Initial experience with iMRI-DBS targeting of the subthalamic nucleus in Parkinson's Disease

Gregory Weiner MD; Samuel S. Shin MD PhD; Danielle M Wagner PA-C; Yeu-Fang Chang PhD; Robert Mark Richardson MD PhD

Department of Neurological Surgery, University of Pittsburgh Medical Center, Pittsburgh, PA 15217

Introduction

-Interventional MRI (iMRI)-guided technique for implanting DBS electrodes based on target anatomy alone, without microelectrode recording (MER), is starting to be widely utilized.

-Efficacy data reported by the center that originated this procedure is promising.

-We evaluated our initial experience with iMRI-guided bilateral subthalamic nucleus (STN) implantation as compared to concurrent MER-guided implantations.

Methods

-Thirty-nine consecutive patients undergoing bilateral subthalamic nucleus (STN) electrode placement for the treatment of Parkinson's disease (PD), from August, 2012 to December, 2013.

-Patients underwent either iMRI-guided surgery using the ClearPoint system (iMRI-DBS), or MER-guided surgery using a Leksell frame (MER-DBS), a decision primarily based on patient preference.

-Radial errors in electrode placement were measured by comparing the initial AC-PC target coordinates to the lead artifact on postoperative MRI in the axial plane 4mm below the AC-PC line.

-Voltage thresholds for producing motor, sensory, gait, and associative side effects and thresholds for achieving benefits in rigidity, bradykinesia, tremor, and gait were tabulated from monopolar survey data obtained during initial programming one-month following lead implantation.

Results

-19 (49%) and 20 (51%) patients underwent MER-DBS and iMRI-DBS , respectively

-37 electrodes were placed in each cohort.

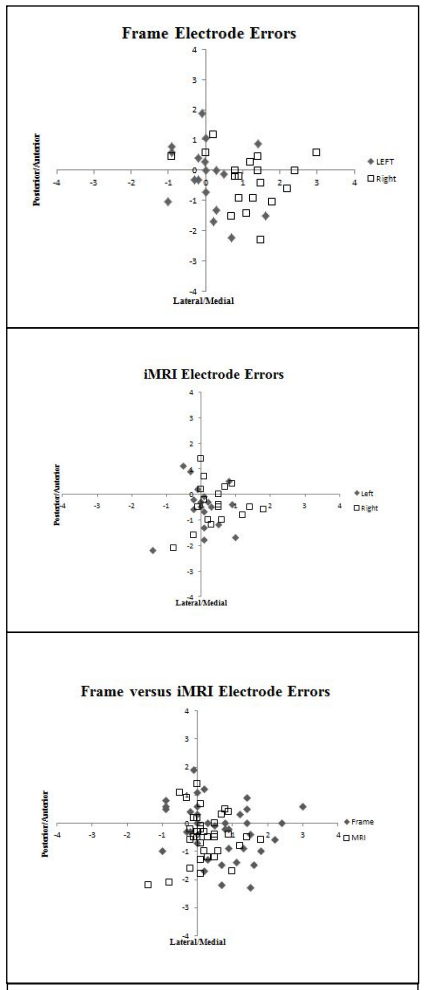
-The mean OFF/ON motor UPDRS scores were 41/19 (MER) and 47/21 (iMRI).

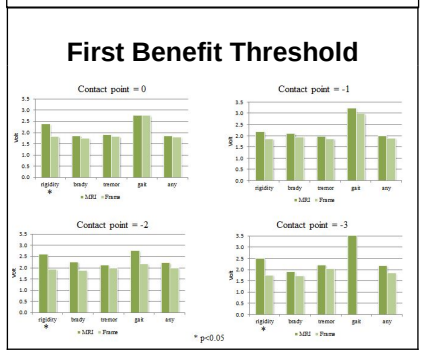
-The mean radial error was 1.3 ± 0.7mm in the MER group vs. 1.0 ± 0.6mm in the MRI group (p=0.03).

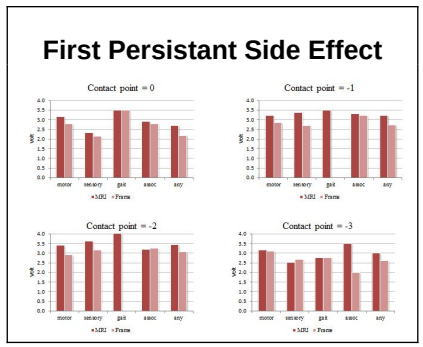
-No clinically significant differences in side effect or symptom benefit thresholds obtained during initial programming were demonstrated.

Table 1. Patient Demographics and Symptoms

	Total N=39	Frame N=19	iMRI N=20
Gender			
Males (%)	28 (72)	12 (63)	16 (80)
Females (%)	11 (28)	7 (37)	4 (20)
Age (years)			
Mean (SD)	66.8 (7.5)	67.7 (5.2)	66 (9.1)
Range (SD)	44-78	59-78	44-77
Years from Diagnosis			
Mean (SD)	9.6 (4.8)	8.9 (4.4)	10.3 (5.2)
Range (SD)	2-24	4-20	2-24
Presenting Symptoms			
Tremor (%)	26 (66)	11 (58)	15 (75)
Rigidity (%)	17 (44)	8 (42)	9 (45)
Bradykinesia (%)	23 (59)	10 (53)	13 (65)
Gait/Balance (%)	10 (26)	6 (32)	4 (20)







Conclusions

-iMRI-DBS placement does not result in clinically significant differences in thresholds for production of either unwanted side effects or symptomatic benefit during initial programming,

-This suggests that electrode targeting does not suffer from lack of MER guidance.

-Follow up studies are necessary to determine whether short and long-term UPDRS motor scores are similarly equivalent.

Learning Objectives

-To appreciate that short-term postoperative outcomes indicate equivalence between MER-guided DBS and iMRI-guided DBS for targeting the STN in Parkinson's disease.

References

Larson PS, Richardson RM, Starr PA, Martin AJ: Magnetic resonance imaging of implanted deep brain stimulators: experience in a large series. Stereotact Funct Neurosurg 86:92-100, 2008

Larson PS, Starr PA, Bates G, Tansey L, Richardson RM, Martin AJ: An optimized system for interventional magnetic resonance imaging-guided stereotactic surgery: preliminary evaluation of targeting accuracy. Neurosurgery 70:95-103; discussion 103, 2012

Starr PA, Martin AJ, Ostrem JL, Talke P, Levesque N, Larson PS: Subthalamic nucleus deep brain stimulator placement using high-field interventional magnetic resonance imaging and a skull-mounted aiming device: technique and application accuracy. J Neurosurg 112:479-490, 2010