MATCHING OF MICROELECTRODE RECORDING AND MRI DATA FOR 3D TARGET VISUALIZATION IN FUNCTIONAL STEREOTACTIC SURGERY

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OBJECTIVE

During functional stereotactic surgery, deviations between the image based calculation of the target and the real position occur. These deviations result from different facts, e.g. limited resolution of imaging, limited accuracy of the ring used, brain shift, chemical shift in MRI etc. To compensate these deviations, the surgeon has to combine different (erroneous) information – imaging, trajectory planning, MER classification – to form an imaginary picture of the electrodes inside the target region and to decide where to place the definite electrode.

Fig. 1 Wire Model for problem demonstration and algorithm development

METHODS

Different models have been developed and evaluated for both target and electrode representation. The procedure actually used is based on an efficient calculation of intersections between the target model and the electrode model. Resulting from these intersections, sections along each electrode path can be determined that should indicate target signals.

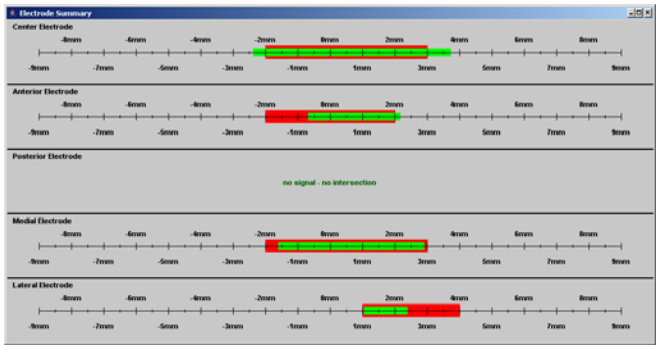

Fig 2. Visualization of overlapping

- sections of the electrodes indicating STN according to MER classification (red) with
- STN sections along the electrode path resulting from intersection calculation (green)

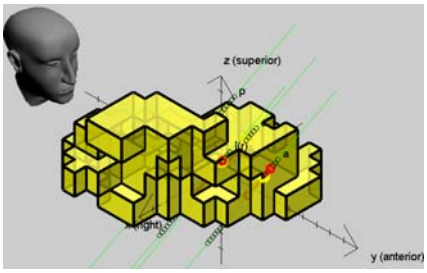

Fig. 3 Result of automatically matched MRI and MER data with positions of electrodes intersecting STN model

The differences between these sections and the sections representing target according to MER classification are minimized using a well-defined quality criterion. The result is a certain position of electrodes inside the target. The sections indicating target signals with respect to MER and the sections representing target according to intersection calculation fit together in an optimal manner and in this way indicate the most appropriate position.

CONCLUSIONS

Determination of the effective position of the electrodes and visualization with respect to the targeted functional area support the surgeon. In addition, a topographical documentation of electrode placement as developed can supply the patient's postoperative care (e.g. choosing another contact of the electrode).

RESULTS

The procedure was tested with the data of 5 patients with Parkinson's Disease and STN surgery. It produced stable results while using 4 or more electrodes. Verification of correct geometric positioning of matched data requires postoperative measurement of the electrode's positions. This will be done with CT images and re-transformed electrode artifacts.

LITERATURE

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