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DISSERTATION TITLE: *Objective Measurements and Cochlear Implants Imaging*

The PhD thesis from Ralf Greisiger investigated objective measurements and imaging of Cochlear Implants (CI). Since 1997 he has been working with CI patients in an effort to improve patient speech perception outcomes.
A CI is a device implanted in the head which allows deaf or partly deaf people to hear by stimulating the inner ear electrically. The studies were carried out at Oslo University Hospital – Rikshospitalet, which has the national responsibility for all deaf children in Norway. Each year 20-30 children are born deaf in Norway. Also, some children and adults lose their hearing progressively. Every year, approximately 125 adults and children receive a CI at Rikshospitalet.
With the help of objective measurements, neural responses can be measured along the auditory pathways; these responses were investigated and compared with programming levels of the sound processor which controls the implant, which needs to be adjusted for each patient individually. Ideally, objective measurements can predict programming levels, so that measured neural responses during the surgical procedure in the operation room can be used to program the sound processor without feedback from the patient. This is especially important for young children who usually do not give reliable feedback during the programming sessions. Children that are born deaf should receive their CI as early as possible, in order to learn speech. At Rikshospitalet, deaf children from five months of age can receive a CI. The studies have shown that there is a weak correlation between programming levels and objective measurements. The measurements are useful to check that neural signals travel along the auditory pathways and give an approximation to the programming levels, but accurate prediction is not possible. The measurements were done on 377 patients, who were divided into different age groups. A further study investigated the possibility of speech recognition prediction based on auditory brainstem response measurements during surgery. The results have shown that it is possible to predict outcome in two different categories – open and closed-set speech recognition. Open set speech recognition makes it possible to follow conversations without knowing the context, which is not possible for closed-set speech recognition. Deafness can have different causes. The cause of deafness can have an influence on speech perception outcomes. A patient group with neural synchronization problems along the auditory pathways (Auditory Neuropathy Spectrum Disorder, or ANSD) were compared with other deaf patients in terms of electrical evoked brainstem responses, and no differences were found. A final investigation covered the intra-operative use of imaging such as fluoroscopy (real-time X-ray imaging of moving objects such as a CI electrode array inserted into the inner ear) in surgically difficult cases. This imaging technology has been found very helpful for carrying out successful surgical procedures in challenging cases. The findings of these studies, such as age related programming data, have been partly transferred into clinical routine.