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Review Article

Effect & Intervention of Hearing Loss in Children: A Short Review

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Abstract

Hearing loss affects every sphere of child's life, from language development to the social wellbeing. Even a mild hearing loss is observed to cause significant effect. New inventions have brought phenomenal changes in the intervention of hearing loss. However, Challenge lie in providing efficient intervention as early as possible.

Keywords: Hearing Loss; Effect of Hearing Loss; Early Intervention; Hearing Aids; Cochlear Implant; Baha.

Introduction

The hearing modality plays a crucial role in effective speech & Language development.Hearing loss leads to disability in communication, mainly speech. This has a profound impact on an individual's life [1]. The effect is not only on the speech but also leads to learning problems, reduced academic achievement, social isolation, poor self-regard & impact on vocational choices. Contrary to common understanding that only a severe hearing loss affects the child's development, even a mild degree of hearing loss has an irreversible impact,if left untreated. Hearing loss at an younger age affects the child's development than at later age [22]. Further early r the intervention lessens the impact of hearing loss. Improvement in technology has lead to phenomenal success in intervention of hearing loss in children. This article provides an insight into the effects of hearing loss and an overview about available intervention methods for hearing loss in children.

Effect of Hearing Loss in Children

Effect on Neural Maturation

First three years of child's life is generally accepted as the critical period of the development. During this time the neural maturation and plasticity is at its zenith.Efficient input of the auditory system is crucial for the development of central auditory nervous system and other neural substrates involved in the language & cognition. During the sensitive period cellular & synaptic plasticity is well observed all through the central auditory nervous system [29]. Altered auditory input would lead to improper frequency representation in the central nervous system (CNS). Physical changes too have been noted in the CNS [12]. In children with hearing loss a significant white matter reduction in Heschl's gyrus is been reported. The impact on the maturation is long lasting [30]. Children who receive cochlear implant late in life get less benefit compared to the

children who were implanted very early in life.Various animal studies have recorded the changes in the central nervous system due to hearing loss. Loss & shrinkage of neurons in [23] cochlear nucleus and [26] superior olivary complex were observed. These peripheral neural maturational effects would be reflected up in the higher centres [21]. It affects the normal maturation of auditory cortex especially the GABAergic transmissions which is a critical determinant of neural networking and dynamic range [14]. It is important to note that these deficits are also observed in partial hearing loss.

Effect on Speech & Language

Children with hearing loss exhibit varied disabilities in speech & language depending on the degree, pattern of hearing loss, age of intervention & type of intervention [32]. More than 50% of children with hearing loss would present with severe language delay at the school going age [24]. Children with hearing loss were found to have less vocabulary compared to the normal children. The author reported that at 3years of age a typically normal developing child would produce approximately 210 words and the mean length of utterance (MLU) would be 3.2 words. In contradiction, a child with profound hearing loss would utter only 35 words & the MLU would be only 1.5 words [27].

Penna L.M. et al. studied the auditory and language skills in 110 children with hearing loss of varied degree of hearing loss. The authors reported that the risk of not developing oral language is 6.2 times & 83.1 times more in children with moderately severe/severe hearing loss & profound respectively; compared to children with mild/moderate hearing loss. Irrespective of the degree of hearing loss majority of children had below normal oral and written language skills. In a three years longitudinal study [7], Blamey PJ et al. evaluated 87 primary school children for speech perception, production & other language measures and postulated that if an effective language intervention is not provided those children would lag by about 4 or 5 years, when they enter secondary school.

Effect on Other Academic Skills [27]

Hearing loss has a negative impact on reading, writing, logical and mathematical reasoning [20]. Even a mild degree of hearing loss can have adverse effect on the academic performance [2]. Children with less severe hearing loss may be left undetected at earlier life and its presence would come out only when they exhibit learning disabilities later in school life.

The complexity of the subjects in the class room would increase by increasing grades [18]. It would be a great challenge for these children to decipher meaning as majority of information would be through verbal mode. Although performance of the children with hearing impairment improves by grade their difference with normal children remains.

Impact of a Mild or Unilateral Hearing Impairment

More often hearing loss is thought of only as a severe hearing loss. Even health professional miss to diagnose a mild degree hearing loss or unilateral hearing loss. Hence, mild & unilateral hearing losses are often left undetected or untreated. The ill effects of mild/unilateral hearing loss on the development of the children hadbeen proven [5].

Prevalence of unidentified minimal hearing loss among young school children in a developed country is around 5.4% [9]. Inefficient or poor perception of speech in children with mild/unilateral hearing loss may result in deficits in speech production. Majority of the time it is misarticulations.

Academic difficulties in children with unilateral hearing loss have been widely reported [3,4]. About 35% of these children repeated at least one grade in school & over that 13% of children required assistance for academic difficulties [25]. The rate of academic failure is almost 10 times compared to the normal hearing children.In addition, children with hearing loss in the right ear were found to experience greater academic risk.Further these children may be socially isolate.

In case of children with mild hearing loss they may not exhibit obvious language deficits but may mishear information, have limited vocabulary & difficulty in understanding speech in noise. All these would affect the academic achievements [5]. Bess et al. reported that children with bilateral minimal hearing loss have academic failure rate of around 37% with 8% needing special academic attention over that. Further these childrenperformed significantly poor in reading, language mechanics, word analysis, spelling and science [28]. The academic achievement gap (below 2 SD) between the normal children and the children with minimal/ unilateral hearing loss is significant [6,10]. These children had poor vocabulary, reading comprehension, language use, receptive vocabulary, verbal ability and reasoning scorescompared to the normal children.

These children also have psychosocial issues that needs be addressed [5]. They feel less energetic, stressed, lower social support & self esteem (Bess et

al. 1998) [17]. The feeling being of stressed & drained out may be due to the high listening effort exerted by these children [16]. Physiological evidence to the fatigue is reported by using physiological measures. Children with hearing loss are more fatigued in a classroom where they are involved in multiple tasks.

The impact of mild/moderate hearing loss hearing loss on the family and the education is high [11]. The effect on language & the scholastic achievement in these children may not be a transient phenomenon but could extend lifelong. In a study, involving 19 adolescents (aged 11–15yrs) with mild/moderate Sensori-neural hearing loss (SNHL) the researchers compared the language performance of these adolescents with a group of typically developing & a group of adolescents with specific language impairment (SLI). The hearing loss group exhibited language deficits as that of the SLI group. This supports that hearing loss in the early years has a longitudinal effect.

Intervention of Hearing Loss in Children

The conventional interventional therapeutic methods followed by special educators and the speech language pathologist provide the basis of intervention. Though not very recent, auditory verbal therapy (AVT) had added new philosophies to intervention methods. Aural-oral approach, sign language or an eclectic approach is followed in the intervention depending on many factors, especially, the degree of hearing loss. Through age the improvements in technologyhad led to drastic improvements in the intervention of hearing loss in children. In addition, the current stress on early identification of hearing loss has made these interventions effective. Hearing aids, bone anchored hearing aids & cochlear implants are the common aids used in the intervention.

Hearing Aids

Hearing aid fitting is the most popular and the traditional interventional method for the intervention of children with hearing loss. Paediatric Audiologists face a challenge from the very beginning viz., estimation of the correct hearing threshold. In addition, the hearing aid benefit verification needs a sincere and a specialist approach [2]. To take the advantage of the critical period of development, intervention as early as 6 months of age is desired. Hearing aids are basically sound amplification devices; however, technological advancements have added a wide range of options basically to improve the speech understanding. It is of various types depending upon technology viz., analogue, programmable & digital and, where it is fitted viz., body level, behind the ear, in the ear, in the canal & completely in the canal. The type of hearing aid is selected based, on the scientific methodology and sometimes on the affordability. There are various formulae which are directive for effective hearing aid fitting. The Audiologists take into account various factors including predicted hearing thresholds, behavioural& electrophysiological hearing aid benefit measures, formulae and others. Fitment of a wrong hearing aid affects the child equally or even more not giving a hearing aid at all. The wrong fitment can damage the ear of its residual hearing or it may lead to poor hearing aid benefit thereby, child rejecting it. It would lead to an unwarranted situation of the parents having informed about the importance of an early intervention and the child denying it. In addition, hearing aid fitting in children is equally science and an art. It demands investment of enough clinical time. The fitting has to be carried out in phases and counselling the parents is as important as that of the correct selection procedure.

Bone Anchored Hearing Aids (BAHA)

[13]The BAHA system uses an osseointegrated titanium implant into the mastoid portion of the temporal bone. The principle behind these devices is that when the skull is vibrated, here, the mastoid region, the sound energy directly reaches the cochlea through bone conduction. It bypasses the middle ear viz., the air conduction route. It is a mode of intervention, when there is a significant conductive pathology (unresolved for various reasons) and the use of hearing aid not warranted. In conductive hearing loss, middle ear impedes the sound conduction. It may lead to, not enough sound energy reaching cochlea, defeating the whole process of the intervention [13]. This device is effectively used in children with congenital aural atresia. BAHA is of two type's viz., the soft band & the surgically placed bone anchored type. The head band type is generally for temporary time duration. It is either fitted before a surgically placed bone anchored hearing aid (BAHA) or during bouts of conductive hearing loss. However, in certain time it is advised for permanent use if the surgery is contraindicated or the parents refuse surgical procedure.

Cochlear Implants

Cochlear implants (CI) are considered as the zenith of technology in the intervention of children with severe to profound hearing loss. This is a bio

electronic device, where a series of electrodes are surgically implanted into the inner ear. The sound is transmitted by the microphone to the speech processor where the processing of the speech signals take place. The processed speech signal is then transmitted to the internal implant via radio transmission and finally reaches the implanted array of electrodes. These electrodes which carry the electrical signal directly stimulate the auditory nerve, thus bypassing the damaged inner ear. With stimulation of the auditory nerve the information reaches the brain and the sound is perceived. Children as young as 12 months old are considered for implantation. The outcomes of children with CI have been tremendous. Critical factors that influence the prognosis includes (1) age at the onset of hearing loss and the duration of deafness, (2) progression of hearing loss, (3) educational setting and (4) unilateral Implantation.It is also seen that these children develop speech and language skills at a rate that is comparable to children with normal hearing.Encouragingly, it was also found that an early intervention before one year of age allows the child to develop language in normal range [8]. In spite ofall modifications and improvements in the candidacy criteria over the years, with growing evidences from various research studies being carried out worldwide, there is a dire need for reassessment of the paediatric CI candidacy in order to make CI available for many children.However, the success of CI lies on the implementation of the stringent candidacy selection.

Conclusion

Effect of hearing in various dimensions of life in children had been widely reported. Though children with more severe hearing loss may face more challenges, the effect of milder hearing loss is still not looked into in the developing countries. With the advent of new technologies the effect of hearing loss on the children's life can be efficiently minimised. Health care professionals ought to be aware of the effects and the interventional methods, so as to, provide valuable information to the parents without any delay.

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