Force measurement at the insertion process of cochlear implant electrodes

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Several research groups have reported studies on the insertion force measurement at different cochlear implant electrodes. So far, all experimental setups to measure the forces applied to the electrode outside the cochlea (inner ear), ie have measured externally. Our aim was to integrate the sensors into an automatically operating instrument insertion, so that the forces can be measured, which act directly on the electrode, ie an internal force measurement.

Study Design: We designed an insertion instrument based on two piezoelectric motors for inserting the CI electrode into the cochlea. The integrated force sensor system consists of four micrometer strain gauge sensors. We performed 14 Contour Advance electrode insertions (Cochlear, Sydney, Australia) in a cochlear phantom. During the insertion process the internal and external forces were measured.

Results: Results are preliminary. The results of the internal and external forces showed a significant difference during the insertion of the electrode into the cochlea. The external forces ranged around 3 mN, while the internal forces measured varied by 40 mN. While the external force while insertion the pre-curved electrode into the cochlea after (partial) withdrawal of the metal rod (stylet) were partially measured as negative forces, this effect was not present in the internal force measurement data. Another effect which has been measured was the friction of the electrode to the insertion instrument, which created artifacts of up to 40 mN. This effect was only when the internal power measurement represented (unfiltered data).

Conclusion: The external force measurement upon insertion of CI-electrode is not actually reproducing the forces that act at the cochlea by the deformation of the electrode. By the internal force measurements, this problem can be avoided. However, the friction of the electrode on the insertion tool is a new obstacle of this methodology.