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The mathematical expression of stereotactically standard brain areas

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Introduction

Stereotactically standard areas within human brain nuclei, a knowledge which belongs to the modern field of stereotactic brain microanatomy, are areas resisting to the individual variability of the nuclear location in stereotactic space. Considering the potential benefits of making them mathematically definable, an effort to achieve their mathematical expression was aimed.

Methods

Mathematical analysis was applied to the anatomic concept of stereotactically standard areas, as it was described in recent focused stereotactic anatomic studies of the human nucleus accumbens and subthalamic nucleus.

Results

A general mathematical formula was invented to express the set of points of a complete stereotactically standard area within a given brain nucleus in Cartesian stereotactic space of the human brain. Its current applications include the mathematical expression of stereotactically standard areas of the human nucleus accumbens and subthalamic nucleus. Beside the mathematical formula, other basic parameters for reporting stereotactically standard brain areas were determined.

Conclusions

The mathematical formula of stereotactically standard areas is necessary for their robust, reproducible and accurate application to laboratory studies and clinical practice. Mathematical accuracy can be thus safely translated into microsurgical accuracy and this is particularly crucial when dealing with minimally invasive interventions within the human brain.

Learning Objectives

1) To present the concept of stereotactically standard areas, 2) To present the general formula for their mathematical expression, 3) To present the mathematics-based clinical application of stereotactically standard areas.

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