An Accuracy Study of Deep Brain Stimulator Placement Using Frameless, Fiducial-less, O-Arm Auto-Registration Compared with the Fiducial Based Nexframe Procedure

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Introduction

In its infancy, lead placement in deep brain stimulation required a cumbersome frame. Then frameless systems emerged, but bone fiducial placement was still necessary. Our study compares the accuracy and efficiency of frameless, fiducial-less, O-arm auto-registration with standard Nexframe O-arm registration using bone fiducials. Pitfalls and pearls of this new technique are outlined.

Methods

Patients underwent deep brain stimulation surgery using Nexframe technology at Richmond's VA Medical Center and VCU-Health. Surgical navigation registration was performed with a Stealth station and an O-arm. Patients either underwent fiducial-less registration or standard fiducial registration. Intraoperative imaging was used to determine vector and radial error by using algorithms to extract the implants from the unreconstructed O-arm data to more precisely localize the implants and compare them with the preoperative plans within the same image space. Operative times and number of passes were also collected and compared.

Figure 1: Fess Frame for Fiducial-less Registration

Results

A total of 33 of a planned 40 patients have undergone placement of leads utilizing fiducial-less registration. These are compared with 37 patients who have had leads implanted utilizing fiducial based registration. In comparing the two groups, total operative time was reduced by 23.6 minutes (p=0.017) in the fiducial-less group undergoing placement of a unilateral VIM lead. Operative times were relatively the same in the unilateral GPi patients (fiducial-less registration adding 3 minutes p=0.44) **(Figure 2)**. Also, the number of microelectrode passes between the 2 groups was not significant **(Table 1)**. There was a small change in radial error and vector error between the two groups **(Table 3)**.

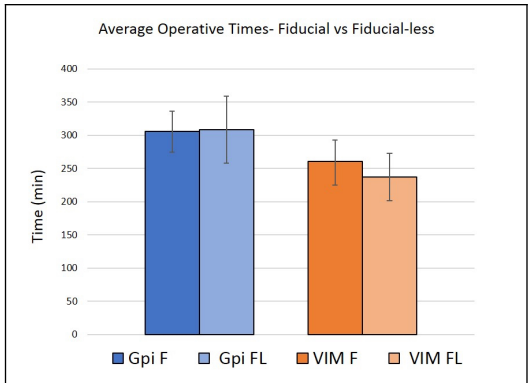

Figure 2

Conclusions

Based on preliminary data, we have changed our practice to an exclusively fiducial-less approach. Despite the learning curve, we have been able to reduce operative time with this procedure without an increased number of microelectrode passes. Despite a small increase in radial error, there has been no clinically significant change to the patient's outcome. The new procedure also saves the patients and surgeons from multiple incisions for the placement of bone fiducials.

	GPi		VIM	
	Fiducial Based	Fiducial-less	Fiducial Based	Fiducial-Less
Above standard pass number	10.00%	0.00%	21.05%	19.05%

Table 1

	Radial Error (mm)		Vector Error (mm)	
	Fiducial Based	Fiducial-less	Fiducial Based	Fiducial-less
Mean	1.33±0.58	1.73±0.89	2.14±1.05	2.06±0.91
	p=0.018		p=0.38	

Table 2

Learning Objectives

By the conclusion of this session, participants should be able to:

- Understand the techniques involved in placing deep brain stimulator leads using a frameless fiducial-less system.
- Discuss the difference between fiducial based Oarm registration and fiducial-less O-arm registration.
- Compare the accuracy of different methods of deep brain stimulator lead placement.

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