TWO DIMENSIONAL FEM ANALYSIS ON THE MECHANICAL EFECT OF COCHLEAR ELECTRODE WITH VARIOUS WIRE ARRANGEMENTS

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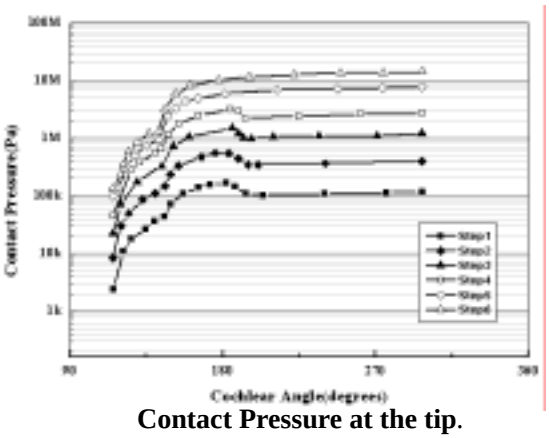
Many researches have been conducted to examine the trauma of cochleae by intra-cochlear electrode array. In one study, the wire leads of electrode were bundled in a vertical to avoid breaking a basilar membrane and the insertion forces were evaluated by inserting the electrode into a plastic cochlear model using strain gauges [1]. And in another study, contact pressures of three electrode arrays with different mechanical properties (uniform stiffness, graded stiffness, soft tip) were evaluated by two dimensional finite element analysis to estimate the effect of electrode stiffness on the cochlea [2].

To estimate the effect of the electrode on the inner wall structure of cochlea such as a basilar membrane more exactly, the analysis should be conducted in a realistic environment. In this study, we use 2D FEM analysis to evaluate 6 electrodes with different wire arrangement generated by adjusting the fitness function of simple genetic program. A 2D cochlea model is generated by projecting 3D cochlea model which is made by the helico-spiral approximation. 3D cochlea model is verified by comparing the width and height of real human cochlea along the depth [3]. Mechanical effect of each electrode on the cochlea is evaluated by contact pressures at the tip and along the length of electrode.

According to the 2D simulation, the contact pressure on the outer wall of scala tympani was minimized when the wires are stacked in a vertical direction. And if the limit of contact pressure at the tip is determined, we can construct an allowable range of electrode rigidity.



Contact Pressure at the tip.

Through a 2D simulation, it is impossible to verify the trauma range around a basilar membrane. Therefore, now a 3D simulation is being undertaken. We expect that not only trauma range of cochlea three dimensionally but also angular orientation of electrode can be evaluated through the 3D simulation.

Reference

[1] Stephen J. Rebscher, *et. al. IEEE Trans. Biomed. Eng.* 1999;46(3):340-352
[2] B.K. Chen, *et. al. Medical Eng. and Physics* 2002;25(2):141-147
[3] Shin-Ichi Hatsuchika, *et. al. Ann Otol Rhinol Laryngol* 1990;99:871-876