A Novel Technique to Predict and Adjust for Microelectrode Recording Tract Error Prior to Dural Opening Using Intraoperative Computed Tomography

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Introduction

At our institution, we routinely perform anatomically targetted MER in DBS surgery in order to optimize therapeutic efficacy and minimize side effects. We describe a novel technique to predict the MER target location and subsequently adjust for the predicted error prior to dural opening.

Learning Objectives

1) Understand the utilization of intraoperative CT to predict accuracy of MER (microelecrode recording) targeting during DBS surgery

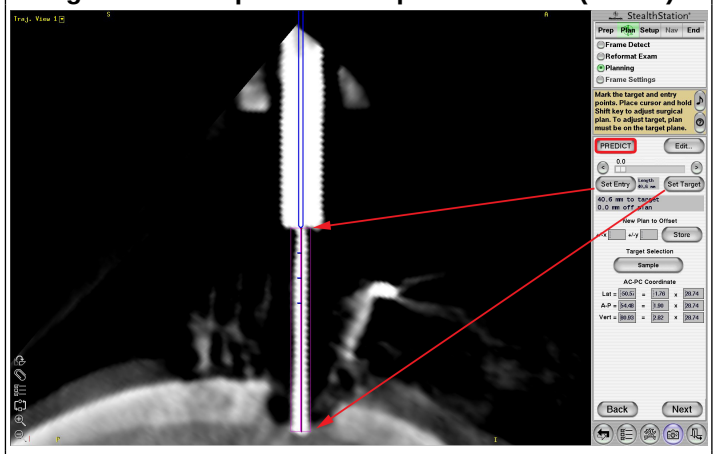
2) Become familiar with the technique of targetted MER using intraoperative CT during DBS surgery

3) Understand how intraoperative CT can be used for real-time adjustments in ME (microelectrode) trajectory

Methods

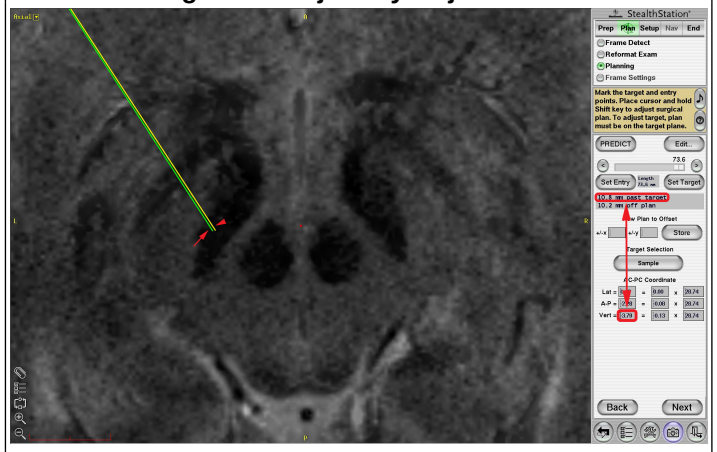
Twenty patients underwent frame based uni- or bilateral DBS lead placements under local anesthesia using MER. After assembly of the stereotactic arc and headstage, placement of burr holes, and before dural opening, a guide tube was inserted through the headstage and set to rest on dura. Intraoperative CT imaging prior to dural opening was obtained and images were merged with preoperative CT and MRI studies. Using the planning software, a trajectory was created along the path of the guide tube (Figure 1). Once created, the trajectory was extrapolated to target depth and the coordinates recorded and compared to the initial plan (Figure 2). Adjustments in the X and Y coordinates were made depending on the degree of the error in those respective planes. The guide tube and microelectrode were then inserted for MER. Once at target depth, the final ME tip coordinates were recorded and compared with corrected MER tract coordinates.

Figure 1. Intraoperative Pre-placement CT (iPPCT)



An intraoperative CT is obtained prior to brain penetration and the trajectory of the guide tube is extrapolated to target

Figure 2. Trajectory Adjustment



The extrapolated trajectory is then compared to the planned trajectory and appropriate adjustments are made in the x and y coordinates

Table 1. Patient Demographics

Patient	Age	Sex	Diagnosis	Target	Uni- or Bilateral
1	69	M	PD	STN	B
2	67	F	PD	Gpi	B
3	57	M	PD	STN	B
4	80	F	PD	ViM	L
5	69	M	PD	STN	B
6	68	F	ET	ViM	L
7	67	F	ET	ViM	B
8	74	M	PD	ViM	B
9	60	M	PD	STN	B
10	35	F	MS T	ZI	B
11	60	M	PD	STN	B
12	63	M	PD	ZI	B
13	62	M	PD	STN	B
14	71	F	ET	ViM	L
15	68	M	PD	STN	B
16	64	F	PD	STN	B
17	68	F	ET	ViM	B
18	72	M	ET	ViM	L
19	75	F	PD	Gpi	B
20	75	M	ET	ViM	B

Results

Demographic information is provided in Table 1. Initial Euclidean error between planned MER trajectory and predicted trajectory as extrapolated by intraoperative pre-placement CT (iPPCT) was 1.80± 0.16 mm. iPPCT was used to make trajectory adjustments which improved Euclidean error between adjusted iPPCT and final MER tract to 0.93 ± 0.09 mm (Table 2).

Table 2. Mean Error Calculations

iPPCT – Planned Tract Mean Error				Corrected plan - Actual Tract Mean Error			
X	Y	Z	Euclidean Error	X	Y	Z	Euclidean Error
0.82	1.36	0.05	1.8±0.16	0.54	0.63	0.09	0.93±0.09

N = 20

Conclusions

iPPCT can be a useful tool to accurately predict and adjust for MER tract error prior to dural opening and entry into brain parenchyma. Confirming accuracy could potentially reduce the number of MER tracts thus leading to safer outcomes and shorter operative times.