Case Report

Relato de Caso

Auditory and oral language abilities in children with cochlear implants: a case study

Habilidades auditivas e linguísticas iniciais em crianças usuárias de implante coclear: relato de caso

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Keywords

Disabled children
Hearing loss
Cochlear implantation
Rehabilitation of hearing impaired
Treatment outcome

ABSTRACT

The cochlear implant (CI) represents the most important advance in the treatment of individuals with severe to profound bilateral hearing loss who do not benefit from hearing aids. Children who receive the CI during the critical period of neuroplasticity of the auditory system, when combined with speech therapy, have the chance to develop the auditory and linguistic skills similarly to their normal hearing peers. Two cases of implanted children are presented in this study, and one of them was not enrolled in a formal aurioral therapeutic program since the implantation surgery. At the moment of language and auditory assessment, the children were 2 years and 5 months old, and the CI had been used for 11 months. According to the results presented, it was observed that the child enrolled in rehabilitation program had better auditory and language performance when compared to the other child. Despite the remarkable benefits that the CI provides to children with hearing impairment, the device itself only provides the child with the audibility of environmental sounds and speech signal. For the auditory and language development to happen, it is necessary, among other factors, a speech-language intervention, with partnership between professionals and parents.

Descritores

Crianças com deficiência
Perda auditiva
Implante coclear
Reabilitação de deficientes auditivos
Resultado de tratamento

RESUMO

O implante coclear (IC) representa o mais importante avanço no tratamento de deficientes auditivos de grau severo e/ou profundo bilateral que não apresentam aproveitamento com o aparelho de amplificação sonora individual. A realização do IC no período crítico da neuroplasticidade do sistema auditivo possibilita que o desenvolvimento auditivo e linguístico de crianças implantadas precocemente sejam semelhantes ao desenvolvimento destas habilidades em crianças ouvintes, quando associadas à terapia fonoaudiológica. Os casos a serem apresentados referem-se a duas crianças usuárias de IC, sendo que uma delas não estava inserida em programa terapêutico com abordagem aurioral desde a realização da cirurgia do dispositivo. No momento da aplicação dos protocolos para avaliação das habilidades auditivas e de linguagem, as crianças estavam com 2 anos e 5 meses de idade e 11 meses de uso do IC. De acordo com os resultados apresentados pelos casos estudados foi possível observar que a criança inserida em programa terapêutico apresentou melhor desempenho auditivo e linguístico, comparada ao desenvolvimento da outra criança. Apesar dos notáveis benefícios que o IC proporciona nas crianças deficientes auditivas, o dispositivo por si só proporciona à criança audibilidade aos sons ambientais e de fala. Para que o desenvolvimento auditivo e linguístico aconteça torna-se necessário, dentre outros fatores, a realização da terapia fonoaudiológica, com parceria entre profissionais e pais.

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INTRODUCTION

The cochlear implant (CI) is the most important progress in the treatment for adults and children with severe to profound bilateral sensorineural hearing loss who do not receive adequate benefit from hearing aids. In recent decades, due to CI technological development and continuous improvement of audiological diagnostic techniques, the indications of the device have included children aged ever smaller[1].

The early CI implantation (up to 3 years old) enables electrical stimulation device activates the auditory pathways concomitantly with the critical period for the development of this sensory system. This provides better opportunities for the acquisition of auditory skills and language towards children operated on later age, in addition to better auditory perception of speech sounds, oral language incidental ownership and better speech intelligibility[2-3].

Despite the remarkable benefits gives by CI for children with hearing impairment, the device itself does not provide the development of auditory and oral language skills. It becomes necessary to insert these children into a rehabilitation program, with an emphasis on auditory function in the development of oral language, with competent and specialized professionals, in partnership with the child's family[4].

The scientific literature suggests that the auditory and oral linguistic development of early implanted children may be similar to the development of these skills in hearing children[5-7], when associated to appropriate rehabilitation program.

In this context, the hearing cannot be considered as single factor in language acquisition process, emphasizing the quality of social interactions as well significant factor in the formation of the child as a subject of language[8].

Considering the issue exposed, the objective of this study was to analyze the auditory and language skills of two early implanted children, which one was not inserted in rehabilitation program in the early months of CI use.

CLINICAL CASES PRESENTATION

The study included two children: one that did not perform aurioral rehabilitation (named in the study as child A) since the first stimulation of the CI and another child who was inserted in therapeutic program with aurioral approach (child B) since the first stimulation of the CI. The studied children were matched for chronological age, time of sensorial deprivation and time of CI use. They were assessed after 11 months of CI use (chronological age = 2 years and 5 months) by evaluation protocols that will be described below.

Child history

Child A

Child diagnosed with profound bilateral sensorineural hearing loss at 5 months old (deaf from unknown causes). The therapeutic process began at 8 months, using hearing aids and speech therapy (aurioral approach). At the moment of CI indication, the child had 1 year and 4 months and was included on a therapeutic program based on aurioral approach.

The CI surgery was performed without complications, with full insertion of electrodes. In the intraoperative testing, the results of impedance telemetry showed adequate functioning of all electrodes and neural response telemetry pointed activity of the auditory nerve to electrical stimulation. The device implanted was Nucleus Freedom – Cochlear Corporation.

At the age of 1 year and 6 months, the child was fitted with her external processor (Freedom processor). The processor was programmed with Advanced Combination Encoders (ACE) speech coding strategy and spectral maximum equal to 12. According to the informant (parent), the child made effective use of the CI, associated with contralateral hearing aids, since the CI first stimulation.

Since the CI first stimulation the child was not referred to speech therapy and this situation remained until the time of the evaluation described in this paper. The child also was not inserted in the school and throughout the day, the child remained with her mother. The family showed participative and interested throughout the therapeutic process. After the assessment presented in this study, the parents regularly bringing the child in speech therapy and serve as good language models and trying hard to implement the techniques suggested at home.

Child B

Child diagnosed with profound bilateral sensorineural hearing loss at 6 months old (deaf from unknown causes). The therapeutic process began at 6 months, using hearing aids and speech therapy (aurioral approach). The speech therapy is done until the evaluation conducted in this study.

At the moment of CI surgery, the child had 1 year and 4 months. The CI surgery was performed without complications, with full insertion of electrodes. In the intraoperative testing, the results of impedance telemetry showed adequate functioning of all electrodes and neural response telemetry pointed activity of the auditory nerve to electrical stimulation. The device implanted was HiRes 90K - Advanced Bionics.

At the age of 1 year and 6 months, the child was fitted with her external processor (Harmony processor). The processor was programmed with HiResolution with Fidelity (HiRes 120) speech coding strategy. According to the informant (parent), the child made effective use of the CI, but did not use the contralateral hearing aids since the CI first stimulation.

Until the moment of the evaluation, the child was not inserted in school and throughout the day, the infant stayed with her mother. The family showed to be participative and interested throughout the therapeutic process, serving as a good language models for the child.

Auditory and oral language abilities evaluation

The procedures for the assignment of hearing abilities were: clinical evaluation of hearing behavior and Infant Toddler: Meaningful Auditory Integration Scale (IT-MAIS), translated and validated for Portuguese[9].

The IT-MAIS is a parents' questionnaire that consists of 10 questions regarding a young infant or toddler's auditory behavior, using examples in three different hearing ability developmental areas. These three areas include vocalization changes associated with using the device, alertness to environmental sounds and attribution of meaning to sounds. Using information provided by parents, an examiner scores each question, according to the occurrence frequency of the behavior, from 0 = never, 1 = rarely, 2 = occasionally, 3 = frequently, and 4 = always. The maximum IT-MAIS score is 40. After application of the hearing behavior evaluation and IT-MAIS questionnaire, the hearing ability of children studied was classified according to hearing categories[10]. The results are available in Chart 1.

The procedures for the assignment of language abilities were: assessment of the oral communication behavior under playful interaction situation and under special activities with the audiologist and the adult responsible for the child and Meaningful Use of Speech Scales (MUSS)[11]. After application of these procedures, the oral language ability of children studied was classified according to expressive language[10]. The results are available in Chart 2.

The MUSS is a parent report scale, which is designed to assess the child's use of speech in everyday situations. It consists of ten inquiries which assess the following areas: vocal control, use of speech without gesture or sign, and use of communication strategies in everyday situations. Using information provided by parents, an examiner scores each question, according to the frequency of occurrence of the behavior, from 0 = never, 1 = rarely, 2 = occasionally, 3 = frequently, and 4 = always. The maximum MUSS score is 40.

All the responsible guardians signed the Informed Consent Term to participate in this study.

DISCUSSION

The benefits provided by CI in development of auditory skills, language, social and academic area are

Chart 1. Results of auditory development

Evaluation	Results	
	Child A	Child B
Clinical evaluation of hearing behavior (Ling's sound)	Detection of all sounds (medium intensity of presentation)	Detection of all sounds (poor intensity of presentation)
IT-MAIS	35.0% The informant reported increased vocalizations with CI and always responds to the name in silent environments, but never exhibits this behavior in noisy environments. The child is always attentive to environmental sounds and discriminate two familiar voices, but never realizes the emotion inherent in the voice.	100.00% The child responds spontaneously to the name in all environments, even in new environments. The child can discriminate different voices and can discriminate ambient sounds from speech sounds. Also notice the emotion inherent in the speaker's voice.
Hearing categories	Beginning Category 2 (Beginning pattern perception) The child is able to discriminate words based on temporal or stress cues (e.g. baby vs. airplane).	Category 3 (Beginning word identification) The child can recognize words in a close-set context, based on phoneme information (e.g. airplane vs. lunchbox).

Chart 2. Results of oral language development

Evaluation	Results	
	Child A	Child B
MUSS	15% The informant reported that the child rarely vocalizes spontaneously to pay people's attention, and there are not vocalization variations, as function of the context.	52.5 % The child vocalizes spontaneously to pay people's attention and produces differentiated vocalizations, according to the context and message.
Expressive language categories	Beginning Category 2 The child speaks only isolated words, produced under repetition and not spontaneously.	Category 3 The child makes simple sentences (with 2 or 3 words).

unquestionable[1-3]. However, the performance of children implanted in these areas mentioned is closely related to factors such as device use, age at surgery, duration of hearing sensory deprivation, etiology of hearing loss, familiar permeability degree in the therapeutic process, rehabilitation program, the existence of additional disabilities, among others[13].

In the cases presented in this study, the CI was indicated and activated at an early age (1 year and 6 months old) and short period of hearing sensory deprivation, which may contribute to the development of hearing and language of the evaluated children, since hearing stimulation provided by CI occurred concomitantly to the period of neuronal plasticity of the central auditory pathways.

Other indicators of success for CI also support the benefit of the device in both cases, as the effective use of the CI, the familiar involvement in the therapeutic process and absence of additional disabilities. However, one of the children studied was not inserted into a rehabilitation program since the CI first stimulation, which may have influenced the auditory and language progress in the first year of CI use[9].

From the hearing perspective, after 11 months of CI use, both children were able to detect all Ling's sounds. In others words, the children were able to detects sounds that cover the speech frequency spectrum (500 Hz to 4 kHz), which are important for speech recognition (Chart 1).

The hearing abilities of children using CI during the first year of device use develop rapidly, especially those implanted early. However, when comparing the auditory performance of the cases, the child A, who was not inserted in the rehabilitation program, underperformed the child B, i.e., the child A had only the ability to detect sounds that is a skill that can already be observed in many cases, at the time of the first stimulation.

Regarding the oral language, there was an increase in vocalizations after CI first stimulation (Chart 2) in both cases, which can be assigned by the auditory feedback provided by the device. However, once again, the linguistic performance of child A appeared inferior to the child B performance, i.e., the child inserted into the rehabilitation program was able to produce sentences with two or three elements spontaneously. While the child not inserted into speech therapy vocalized spontaneously to attract the attention of people and has not performed differentiated vocalizations (Chart 2). To produce isolated words, they needed to be induced by repetition and not spontaneously.

Note that the findings of oral language assessment were obtained primarily by parental report, since this form of assessment provides data that are more representative of the infant universe than the samples from clinical situation assessment, because parents observe children in different situations[14]. Furthermore, in younger children, parental reporting enables more comprehensive and representative data of the child's linguistic universe.

Considering that auditory development is directly linked to oral language development, it is not surprising that child A's linguistic performance is also lower than the performance shown by child B, since the auditory development delayed leads to a delay in oral language development.

In cases of children with hearing loss, the auditory and oral language improves not only with age and development, but also with auditory practice. Thus, it is expected that the auditory and language development continue to occur with CI use and some authors consider that it takes approximately two years of CI use to prove the benefits in young children[13]. But, considering that in child A several positive aspects for success with CI are present, it would be expected that auditory and oral language skills were better than the results observed in the assessment.

FINAL COMMENTS

The results for the auditory and oral language skills of the children showed a worse performance of the child who was not inserted into rehabilitation program in comparison to the child that was inserted into the rehabilitation program.

Despite the remarkable benefits that CI provides to the children with hearing impairment, the device itself only provides the audibility of speech and environmental sounds for CI users. For auditory and language development, it is necessary, among other factors, the realization of appropriate rehabilitation, with partnership between professionals and parents.

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