impacting their quality of life. Roughly half of children who are severely deaf do not complete high school, and only five percent go on to college. 34 million children worldwide suffer from a disabling hearing loss, out of 466 million individuals worldwide, according to current data from the WHO. It is estimated that untreated hearing loss costs the economy a significant US$750 billion annually [1]. Cochlear implantation (CI) is a groundbreaking neuro-prosthetic procedure for individuals with severe to considerable sensorineural hearing impairment, particularly for those who find conventional acoustic hearing aids to be unsuccessful. When it comes to pediatric cochlear implantation, the main objective is to help children who are hard of hearing to detect sound as soon as possible. This will help them improve their speech and language abilities. The introduction of cochlear implants has revolutionized outcomes for hearing-impaired children. In the United States, over 50% of children with profound sensorineural hearing loss have received at least one cochlear implant, and 75% of these children seamlessly integrate into mainstream schools [1]. Significantly, there is a growing trend towards early implantation, supported by compelling evidence indicating markedly improved hearing outcomes in children implanted at younger ages compared to their older counterparts. The recommended age for optimal outcomes is currently set at under 2 years old, recognizing the impact of neuroplasticity beyond this critical period [2]. Patients have been using bilateral cochlear implants more frequently during the past 10

years in an effort to improve their binaural hearing, namely improving their ability to localize sounds, perceive space, and function in loud surroundings [3]. The scheduling of the implants in a sequential method can affect auditory outcomes. Bilateral cochlear implant (CI) procedures can be performed simultaneously or sequentially. Many factors affect the overall functioning of children with cerebral palsy (CIs), including intrinsic characteristics like cognitive level, the presence of additional disabilities, family size, socioeconomic position, and the management of audiology, healthcare, and education [4]. The evaluation of outcomes for bilateral cochlear implants encompasses multiple parameters, primarily focusing on hearing outcomes and speech-language proficiency, assessed using various questionnaires and auditory scales. The Determinants of Auditory Performance (CAP-II) is one of the most widely utilized assessment tools [5] and the Speech, Spatial, and Qualities of Hearing questionnaire (Gatehouse & Noble, 2004). The CAP-II scales, a non-language-based index, has universal applicability across diverse linguistic backgrounds. It objectively assesses auditory performance and has undergone revisions to enhance its relevance. Additionally, the SSQ questionnaire, originally developed for adults, gauges hearing disabilities across various domains, proving particularly useful in evaluating interventions involving binaural function, such as bilateral cochlear implants [6]. This study sheds light on the experiences of bilateral pediatric cochlear implant users in Bangladesh and offers crucial data regarding the effectiveness of cochlear implantation in this specific demographic.

2. METHODOLOGY

Between January 2018 and November 2019, a cross-sectional descriptive research of cochlear implant recipients was carried out at the Combined Military Hospital in Bangladesh's Otorhinolaryngology, Head and Neck Surgery (ORL-HNS) clinic. The study concentrated on children with bilateral cochlear implants, ensuring a minimum usage duration of 6 months and complete medical, audiology, and speech reports. The entire intervention adhered to the principles of human research outlined in the Helsinki Declaration [7] and was carried out following current regulations and the provisions of the General Data Protection Regulation (GDPR) [8]. Exclusion criteria included cases with incomplete data, defaulted follow-up and rehabilitation, and those unwilling to participate. Interviews were conducted with both the children and their primary parent participants. The performance of each child throughout the interview was categorized using the Categories of Hearing Performance-II. An explanation regarding the SSQ-P questionnaire was then given to the responsible parent. They could spend as much as a month observing children and answering the questionnaire according to predetermined scenarios.

The SSQ-P questionnaire comprises three sections:
(A) Speech Understanding: Evaluating comprehension in quiet environments, background noise, groups, reverberant settings, and on the telephone.

(B) Spatial Hearing: Evaluating how well sound sources are perceived in terms of their position, motion, and distance.

(C) Qualities of Hearing: Identifying sounds and voices, ease of listening, and segregating sounds.

In each section, there are multiple questions for the parent or primary caretaker to rate on a scale of 0–10. The SSQ-P questionnaire is designed to collect information about three crucial aspects of a child's daily functioning when using cochlear implants and/or hearing aids.

Descriptive analysis was utilized to summarize the age of the first cochlear implantation, duration of usage, age of the second implantation, and the interval between the two cochlear implants. Statistical analysis was performed using MS Office tools. The study specifically involved 10 children purposefully selected within the unique context of the Combined Military Hospital in Bangladesh.

3. RESULT

The study outcomes, with reference to the Auditory Performance-II Categories and the SSQ-P questionnaire, provided valuable insights into the daily functioning of 10 children utilizing bilateral cochlear implants (CIs) in Bangladesh. All participants exhibited normal cochlear anatomy with no surgical complications, undergoing the round window approach. Concerning speech (Section A), the results indicate a commendable level of speech understanding, with an average score of 7.5, suggesting positive outcomes in speech-related auditory performance across various conditions. For spatial hearing (Section B), children demonstrated a mean score of 7, reflecting satisfactory abilities to perceive the position, movement, and distance of sound sources. Regarding qualities of hearing (Section C), which encompasses the ability to distinguish between different sounds and speech, make listening easier, and separate sounds, children achieved a mean score of 7, indicating well-rounded performance in these auditory perception aspects. The collective findings suggest positive outcomes in speech understanding, spatial hearing, and qualities of hearing among the 10 children who underwent bilateral cochlear implantation at the Combined Military Hospital in Bangladesh. The mean scores underscore the effectiveness of cochlear implant interventions, emphasizing favorable impacts on the daily functioning of these children. Additionally, all participants exhibited normal cochlear anatomy with no surgical complications. The majority underwent simultaneous implantation using MEDEL Sonata-2 with

an off-the-ear processor, except for one child who utilized an AB device with a behind-the-ear processor following a sequential approach.

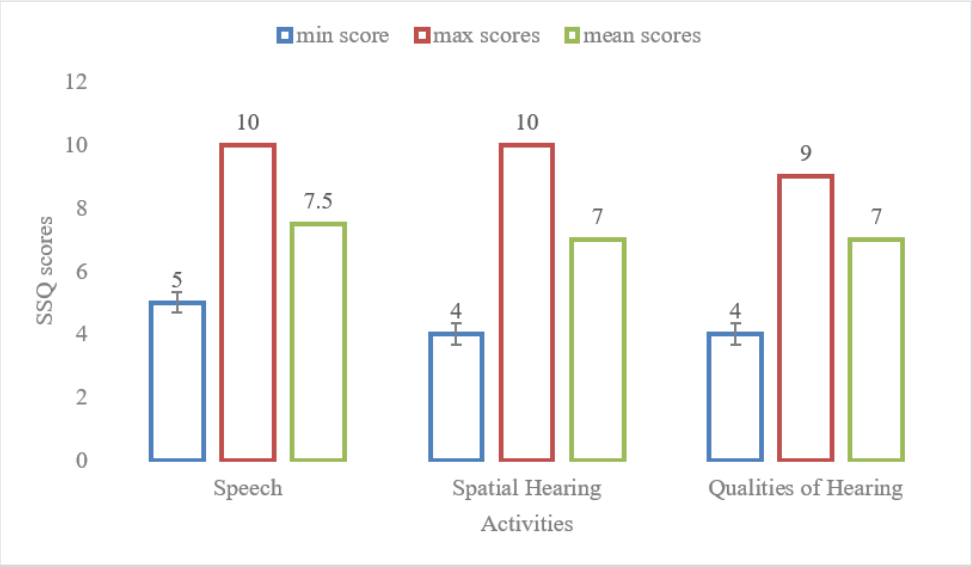

Figure 1: SSQ score distribution

4. DISCUSSION

The findings of this study shed important light on the results of bilateral cochlear implantation in a sample of ten Bangladeshi children. The Criterion of Auditory Performance-II (CAP-II) was used in the study to measure speech understanding, spatial hearing, and hearing characteristics [5] and the SSQ-P questionnaire [6]. The discussion delved into the implications of these findings and their broader significance.

4.1 Positive speech outcomes

The impressive average score of 7.5 in speech understanding (Section A) [6] signifies positive outcomes for the participants. This aligns with the overarching objective of pediatric cochlear implantation, aiming to facilitate early perception of sound and foster the development of speech and language skills. The study indicates that bilateral cochlear implants play a substantial role in enhancing speech-related auditory performance across diverse conditions, underscoring the success of the intervention [1].

4.2 Spatial hearing abilities

The mean score of 7 in spatial hearing, assessed in Section B [6], indicates that the children have satisfactory abilities to perceive the sources of sound's setting, acceleration, and range. The significance of spatial hearing is crucial, especially in dynamic environments. These results suggest that bilateral cochlear implantation has a positive impact on spatial hearing, potentially improving the overall auditory experience for children in real-world situations [3].

4.3 Well-rounded qualities of hearing

The mean score in Section C, which examined aspects of hearing such voice and sound recognition, listening accessibility, and sound segregation, was 7[6]. This suggests that the individuals involved demonstrated well-rounded performance in various aspects of auditory perception. These outcomes are vital for the daily functioning of the participants, encompassing their ability to recognize and interpret sounds in diverse contexts.

4.4 Device utilization and surgical approach

The results emphasize an important aspect related to the use of cochlear implant devices. The majority of participants underwent simultaneous bilateral implantation using MEDEL Concerto, while one child followed a sequential approach with an AB device [3]. This information offers valuable insights into the practical aspects of cochlear implantation in Bangladesh, encompassing considerations such as the choice of devices and the surgical approach.

4.5 Clinical implications

The favorable results of this investigation contribute to the growing amount of data demonstrating the efficacy of bilateral cochlear implantation in underprivileged children [3]. The results emphasize the significance of early intervention and the role of cochlear implants in addressing the auditory needs of children with hearing impairment. Additionally, the study highlights the adaptability and applicability of assessment tools like CAP-II and SSQ-P in evaluating outcomes across diverse cultural and linguistic contexts.

Limitation of the study:

This study was conducted at a single center with a limited sample size. Additionally, the study duration was relatively short. As a result, the findings may not accurately represent the broader scenario of the entire country.

5. CONCLUSION

The study highlights the positive outcomes of bilateral cochlear implantation in 10 children in Bangladesh, showcasing improved speech understanding, spatial hearing, and overall auditory experiences. These favorable results underscore the effectiveness of cochlear implants in enhancing auditory outcomes for children with hearing impairment. The findings provide valuable insights for clinicians and researchers, guiding interventions in Bangladesh and similar contexts. To improve generalizability, future research with a larger and more diverse cohort is recommended. Longitudinal studies could also offer insights into the sustainability of the observed improvements over time.

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REFERENCES

1. Blanchfield, B. B., Feldman, J. J., Dunbar, J. L., & Gardner, E. N. (2001). The severely to profoundly hearing-impaired population in the United States: prevalence estimates and demographics. *Journal of the American Academy of Audiology*, *12*(04), 183-189.
2. Clark, J. H., Wang, N. Y., Riley, A. W., Carson, C. M., Meserole, R. L., Lin, F. R., ... & CDaCI Investigative Team. (2012). Timing of cochlear implantation and parents' global ratings of children's health and development. *Otology & Neurotology*, *33*(4), 545-552.
3. Kraaijenga, V. J., Ramakers, G. G., Free, R. H., Frijns, J. H., Huinck, W. J., & Stokroos, R. J. (2019). No difference in behavioral and self-reported outcomes for simultaneous and sequential bilateral cochlear implantation: evidence from a multicenter randomized controlled trial. *Frontiers in Neuroscience*, *13*, 408982.
4. Govaerts, P. J., De Beukelaer, C., Daemers, K., De Ceulaer, G., Yperman, M., Somers, T., ... & Offeciers, F. E. (2002). Outcome of cochlear implantation at different ages from 0 to 6 years. *Otology & neurotology*, *23*(6), 885-890.
5. Archbold, S., Lutman, M. E., & Marshall, D. H. (1995). Categories of auditory performance. *The Annals of otology, rhinology & laryngology. Supplement*, *166*, 312-314.
6. Gatehouse, S., & Noble, W. (2004). The speech, spatial and qualities of hearing scale (SSQ). *International journal of audiology*, *43*(2), 85-99.
7. World Medical Association. (2001). World Medical Association Declaration of Helsinki. Ethical principles for medical research involving human subjects. Bulletin of the World Health Organization, 79 (4), 373 - 374. World Health Organization. https://apps.who.int/iris/handle/10665/268312.
8. Voigt, P., von dem Bussche, A., Voigt, P., & von dem Bussche, A. (2017). Enforcement and fines under the GDPR. *The EU General Data Protection Regulation (GDPR) A Practical Guide*, 201-217.