Axial Angulations of DBS Targets and Offering a New Design for Ben's Gun

WSSFN 2025 Interim Meeting. Abstract 0073

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How to Cite: Simsek I, Anil Eray H, Yilmaz A. Axial Angulations of DBS Targets and Offering a New Design for Ben's Gun: WSSFN 2025 Interim Meeting. Abstract 0073. NeuroTarget. 2025;19(2):50.

Abstract

Introduction: Globus Pallidus Interna (GPi) and Subthalamic Nucleus (STN) are primary targets in deep brain stimulation (DBS) surgeries for Parkinson's disease (PD). Intraoperative macrostimulation helps to determine electrode positioning within the substructure of nucleus and its proximity to eloquent areas like internal capsule etc. Precise electrode placement in therapeutic areas is crucial to maximize benefits and minimize side effects, sometimes even necessitating intraoperative repositioning. So, we offer another improvement for DBS with a rotatable microelectrode array or so-called Ben's gun.

Method: The study included 52 patients (35 men and 17 women) diagnosed with PD. GPi or STN-DBS was performed between 2023 and 2025 at the same Turkish neurosurgery clinic. Magnetic resonance imaging (MRI) scans of patients were analyzed. In every patient medial border of both STN and GPi nuclei and angulation of these borders with midline were calculated. MRIs were evaluated with Stealthstation workstation S8 while angulations were calculated using a smartphone application.

Result: In case-based evaluation, mean angulation of left GPi was 41,8 while right GPi was 42,3. Mean angulation of left STN was 39,8 while right STN was 42,2. Angulations were close to 45 degrees however except 5 cases, almost every case (n=47, %90.3) had 1 or more nucleus with angulation more than 5-degree deviation from 45 degree. In cerebral hemisphere-based evaluation, angulation of more than 100 nuclei of STN and GPi were evaluated. Mean angulation of GPi was 42,1 (30,7-54.9). Mean angulation of STN was 41,05 (29,2 – 51,2).

Discussion: Using only two fixed electrode configurations reveals its major limitation during intraoperative macro- or microstimulation. For instance, employing a "+" configuration and stimulating a channel labeled as posterior does not necessarily correspond to the true posterior aspect of the nucleus but rather a posteriomedial position. In the case of the GPi, this could mean stimulation near the internal capsule, and for the STN, near the oculomotor nerve. Similar mismatches also occur with anterior, medial, or lateral channels. Therefore, to achieve more anatomically accurate and effective stimulation aligned with the individual nucleus' orientation, it is essential to measure the angulation of the target nucleus preoperatively and adjust the orientation of Ben's Gun microdrive accordingly.

Conclusions: Ben's gun microdrive may be only component of frame and DBS which was not improved since works of Benabid and colleagues. Optimal results in DBS, precise electrode repositioning must be based on the 3D anatomical topography of nuclei. These results suggest that STN and GPi had varying degree of angulation and using Ben's gun microdrive only with "+" or "x" configurations may not be enough for this precision. We suggest a rotatable Ben's gun microdrive which can be measured according to preoperative MRI.

References

1. Hariz MI, Blomstedt P, Zrinzo L. Deep brain stimulation between 1947 and 1987: the untold story. Neurosurg Focus. 2010;29:E1.
2. Ge M, Chen J, Zhu ZJ, Shi P, Yin LR, Xia L. Wrist ROM measurements using smartphone photography: Reliability and validity. Hand Surg Rehabil. 2020;39:261–264
3. Holanda VM, Okun MS, Middlebrooks EH, Gungor A, Barry ME, Forder J, et al. Postmortem Dissections of Common Targets for Lesion and Deep Brain Stimulation Surgeries. Neurosurgery. 2020;86:860–872
4. Bus S, Pal G, Ouyang B, van den Munckhof P, Bot M, Sani S, et al. Accuracy of Microelectrode Trajectory Adjustments during DBS Assessed by Intraoperative CT. Stereotact Funct Neurosurg. 2018;96:231–238