Critical Review: How do children with cochlear implants perform in mainstream education compared to normal hearing peers?

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This critical review examines the performance of children with cochlear implants in mainstream education in comparison to their normally hearing peers. Study designs include quantitative research with the administration of instruments to assess overall performance and compare results between children with cochlear implants and age-matched normal hearing peers. Overall, research suggests that children with cochlear implants in mainstream education do not perform as well as their normally hearing peers. More specifically research reveals the deprivation of children with cochlear implants in the area of communication compared to their normal hearing peers and suggests that support may be needed for children with cochlear implants in mainstream education for development of age-appropriate communication skills. Further, some research also suggests that the tools implemented in research be used as a predictive tool for language development of children with cochlear implants in mainstream settings.

Introduction

With the advent of cochlear implants our expectations for auditory verbal communication ability in children with profound hearing loss have changed. Previous to cochlear implants many children with profound may have been fitted with hearing aids and/or educated using ASL or Total Communication. Cochlear implants have changed educational approaches. Deaf children with cochlear implants have been shown to have better language comprehension and production than deaf children with hearing aids (Toblin et al, 1999). Geers et al (2003) administered various language tests to 181 children between 8 and 9 years of ages in the United States and Canada who received cochlear implants by 5 years of age and found that more than half of the children performed as well as their normal hearing 8 to 9 yr old peers. With improved auditory verbal communication in children with profound hearing loss due to early identification and cochlear implantation many children are being mainstreamed in educational placement. Unfortunately many children are being mainstreamed regardless of auditory verbal communication ability. Mukari et al (2007) noted a bias in Malaysia toward mainstream education for children with cochlear implants even for those with minimum spoken language. Assessment of how these children are performing in comparison to their normal hearing peers may be necessary to identify children in need of educational support to acquire age appropriate language and communication skills.

Objectives

The primary objective of this review was to critically evaluate the existing literature regarding the performance of children with cochlear implants in mainstream education. The secondary objective was to propose evidence--based recommendations to audiologists and educational support professionals who may be involved in the decision making process for educational placement of children with cochlear implants.

Methods

Search Strategy

Computerized databases including PubMed and Medline were searched using the following search strategy:

(cochlear implants) OR (cochlear implantation) AND (children) OR (pediatric) OR (school-age) AND (mainstream) OR (public) and (education) or (school)

The search was limited to peer--reviewed articles written in English between 1990 and 2008.

Selection Criteria

Studies selected for inclusion in this critical review were required to investigate the overall performance of children with cochlear implants in mainstream education. No limits were set on the age at which children were implanted, the age at which they entered mainstream education, the research methods, or outcome measures used.

Data Collection

Results of the literature search produced the following types of articles consistent with the previously mentioned selection criteria: non-experimental between-subjects design yielding qualitative and quantitative data and non-experimental

within-subjects design yielding qualitative and quantitative data.

Results

Damen et al (2006) administered the Assessment of Mainstream Performance (AMP-K for kindergarten students and AMP-E for elementary students) and Screening Instrument for Targeting Educational Risk (SIFTER) completed by teachers for 32 prelingually deafened students with cochlear implants and 35 randomly selected normal hearing peers. The results of the AMP-K showed that both children with cochlear implants and normal hearing peers were performing to their ability in class 75% to 90% of the time (mean AMP-K scores of 4.6 and 5.3 respectively). Children performing to their ability participated in class activities and showed age-appropriate behavior.

The results of AMP-E showed that children with cochlear implants performed to their ability 51% to 70% of the time compared to their normal hearing peers who performed to their ability 75% to 90% of the time (mean AMP-E scores of 4.1 and 5.0 respectively) resulting in a significant difference between the children with cochlear implants and their normal hearing peers on AMP-E scores ($p < .001$). Furthermore, the peak scoring differences between the students with cochlear implants and normal hearing peers were in questions on communication breakdown, engagement in group discussion, turn-taking abilities or leadership. When duration of deafness was examined, significantly higher overall AMP results were found for children with periods of deafness shorter than 4 years ($p < .01$).

The results of the SIFTER were obtained and were coded into three categories: failure, marginal or sufficient. The results showed that overall the children with cochlear implants had sufficient outcomes but significantly poorer than hearing peers in 4 out of the 5 areas of the SIFTER ($p = 0.1$ for Academics and $p < .001$ for Attention, Communication and Class Participation). Children with cochlear implants in kindergarten scored marginal on Communication performing significantly worse than normal hearing peers (SIFTER Communication scores 8.83 and 12.17 respectively $p < .001$). Elementary school children with cochlear implants in the study failed on Communication, performing significantly worse than their normal hearing peers (SIFTER Communication scores 7.2 and 11.4 respectively, $p <.001$). These results suggest poorer communication skills in students with cochlear implants of all ages. When children with cochlear implants were compared with their matched normal hearing classmates only the Communication scores of the SIFTER differed significantly ($p = .04$) the normal hearing classmates outperforming their cochlear implanted classmates.

In summary, the results of Damen et al (2006) indicated deprivation in the area of communication for the population of cochlear implanted children in mainstream education compared to their normal hearing peers as reflected by the results of the AMP-E and the SIFTER.

Damen et al (2007) conducted a study using 26 of the participants from the previous study, excluding children in kindergarten, using the AMP and SIFTER with the same methods and obtained similar results. The children with cochlear implants were rated as "failure" on the communication domain of the SIFTER. Consistent with the previous study these results suggested deprivation in the area of communication for these children. Further Damen et al (2007) conducted language testing using the Reynell test of comprehension and the Schlichting test of expression to assess the relationship between classroom performance and language development in children with cochlear implants in mainstream classrooms. The researchers reasons for selection of these tests for purposes of this were not given.

The results of language testing showed that, on average, children with cochlear implants lag 30 to 35 months behind normal hearing peers in expressive and receptive language development. Further Damen et al (2007) found that there was a significant negative correlation between the number of months behind in language development and AMP and SIFTER instrument results. Children with better scores on these instruments had shorter lags in language development ($p < .01$).

Using the general linear model univariate procedure to provide regression analysis and analysis of variance for one dependent variable the researchers found that 10 of 22 items of the AMP and 3 of 15 items of the SIFTER correlated significantly with the language test results ($p < .03$). The authors suggested from this correlation that both instruments, especially the AMP, had predictive potential and could be used as a predictor for language development in children with cochlear implants in mainstream education.

In summary, the results of Damen et al. (2007) showed repeatability of previous results obtained by Damen et al (2006) in the same population. The results of Damen et al (2007) also showed a relationship between language development or lag in the development of language and results of the AMP and SIFTER instruments for children with cochlear implants in mainstream education suggesting predictive value of these instruments.

Mukari et al (2006) conducted a study with 20 school-aged pre- and postlingually deafened children with cochlear implants in mainstream classes using SIFTER, speech testing, examination results and academic standing in the subjects of language,

mathematics and overall academic performance to assess their performance in mainstream education and compare performance to their normal hearing peers.

The results of the SIFTER indicated that the children with cochlear implants scored well on class behavior and participation subscales but very poorly on communication subscale with 76.5% failure rate. On school examinations children with cochlear implants scored significantly better in mathematics than language (mean scores 62.67% and 49.96% respectively, $p < .01$).

A correlational analysis showed a significantly positive correlation between the number of SIFTER components passed and scores on mathematics, language and overall examination scores. These findings suggest a predictive value for the SIFTER in the area of communication as was suggested by Damen et al (2007) as well as in the area of mathematics and overall examinations.

Mukari et al (2006) compared children with cochlear implants to their normal hearing grade-matched peers by categorizing their percentage scores into three categories: below average, average and above average. They found that nearly half (43.8%) of the children with cochlear implants fell into the below average category for language, performing poorer than their normally hearing peers. They also found that most (87.5%) of the cochlear implanted children were performing at or greater than average in mathematics, as well as or better than their normal hearing peers.

In summary, the results of this study showed poor performance in the area of communication for children with cochlear implants in mainstream education as evidenced by results of the SIFTER, final examinations and academic standing in comparison to their normal hearing peers. These results are consistent with the findings of the previously mentioned studies.

Discussion

All of the reviewed studies examined the performance of children with cochlear implants in mainstream classrooms. The results of all three studies suggested that children with cochlear implants in mainstream classroom showed a deficiency in age-appropriate language and communication skills when compared with normal hearing peers. However, there were a number of limitations to the findings.

First, all studies used small sample sizes without random selection of children with cochlear implants. The studies reviewed had sample sizes of 32, 26 and 20 cochlear implanted children. This can partially be justified due to the currently small population of children with cochlear implants in mainstream education with other common demographics. The results obtained with small sample sizes may not, however, be a true reflection of how all children with cochlear implants perform in mainstream education and may limit the generalizability of the results.

Second, there were limitations in the number and type of measurement tools used to assess overall performance. In two of the studies reviewed, Damen et al. (2006) and Damen et al. (2007) there were only two main measures of the children's overall performance, the AMP and the SIFTER. Although the SIFTER is a relatively well known screening instrument used to assess educational risk, the AMP, as noted in Damen et al (2006) had only been used in one other study. In addition, both measures used were teacher-rated measures. The questionnaires were completed by a different teacher for each child. This may have an effect on the reliability of the measures. Interrater reliability was not assessed in any of the studies reviewed.

Third, none of the studies reviewed were completed in North America or with English speaking populations. Two of the studies, Damen et al. (2006) and Damen et al. (2007), were completed in Nijmegan in the Netherlands. Presumably the language of instruction for the children in this study was Dutch since Dutch speech tests were utilized. The language of instruction was not, however, stated in the article. Mukari et al's (2007) study was completed in Malaysia with Mandarin and Malay as the languages of instruction in the schools. Since all of the studies were completed outside of North America and in languages other than English the amount to which the results may be generalized to children with cochlear implants in other education systems and with different languages of instruction may be limited.

Due to the limitations of the studies reviewed the question of how children with cochlear implants perform in comparison to their normal hearing peers still remains somewhat inconclusive.

Recommendations

Caution should be taken in deciding whether or not to enroll children with cochlear implants into mainstream education. Assessment of language and communication skills should be strongly considered before and during enrollment in mainstream education. The limited evidence available has suggests that many children with cochlear implants in mainstream education, when compared with normally hearing peers, are deficient in age-appropriate language and communication skills. Educational support targeted at development of language and communication skills may be necessary.

Assessment tools such as the AMP and SIFTER have be shown to have predictive value for assessing potential development of language skills in these children. These and other language and communication assessment tools should be employed to identify children in need of educational support whether

as an alternative to, or in combination with, mainstream education.

Further research is required in order to more clearly portray the performance of children with cochlear implants in mainstream classrooms and to understand the appropriateness of mainstreaming children with cochlear implants.

Future studies should be performed with English speaking populations, and larger sample sizes, additional standardized assessment tools, external unbiased raters and/or assessors of performance. Future research should also evaluate methods to assess educational support and whether they can enable children with cochlear implants to achieve the language and communication skills necessary to succeed in mainstream education.

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