Intraoperative Use of the O-arm Improves Safety and Efficiency of DBS Surgery

Leonardo A Frizon; Jianning Shao; Andres Maldonado-Naranjo; Darlene Angela Lobel MD, FAANS; Hubert H. Fernandez MD; Sean J. Nagel MD; Andre Machado MD, PhD

Center for Neurological Restoration, Neurological Institute, Clevelan Clinic

CNS 2017 ANNUAL MEETING BOSTON, MASSACHUSETTS OCTOBER 7–11, 2017

Introduction

Deep brain stimulation efficacy is dependent on adequate electrode implantation. Traditionally, intraoperative physiology with microelectrode recording (MER) is used to refine stereotactic accuracy during awake electrode implantation. Recently, portable imaging systems such as the O-arm have become widely available and can be used in isolation or in association with MER to guide DBS lead placement. A key question remains whether combining intraoperative imaging with electrophysiology, made possible by the advent of portable systems for CT scanning or volumentric imaging, offers superior safety, comfort, surgical efficiency or outcomes compared to the traditional surgery guided by intraoperative physiology alone. We evaluated how the routine use of the O-arm affected DBS surgery safety, efficiency and outcomes (Figure 1).

Methods

Two cohorts of patients with Parkinson's disease who underwent MER-guided awake subthalamic DBS lead implantation with and without O-arm were compared. Based on a retrospective chart review, we examined the total number of microelectrode and macroeletrode passes during each surgery, procedure duration, surgical complications, lead revisions and motor outcomes. Motor outcomes were determined by the sum of items 20 trough 26 of the Unified Parkinson Disease Rating Scale - Motor subscale (UPDRS III) scores for the side contralateral to te implanted lead, comparing baseline (OFF-medication) and 6-month postoperatively (OFF-medication/ON-stimulation) scores. In order to minimize experience-related confounding factors, we only included patients who had surgery with a single staff surgeon.

Results

The mean total number of passes per side was 3.88 (SD=1.48) in the group without O-arm utilization, compared to 2.42 (SD=0.83) in the group with O-arm usage ($p<0.001$). A significant reduction was also found in the procedure duration ($p=0.016$), with a procedure length reduced by 22.8 minutes with the O-arm (Table 1).

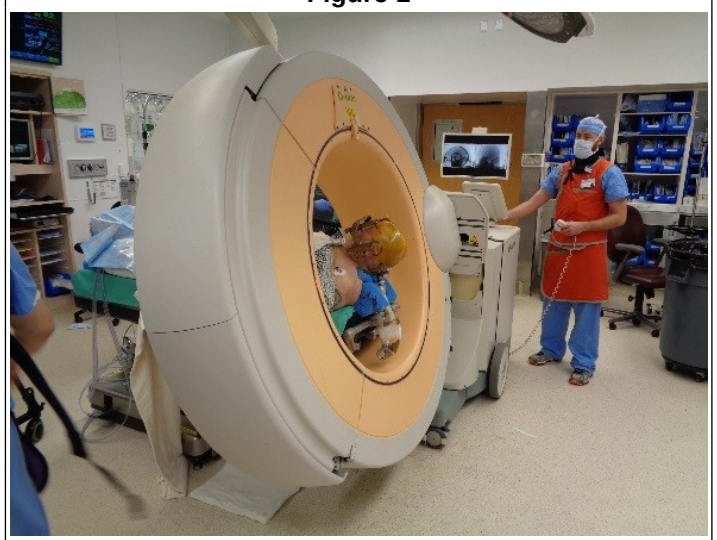
Table 1

	WO-OA group		W-OA group		
Variables	Mean (SD)	Median (min-max)	Mean (SD)	Median (min-max)	P-value
Total number of passes	3.88 (1.48)	3.5 (2-8)	2.42 (0.83)	2 (2-5)	<0.001
MER tracks	2.46 (0.99)	2 (1-5)	1.29 (0.75)	1 (1-4)	<0.001
Lead passes	1.42 (0.65)	1 (1-4)	1.13 (0.34)	1 (1-2)	0.168
Procedure minutes	198 (43)	186 (123-311)	176 (42)	159 (131-277)	0.016
WO-OA= *without* the O-arm; W-OA= *with* the O-arm					

Number of passes and procedure minutes.

No differences were found in motor outcomes between groups. The mean reduction of UPDRS III was 57.6% in the patients who underwent surgery without the O-arm and 52.6% in the patients that underwent surgery with the O-arm.

Figure 1



Photographs showing the O-arm in the scan parking position.

Conclusions

The use of the O-arm during DBS surgery is associated with a significant reduction in the total number of brain penetrations as well as reduced surgical time, without changes in outcome.

Learning Objectives

By the conclusion of this session, participants should be able to: 1) Describe how to use O-arm in DBS surgery in association with microelectrode recording 2) Discuss the pros and cons of using this tool in the clinical practice.

References

1. Sharma M, Deogaonkar M. Accuracy and safety of targeting using intraoperative "o-arm" during placement of deep brain stimulation electrodes without electrophysiological recordings. J Clin Neurosci. 2016;27(2016):80-86. doi:10.1016/j.jocn.2015.06.036.

2. Caire F, Gantois C, Torny F, Ranoux D, Maubon A, Moreau JJ. Intraoperative use of the medtronic O-arm for deep brain stimulation procedures. Stereotact Funct Neurosurg. 2010;88(2):109-114. doi:10.1159/000280823.

3. Servello D, Zekaj E, Saleh C, Pacchetti C, Porta M. The pros and cons of intraoperative CT scan in evaluation of deep brain stimulation lead implantation: A retrospective study. Surg Neurol Int. 2016;7(20):551. doi:10.4103/2152-7806.187534.

4. Deuschl G. A Randomized Trial of Deep-Brain Stimulation for Parkinson. N Engl J Med. 2006;355:896-908. doi:10.1056/NEJMoa060281.

5. Deep-Brain Stimulation for Parkinson's Disease Study Group. Deep-brain stimulation of the subthalamic nucleus or the pars interna of the globus pallidus in Parkinson's disease. N Engl J Med. 2001;345(13):956-963. doi:10.1056/NEJMoa000827.

6. Temel Y, Wilbrink P, Duits A, et al. Single electrode and multiple electrode guided electrical stimulation of the subthalamic nucleus in advanced Parkinson's disease. Neurosurgery. 2007;61(5 Suppl 2):346-55-7. doi:10.1227/01.neu.0000303993.82149.98.

7. Machado A, Rezai AR, Kopell BH, Gross RE, Sharan AD, Benabid A-L. Deep brain stimulation for Parkinson's disease: surgical technique and perioperative management. Mov Disord. 2006;21 Suppl 1:S247-58. doi:10.1002/mds.20959.