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Electrically evoked compound action potentials as a tool for programming cochlear implants in children

Akademisk avhandling

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av Andreas Björsne

Fakultetsopponent:

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Avhandlingen baseras på följande delarbeten

I. Björsne, A., Magnusson, M. When Can Stable AutoNRT Thresholds be Expected? A Clinical Implication When Fitting Young Children. Journal of the American Academy of Audiology, 2020; 31:69–75.

II. Björsne, A., Magnusson, M. The relationship between AutoNRT thresholds and subjective programming levels revisited. *Submitted for publication*

III. Björsne, A., Hällgren, M., Magnusson, M. Validity of ECAP thresholds for predicting cochlear implant settings for young children – Long-term follow-up and comparison with subjectively obtained T- and C-levels. *In manuscript*

IV. Björsne, A., Hällgren, M., Johansson, B., Eklöf, M., Magnusson, M. Impedance changes in cochlear implants after activation – A retrospective study of cochlear implants from Cochlear Ltd for children and adults. *In manuscript*

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Electrically evoked compound action potentials as a tool for programming cochlear implants in children

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Abstract

Cochlear implants are generally the best treatment for young children with a profound hearing loss (or worse) when ordinary hearing aids cannot provide enough auditory stimulation. For these youngest recipients, there must be a valid rationale for deciding the level of stimulation. The aim of this thesis was to investigate aspects that are clinically relevant when programming CIs for young children and choosing implant type for this group, with focus on the electrically evoked compound action potential (ECAP) as a basis for programming stimulation levels. The four studies that constitutes this thesis all regards different properties of the ECAP measurement, though, Study IV were more focused on the impedance related issues for two implant types from Cochlear Ltd. Study I and IV were comprised of both children and adults, Study III only included children, whereas Study II only included adults due to its design and aim. Study I to III were all prospective studies, whereas Study IV was of retrospective design. The results from Study I showed that the ECAP measurement should be re-recorded at least one month after activation of the implant to get a reliable response. For Study II, the result showed that it was possible to apply the profile from the ECAP recording to the subjective thresholds, although, a modification of the ECAP-profile was needed to get an acceptable agreement. In Study III, the result showed that, on group level, the children performed as well with their original ECAP-based setting as with the study implemented subjective setting. However, intra-individual variances between the original ECAP-based and the subjectively based setting was very large, ≥30 current levels, for a few of the subjects. The results from Study III further indicated a possible, small adaptation within the auditory nerve to changes in stimulation levels. Study IV showed that impedance related issues in general was low for both implant types concerned, but that the slim lateral wall (LW) implant for the children was, more likely to get higher impedance levels and electrode failures, compared to the perimodiolar (PM) implant. After five years of usage the probability of still having the default pulse width for the PM implant was 94%, whereas the slim LW implant had dropped to 80% ($p<0.001$) for the children. The overall results show that the ECAP measurement in general can be a valid tool for programming stimulation levels for young children with CIs, and additionally, that care need to be taken when choosing implants for young recipients and acknowledge limitations that might rise after activation.

Keywords: Cochlear implants, ECAP, children, impedance, T-levels, C-levels

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