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Language impairment in children with CI: An investigation of Swedish

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Abstract

In spite of earlier implantation, bilateral implants and advances in the care of deaf children with cochlear implants (CI) within-group variation in language skills is large. We use three tasks with predictive value of language impairment in Swedish to identify children with CI most at risk for persistent difficulties in language development, in need of language intervention. The clinical markers investigated are nonword repetition and past tense inflection. We also assessed language comprehension, a predictor of severe language impairment associated with poorer prognosis. Fifteen Swedish-speaking deaf children with CI and 15 controls aged 5–8 years participated. Most children with CI had bilateral implants and had been fitted with CIs before 12 months. At least 70% in the group with CI performed >1.25 and 47% >2 SD below controls on more than one measure, showing risk for persistent language impairment. Speech perception was more crucial in the nonword repetition and language comprehension tasks. No time factor was significantly related to outcome. We conclude that it is important to allocate resources for continuous follow-up and language intervention. Research and care of children with CI will profit from better integration of knowledge from the fields of audiology, speech-language pathology and linguistics.

Keywords: Cochlear implants; Language impairment; Clinical marker; Nonword repetition; Language comprehension; Past tense inflection

1. Background

In the present study we investigate nonword repetition and past tense inflection, which are proposed clinical markers for language impairment in Swedish, in early implanted children with CI. We also assess language comprehension, which is an important measure of language skills and a predictor of severe language learning difficulties, indicating more severe impairment and worse prognosis. These three measures have been shown to be important in research on hearing children with language impairment, and are therefore of interest to investigate in children with CI, since these children are highly at risk for language impairment due to their hearing loss. Language impairment in normal hearing children (sometimes referred to as Specific Language Impairment, SLI) is persistent and pervasive. This means that the deficit is long-term and often includes difficulties in production and comprehension in more than one of the language domains phonology, lexicon/semantics, grammar and pragmatics. In their recently published follow-up study of 60 children with CI,

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Geers et al. (2015) conclude that, at age 10, approximately one-third of the children with CI exhibited persistent language difficulties (performing at standard score below 85 on standardized tests, i.e., at or more than 1 standard deviation below the normative mean). From a clinical perspective, these children will probably need long-term support and services and, in many cases, intervention at the specialist level by a speech-language pathologist (Ebbels et al., 2018).

The ultimate goal for intervention for hearing loss, through early identification and early and bilateral amplification (hearing aids or CIs) is to achieve age-appropriate language outcome, not only better outcome than in later identified hearing losses. Fulcher et al. (2012) found that a majority of children with hearing loss having received their hearing aids or CIs before age 18 months in combination with oral language intervention performed at age appropriate levels. Leigh et al. (2013) report similar findings. Geers et al. (2009) found that up to 58% of children with CIs obtained age appropriate scores on language tests, although performance varied across different language domains. For example, receptive and expressive vocabulary skills were stronger than comprehension and production at the sentence level. Geers et al. (2015) found good prognosis, again with implantation before age 18 months. However, even if the prognosis is much better with early bilateral CIs or hearing aids, children with hearing loss demonstrate language impairment significantly more often than children in the normal hearing population, where the prevalence is estimated to 6–7% (Law et al., 2000; Tomblin et al., 1997). Language impairment can thus co-occur with hearing loss (Gilbertson and Kamhi, 1995). For example, in a small (n = 10) pilot study comparing children with severe/profound hearing loss and CI with and without language deficits. Hawker et al. (2008) conclude that in some children problems are clearly disproportionate and may be attributed to the same genetic (heritable) predisposition as in children with normal hearing and language impairment, further emphasizing the possibility for co-occurrence of language impairment and hearing loss.

In the present paper we used two potential clinical markers for language impairment (non-word repetition and past tense inflection) and the predictor, sentence comprehension, to identify children with language impairment in a group of early implanted Swedish-speaking children with CI aged 5–8 years. A clinical marker is a sign or symptom, which with reasonable sensitivity and specificity can identify if an individual has, for example, language impairment or not (Rice and Wexler, 1996). A clinical marker can thus help to identify which children are most in need of support for their language development and also indicate a need for increased intensity of intervention. The choice of potential clinical markers is guided by results from studies comparing Swedish children with language impairment and controls with typical language development and are those where children with language impairment more consistently show significant difficulties. This is elaborated more below.

Language learning is dependent on a large number of potentially influencing internal and external factors that interact in a complex way. Thus, both language input and language intake must be taken into consideration when making predictions for the individual child. In addition, time factors, such as age at diagnosis and age at fitting seem particularly crucial for children with CI. An intake deficit in children with SLI has been attributed to limited processing abilities, such as reduced speed of auditory information processing (Benasich and Tallal, 2002; Kail, 1994) or limited working memory capacity (Botting and Conti-Ramsden, 2001; Gathercole and Baddeley, 1990; Montgomery and Evans, 2009; Montgomery et al., 2010; Vugs et al., 2016). Limited processing ability will result in reduced effective intake of linguistic material, which, in turn, will eventually lead to protracted language development. The idea behind these accounts is that there is a limited amount of resources available for information processing. If task demands exceed this amount of resources, it will inevitably have a negative effect on the processing and storage of linguistic material. Because of their reduced possibilities to process and store information children with SLI need language input which is both quantitatively and qualitatively adjusted in order to adequately integrate, for example, different morphological forms into their language system (Leonard et al., 2007; Locke, 1997). A range of evidence based methods have been reported and care-givers are recommended to, for example, recast and/or expand their utterances (Fey et al., 2003). Although different in nature, reduced effective intake of linguistic material in the speech stream also arises in the case of hearing loss. In children with CI the cochlear implant provides a temporally and spectrally reduced auditory signal as compared to the signal provided by the normal functioning cochlea (Moore, 2003). This influences both long-term development of language and online speech perception. Although the source of the reduced exposure to and intake of auditory speech input may differ between children with SLI and children with CI, we expect that reduced input will result in difficulties in the acquisition of morpho-syntax (i.e., the correct use of word forms and how they are combined to form phrases and sentences) in both groups of children (Locke, 1997).

An extensive amount of research on language development and difficulties in children with CI has focused on trying to find predictors of language development (e.g., Geers et al., 2009, 2015; Peterson et al., 2010; Schorr et al., 2008). However, it is not common to apply the concept of clinical markers for language impairment in children with CI. One exception is Nittrouer et al. (2014). They assessed nonword repetition and other aspects of language abilities (vocabulary, grammar and reading) to investigate whether these skills could be predicted by nonword repetition in English-speaking children with CI. They found correlations with vocabulary and word reading, but not with grammar and reading comprehension. Nittrouer et al. (2014) conclude that the nonword repetition task has a potential as a clinical tool in the assessment of language in children with CI. In the present study we use three different tasks with predictive value