

The accuracy of intra-operative CT during DBS procedures: comparison with post-operative MRI

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Introduction

Optimal lead location is the critical factor for the outcome of DBS procedures. Intraoperative CT offers 3-dimensional verification of both micro-electrode and DBS lead placement during DBS surgery. The accuracy of ICT for DBS procedures has not been extensively studied .

Methods

DBS surgery was performed using the Leksell stereotactic G frame. The stereotactic coordinates of the ventral electrode contact of 25 DBS leads were determined on ICT and corresponding postoperative MRI and compared with the intended target coordinates. The resulting absolute differences in X (medial-lateral), Y (anterior-posterior) and Z (dorsal-ventral) coordinates (ΔX , ΔY and ΔZ) for both modalities were then used to calculate the Euclidian distance: $\sqrt{(\Delta X)^2 + (\Delta Y)^2 + (\Delta Z)^2}$) which describes the accuracy in 3-dimensional space.

Learning Objectives

By the conclusion of this session, participants should be able to: 1) describe the usage of ICT in DBS surgery 2) describe the equivalent lead localization on ICT compare to postoperative MRI 3) discuss possible benefits of implementation of ICT in DBS surgery

Results

For the ICT the (mean \pm SD) absolute differences for X, Y and Z were 1.2 ± 0.85 mm, 0.98 ± 0.89 mm, 1.2 ± 1.06 mm, while the corresponding numbers for the MRI were 1.28 ± 0.86 mm, 1.36 ± 1.15 mm, 1.28 ± 0.86 mm. There was no significant difference in absolute distances, although ICT showed a trend towards a more dorsal lead position ($p=0.05$). The Euclidian distance for ICT was 2.64 ± 0.94 mm and 2.69 ± 1.15 mm for MRI ($p=0.1$).

Conclusions

The data suggest that ICT imaging of DBS leads is as accurate as post-operative MR imaging. ICT therefore is a reliable technique for intra-operative confirmation of lead placement. In addition, merging of ICT with preoperative MRI could potentially obviate the need for postoperative MRI, which is considered to be the gold standard to verify DBS lead placement.