Frameless deep brain stimulation

Moser et al. described a technique of optimizing the accuracy of frameless deep brain stimulation (DBS) lead placement through the use of a cannula poised at the entry to predict the location of the fully inserted device. This allows real-time correction of error prior to violation of the deep gray matter.

They prospectively gathered data on radial error during the operative placements of 40 leads in 28 patients using frameless fiducial-less DBS surgery. Once the Nexframe had been aligned to target, a cannula was inserted through the center channel of the BenGun until it traversed the pial surface and a low-dose O-arm spin was obtained. Using 2 points along the length of the imaged cannula, a trajectory line was projected to target depth. If lead location could be improved, the cannula was inserted through an alternate track in the BenGun down to target depth. After intraoperative microelectrode recording and clinical assessment, another O-arm spin was obtained to compare the location of the inserted lead with the location predicted by the poised cannula.

The poised cannula projection and the actual implant had a mean radial discrepancy of 0.75 ± 0.64 mm. The poised cannula projection identified potentially clinically significant errors (avg 2.07 ± 0.73 mm) in 33% of cases, which were reduced to a radial error of 1.33 ± 0.66 mm ($p = 0.02$) after correction using an alternative BenGun track. The final target to implant error for all 40 leads was 1.20 ± 0.52 mm with only 2.5% of errors being >2.5 mm.

The poised cannula technique results in a reduction of large errors (>2.5 mm), resulting in a decline in these errors to 2.5% of implants as compared to 17% in our previous publication using the fiducial-less method and 4% using fiducial-based methods of DBS lead placement [1)].

1: Eleopra R, Rinaldo S, Devigili G, Mondani M, D'Auria S, Lettieri C, Ius T, Skrap M. Frameless Deep Brain Stimulation Surgery: A Single-Center Experience and Retrospective Analysis of Placement Accuracy of 220 Electrodes in a Series of 110 Patients. Stereotact Funct Neurosurg. 2019;97(5-6):337-346. doi: 10.1159/000503335. Epub 2020 Jan 14. PMID: 31935742.

2: Zahos PA, Shweikeh F. Frameless deep brain stimulation surgery: a community hospital experience. Clin Neurol Neurosurg. 2013 Jul;115(7):1083-7. doi: 10.1016/j.clineuro.2012.11.006. Epub 2012 Dec 21. PMID: 23265558.

3: Smith AP, Bakay RA. Frameless deep brain stimulation using intraoperative O-arm technology. Clinical article. J Neurosurg. 2011 Aug;115(2):301-9. doi: 10.3171/2011.3.JNS101642. Epub 2011 Apr 15. PMID: 21495822.

4: Eljamel MS, Tulley M, Spillane K. A simple stereotactic method for frameless deep brain stimulation. Stereotact Funct Neurosurg. 2007;85(1):6-10. doi: 10.1159/000096633. Epub 2006 Oct 30. PMID: 17077650.

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Moser M, Koch P, Shah HP, Docef A, Holloway KL. The Poised Cannula Technique Reduces the Stereotactic Error of the Fiducial-Less Frameless DBS Procedure. Stereotact Funct Neurosurg. 2021 Jun 11:1-9. doi: 10.1159/000512615. Epub ahead of print. PMID: 34120107.