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Hippocampal Stereotaxy: A Novel Mesial Temporal Stereotactic Coordinate System

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Introduction

Stereotactic laser ablation and neurostimulator placement represent an evolution in staged surgical intervention for epilepsy. As practice evolves, optimal targeting will require standardized outcome measures that compare electrode lead or laser source with post-procedural changes in seizure frequency. We propose and present a novel stereotactic coordinate system based upon mesial temporal anatomic landmarks to facilitate the planning and delineation of outcomes based on extent of ablation or region of stimulation within mesial temporal structures.

Methods

The body of the hippocampus contains a natural axis, approximated by the interface of CA4 and the dentate gyrus. The uncal recess of the lateral ventricle acts as a landmark to characterize anterior-posterior extent. Several volumetric rotations are quantified for alignment with the hippocampal coordinate system. First, the brain volume is rotated to align with standard AC-PC space. Then, it is rotated through the axial and sagittal angles the hippocampal-axis makes with the AC/PC-line.

Results

Using this coordinate system, customized MATLAB software was developed to allow for intuitive standardization of targeting and interpretation. The angle between the AC/PC-line and the hippocampal -axis was found to be ~20-30° when viewed sagittally and of order ~0-10° when viewed axially. Implanted electrodes can then be identified from CT in this space, and laser tip position and burn geometry can be calculated based on the intraoperative and post-operative MRI.

Conclusions

With the advent of stereotactic surgery for mesial temporal targets, a hippocampal stereotactic system is introduced which may facilitate operative planning, improve surgical outcomes, and standardize outcome assessment.

Learning Objectives

By the conclusion of this session, participants should be able to: 1) Describe a set of anatomic landmarks for a stereotactic coordinate system for the hippocampus, 2) Download and implement the "Hippotaxy" customized software program to evaluate post-operative result and stereotactically target the hippocampus and adjacent structures for surgical planning.

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