Instruments to assess the oral language of children fitted with a cochlear implant: a systematic review

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Received: July 26, 2010 - Accepted: August 16, 2011

ABSTRACT

The oral language development depends on the effective development of the hearing system. In cases of children presenting with hearing loss, a cochlear implant is an electronic device indicated to (re)habilitate the hearing function. Thus, it is of paramount importance to assess and follow the oral language development of children fitted with a cochlear implant (CI) to measure the effectiveness of the electronic device and support the therapeutic planning of these children. Questions are currently being raised about the instruments to assess the oral language of children using a CI, and, seeking the answers, this systematic review aimed at surveying these instruments. Searches were performed in three different databases utilizing six different descriptors to select articles published from 2004 to 2009 that performed an oral language assessment of children with a CI. Initially, 373 articles were found, and, after the application of inclusion criteria, 47 articles were analyzed, resulting in a survey of 74 instruments for oral language assessment, including tests, questionnaires and inventories. In analyzing the articles, it was realized that the studies included in this systematic review presented varied methodologies and low levels of evidence, with a greater concentration of instruments assessing receptive and expressive language, emphasizing the survey of the child's vocabulary and questionnaires. Thus, it can be verified that other linguistic skills, such as morphosyntactic, semantic, and narrative-pragmatic ones that are important in structuring speech and language for the effectiveness of the child's speech, are not being focused on. Just one of the instruments cited, a questionnaire, was specific for the oral language assessment of children with cochlear implants.

Key words: Cochlear implantation. Language. Language tests. Child. Preschool.

INTRODUCTION

Hearing is the main sense for the development of communication and language. Any hearing deprivation may interfere with the development of oral language since it prevents the perception of speech acoustic traces or the comprehension of the meaning of the words the child has heard[14].

In the first few months, the child's productions are reflex behaviors and, throughout the early years, it is the child's hearing that exerts direct control in the development and acquisition of language and speech[16].

For children presenting with hearing loss, it is known that the earlier the hearing loss is detected, the better the prognosis will be since it is in the first years of life that greater neuronal plasticity activity takes place[2].

Children who face greater difficulties to develop their oral language are those who present sensory-neural severe or profound hearing loss, and, in cases of more profound degrees, there is no oral development if the child is not habilitated early[14].

Therefore, in cases of severe or profound

sensory-neural hearing loss, the cochlear implant (CI) is a device aimed at restoring the hearing perception by directly stimulating the auditory nerve[3].

The literature[9,13] indicates that the CI causes significant improvement in speech perception skills, which is extremely important in the acquisition and development of oral and written language. Furthermore, with technological advances, signal processing strategies in the CI have been improved, allowing better speech perception and comprehension.

Thus, it is believed that oral language acquisition is related to hearing and depends on the first phases of infantile maturation. Research with children using CI confirms that the development of hearing perception and oral language skills of children implanted prior to 12 months[4-7] and 24 months[1,6-13] of age is superior compared to that of children implanted following this period.

Taking into account the narrow relation of hearing dependency for language development and the fact that the CI is a device that allows this relation to be constituted, it is extremely important that implanted children be subjected to assessment and follow-up of their oral language development. Questions are raised about the instruments currently utilized to assess the oral language of children fitted with a CI.

Thus, this systematic review aimed at surveying the instruments utilized in such procedures.

MATERIAL AND METHODS

This systematic review followed the parameters indicated by the Cochrane Center of Brazil (http://cochrane.bvsalud.org). Initially, the inclusion and exclusion criteria of the articles found through searches in the PubMed (http://www.pubmed.gov), LILACS (http://www.bireme.br) and SciELO (http://www.scielo.br) databases were determined.

The following descriptors (according to DeCS/Mesh) were utilized to search the databases: 1) cochlear implantation; 2) language; 3) language tests; 4) children; 5) preschool; and 6) infant. The combinations were: 1-2-4, 1-2-5, 1-2-6, 1-3-4, 1-3-5, and 1-3-6. Descriptors in Portuguese were used for the searches in LILACS and SciELO, and descriptors in English were used for PubMed.

The inclusion criteria were: 1) article publication in the years 2004-2009; 2) mention in the title or abstract of the oral language assessment of implanted children; 3) availability both in English and Portuguese; 4) availability in full; and 5) passing of the analysis of the evidence standard. Article selection was performed by two different researchers, aiming at comparing the results achieved.

A difference was seen in the results of each researcher in PubMed. Researcher 1 used simple research by manually separating each descriptor by the operator "AND", and Researcher 2 utilized advanced research in which each descriptor was placed in a specific line and automatically separated by the operator "AND". It should be noted that the search method performed by each researcher was randomly decided, and just during the crossing of the articles retrieved, the variability between the searches was perceived (Figure 1).

The following selections were performed in each phase: 1) Phase 1: Total number of articles found in the database using the descriptors; 2) Phase 2: Number of articles that mentioned language assessment procedures in the title or abstract; 3) Phase 3: Number of articles available in English or Portuguese; 4) Phase 4: Number of articles after the crossing between researchers; 5) Phase 5: Number of articles available in full; 6) Phase 6: Number of articles that reported on the oral language assessment of the sample researched. It was necessary to perform the sixth phase because the use of the descriptors "language" and "language tests" was found in the descriptions of the methodology of some articles to discuss written language/speech perception tests. Hence, these articles were excluded, for they did not assess the child's oral language.

The criteria described by Cox[5] (2005) were used to evaluate the evidence standard and recommend the articles. The evidence level varies from one to six and the degree of recommendation from A to D, that is, level 1: systematic reviews or meta analysis of random clinical studies or other quality studies; level 2: controlled random clinical studies; level 3: nonrandom intervention studies; level 4: cohort, control-case, cross-sectional studies

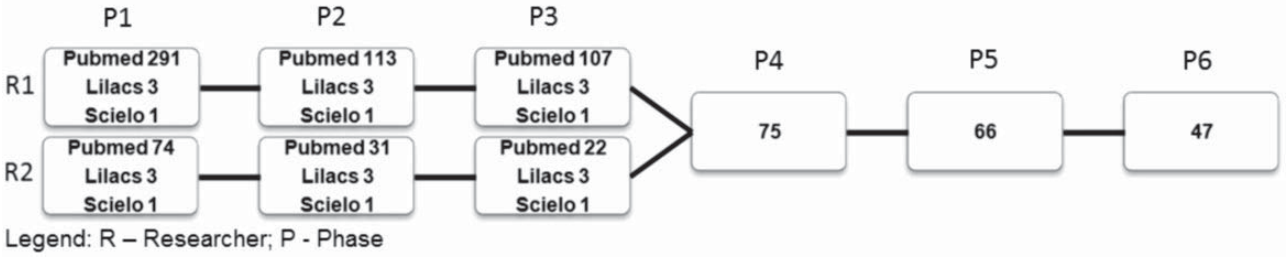

Figure 1- Phases of article selection

and non-controlled experiments; level 5: case studies; and level 6: specialists' opinions. The degree of recommendation is defined from the level in which the article fits and the conclusion it presents, whether it extrapolates the data or not, with A being the best degree. Nevertheless, the evidence standard cannot be a selective criterion since the studies included in this systematic review presented methodological variability and low levels of evidence, with 46 articles at level 4 and one article at level 5.

RESULTS

As a result, 47 articles were analyzed, of which 21% were from 2004, 6% from 2005, 11% from 2006, 17% from 2007, 32% from 2008, and 13% from up to October 2009. The 47 articles selected showed that the size of the samples described varied from one (case study) to 285 subjects, determining the minimum and maximum, respectively. All articles had CI users as the target population, and 19% of these articles compared the implanted group with those of normally hearing subjects, hearing aid (HA) users, and other groups. The age range of the sample at the time of assessments was described distinctly in the articles: hearing age, which varied from 5 months to 7 years, and chronological age, varying from 6 months to 15 years.

Regarding the designs of the studies, the articles selected were 80% cohort studies, 15% cross-sectional, 2.5% control cases, and 2.5%, case studies. Nevertheless, as mentioned in the methodology, it should be emphasized that the evidence standard cannot be a selective criterion since the studies included in this systematic review presented variability in the methodology and low levels of evidence.

During the research and analysis of the articles, besides language tests, information was sought on questionnaires and inventory software to analyze the transcription of oral language samples. These data were analyzed aiming at assessing the child's oral language. Hence, tests, questionnaires, inventories, and programs will be termed "instruments". Cognitive skills tests were analyzed as well, for they were often utilized in the survey of linguistic skills.

Seventy-four instruments were utilized in the methodology of the 47 articles analyzed, and, owing to the variability of the instruments found, we chose to divide them into categories according to the type and goal of the instrument mentioned in the article (Figure 2). Among the 74 instruments found, 50 were uncommon and 24 were re-editions, adaptations, or translations edited by different authors; therefore, they were categorized separately.

The five most often-used instruments, in their different versions, were found to have the following percentages: 11.54%, 9.22%, 4.62%, 4.62%, and 3.85%, respectively:

Peabody Picture Vocabulary Test (PPVT), created in 1959 by Dunn and Dunn, currently available in different versions and translations, and described as an assessment test for receptive language.

Reynell Developmental Language Scales (RDLS), cited as a test to assess receptive and expressive language. The first version was described by Reynell and Huntley in 1985 and is currently available in different versions and translations.

MacArthur Communicative Development Inventories (MCDI), created by Fenson, et al. in 1993, are utilized to assess children's lexical development.

Meaningful Use of Speech Scale (MUSS). This

Categories	Number of instruments
Receptive and expressive language tests	19
Questionnaires/Checklists/Scales/Inventories	12
Receptive language tests	11
Cognitive skills tests	10
Expressive language tests	8
Articulatory/phonetic/intelligibility precision tests	4
Recording (transcription) analysis program	4
Motor, cognitive, and behavioral skills tests	2
Neuropsychological test	1
Syntactic analysis protocol	1
Oral and written language test	1
Proficiency test	1
Total	74

Figure 2- Number of instruments found by category

questionnaire created by Robbins and Osberger in 1990 assesses the use of oral language in children presenting with hearing impairment.

Clinical Evaluation of Language Fundamentals (CELF), developed initially by Wiig, Secord, and Semel in 1992, is available in different versions and translations and assesses receptive and expressive language.

DISCUSSION

Regarding the general data of the articles, variability in the number of participants in each research study and research article, including children of different ages in a single analysis group, was noticed initially. It was possible to realize, also, that the number of research studies utilizing a comparison group (control) was low (19%). These data indicate the difficulty to of performing a systematic review with high evidence standards in the field of speech pathology. A similar study[8] aimed at analyzing the results of systematic reviews encompassing the areas of speech therapy, language, and hearing presented the same conclusion as to the design of research studies performed in the area, methodology variability, and low level of evidence.

Of the 47 articles selected that were published between 2004 and 2009, it was noticed that, except for 2004, which presented a high percentage of articles published in the field, each year showed an increasing number of publications, suggesting that more and more research has taken place to study the oral language of children using a cochlear implant.

As to the instruments, the variability of tests utilized in the assessment of the oral language of CI users was observed, and none of the tests were reported to be specifically designed for this population, and, within the "Questionnaires/ Checklists/Scales/Inventories" category, only the Meaningful Use of Speech Scale (MUSS) test, developed by Robbins and Osberger in 1990 and adapted by Nascimento in 1997 in Brazil is described as a specific instrument to assess the language of hearing-impaired children. Currently, the MUSS is a widely utilized instrument in the services to assist the hearing impaired in Brazil.

However, a Brazilian research study[15] has shown that the results of assessments conducted using this test may be different from those found through observation of the child, and one of the reasons may be that these results reflect the view of caregivers regarding the child. This finding raises the importance of elaborating and standardizing objective tests to assess children's oral language. Furthermore, it reinforces the value of clinical observation of children and highlights the fact that professional insight is indispensable in diagnosis and therapeutic procedures.

Another factor to be taken into account in this discussion is the difference between the methodologies of test application, realized during the reading of the articles, with some applications performed in full and others just done with subtests available in these tests. This is another issue that interferes with the possibility of performing a systematic review with high evidence-standard studies in the field.

One of the studies found[13] reports that the longitudinal assessment of children fitted with cochlear implants is extremely important and mainly that previously utilized and standardized instruments must be utilized.

The category with the greatest number of tests was the receptive and/or expressive one. It should be highlighted that, in a more detailed analysis of the articles, we realized that most tests in this category aimed at surveying data of the children's receptive and expressive vocabulary; in particular, the Reynell Developmental Language (RDLS) test, in its different editions, was most often utilized in the assessments. Thus, it can be seen that other linguistic skills, such as morphosynctact, semantic, and narrative-pragmatic ones, which are important to structure the speech and language and the effectiveness of the child's speech, are not being focused on.

A research study has reported that early implantation is an important facilitator in expressive language development; however, it highlights the importance of studies conducted to explore aspects of the development of morphology, phonology, syntax, and semantics in this population[18], mainly to verify whether the child needs an intervention in a given area[10]. Other authors[11-17] have reported that all aspects of oral language must be analyzed and taken into account in future studies, including intelligibility measurements of the child's speech and more thorough measurements of language development in specific skills, such as the use of grammar[17] and the analysis of discursive skills[11].

Only three of the 47 articles analyzed were Brazilian, and they utilized the following instruments: MacArthur Communicative Development Inventories (MCDI), Reynell Developmental Language (RDLS), and the Meaningful Use of Speech Scale (MUSS). The edition year of the instruments surveyed by this review ranged from 1974 to 2007, a period in which some articles utilized re-editions for data collection. It is believed that the variability in the methodology of test application may be related to the edition time of the instrument, which, in time, was adapted and not reedited.

Finally, it was noticed that most studies included in this review researched to measure

the effectiveness of cochlear implants in the development of hearing skills and oral language compared, or not, with other groups of children. Thus, the importance of oral language assessment and its development, the main goal of cochlear implants, was the primary focus.

CONCLUSION

Initially, it was verified that the studies included in this systematic review presented variability in methodology and low levels of evidence, which hampered the selection of the articles from a cut point of the evidence standard. Thus, we rejected this measure as a selective standard of the articles.

Taking into account the goal of surveying the instruments used for oral language assessment of children using cochlear implants, one may conclude that, of the 47 articles selected between 2004 and October 2009, 74 instruments were utilized.

A greater concentration of instruments used for the assessment of receptive and expressive language was noticed, with an emphasis in the survey on the child's vocabulary, as well as on questionnaires and tests of receptive language and cognitive skills. Thus, it was possible to verify that other linguistic skills, such as morphosyntactic, semantic, and narrative-pragmatic ones that important in the structuring of speech and language and for the effectiveness of children's speech, were not focused on. Nevertheless, several articles report the importance of further studies in these fields.

Finally, of all the instruments analyzed in the articles reviewed, specific tests to assess the oral language of children using cochlear implants were not cited, but a specific questionnaire was found to assess the language of these children, the Meaningful Use of Speech Scale (MUSS).

All facts surveyed point to the need to develop, apply, and standardize tests and other specific instruments for this population, as well as research focusing on other linguistic skills of children fitted with cochlear implants. Beyond vocabulary alone, language analysis in all its components (phonetic-phonologic, morphosyntactic, semantic, narrative, and pragmatic factors) must be encompassed in future research.

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