Stereotact Funct Neurosurg 2010;88:264–265
DOI: [10.1159/000315465](https://doi.org/10.1159/000315465)

Microsurgical Anatomy of the Nucleus Accumbens: The Role of the Two Commissures in Measuring Stereotactic Coordinates of the Target and the Ablation versus the Stimulation Target Area

Ioannis Mavridis, Efsthios Boviatsis, Sophia Anagnostopoulou
Athens, Greece

We read with great interest the article ‘Evaluation of short-term psychological functions in opiate addicts after ablating the nucleus accumbens via stereotactic surgery’ by He et al. [1]. They reported ablation of the nucleus accumbens (NAc) with stereotactic surgery. We would like to make a comparison between the reference points used for measuring the Y stereotactic coordinate of the target and also a comparison between the NAc anatomic area targeted for ablation and the area targeted for deep brain stimulation (DBS), another stereotactic procedure applied to the NAc.

Describing their surgical procedure, He et al. mentioned the following target coordinates for the NAc: 7–9 mm below the anterior commissure-posterior commissure (AC-PC) line, 19–23 mm prior to the midpoint and 4–10 mm lateral to the median line. They specified the core of the NAc as the original target. These coordinates are exactly the same as those used by Gao et al. [2] who first reported a method of ablating the NAc with stereotactic surgery for alleviating opiate drug psychological dependence. These two reports describe the mid-commissural point as a reference point for measuring the Y stereotactic coordinate of the NAc target.

The stereotactic coordinates which have been reported for NAc DBS in obsessive-compulsive disorder, refractory major depression and Tourette syndrome (the main three disorders where this procedure is nowadays applied) are: 4–4.5 mm ventral to the AC-PC plane, 1.5–2.5 mm anterior to the anterior border of the AC and 6.5–8 mm lateral to the midline [3–5]. All these reports of NAc DBS describe the anterior border of the AC as a reference point for measuring the Y stereotactic coordinate of the NAc target.

Recently, Aouizerate et al. [6] reported DBS targeting of the caudate and NAc in treating obsessive-compulsive disorder with coexisting major depression. In their case where the NAc was targeted, the tips of the electrodes were situated 3.0 mm below the AC-PC line, 8.9 mm lateral to the AC-PC line and 36.5 mm anterior to the PC on the right side, and 1.7 mm below and 7.6 mm lateral to the AC-PC line and 31.4 mm anterior to the PC on the left side [6]. This report describes the use of the PC as a reference structure for measuring the Y stereotactic coordinate of the NAc target.

Among the three alternative reference points which have been reported so far for measuring this coordinate, we strongly believe that the most adequate for this purpose is the AC. It is not only closer to the target (the AC is the posterior border of the NAc [7]) than the other two, but also, according to our experience (studying the stereotactic anatomy of the NAc), the most easily identifiable.

In order to estimate the AC-PC length (from the AC center to the PC center at the midline), we used 26 cerebral MRIs (1.5-tesla, T₂-weighted, transverse 2-mm sections) from neurosurgical patients (16 males, 23–70 years old and 10 females, 38–71 years old) from our second author’s personal archive. We followed the same methodology in all cases (using Philips DICOM Viewer). All measurements were made by the same author for more objective results.

We found the mean value of the AC-PC length to be 26.31 ± 2.67 mm with no statistically significant difference among gender (although in females the mean length was 0.39 mm longer). We also found no statistically significant difference between individuals <60 years and individuals ≥ 60 years, although the mean value of the AC-PC length in the older subgroup was 1.35 mm shorter (probably due to age-related brain atrophy).

The target area described by He et al. [1] seems to extend below the NAc [8] and also, according to our radiologic findings, seems to be located approximately 6–10 mm anterior to the (center of the) AC. The target area described by Aouizerate et al. [6] similarly seems to be located approximately 5–10 mm anterior to the (center of the) AC according to our radiologic findings. Considering the width of the AC, we could say that these target areas are a few millimeters more anterior than the respective areas previously reported for NAc DBS in obsessive-compulsive disorder, refractory major depression and Tourette syndrome [3–5]. The potential effect of this difference on clinical outcome would be an interesting research issue.

Of course the ablation area reported by He et al. [1], as well as Gao et al. [2], is wider and deeper compared with the reported stimulation areas [1, 3–6]. The difference in depth is expected because electrodes for NAc DBS are often implanted in a way that permits stimulation of both the ventral part of the anterior limb of the internal capsule and the NAc. The difference in width is also expected considering the technical application of the two methods.

Reports of NAc stereotactic surgery during the first decade of the 21st century indicated that the NAc is at least a promising target in patients with some severe neuropsychiatric disorders (including addiction). More detailed electrophysiological and especially functional neuroimaging methods are necessary to get deeper into the microsurgical anatomy of the human NAc and to provide a more systematic approach to the local functional differences within the microenvironment of the NAc.

References

- 1 He F, Guan H, Zhao Z, Miao X, Zhou Q, Li L, Huang D, Liu A, Miao D: Evaluation of short-term psychological functions in opiate addicts after ablating the nucleus accumbens via stereotactic surgery. *Stereotact Funct Neurosurg* 2008;86:320–329.
- 2 Gao G, Wang X, He S, Li W, Wang Q, Liang Q, Zhao Y, Hou F, Chen L, Li A: Clinical study for alleviating opiate drug psychological dependence by a method of ablating the nucleus accumbens with stereotactic surgery. *Stereotact Funct Neurosurg* 2003;81:96–104.
- 3 Sturm V, Lenartz D, Koulousakis A, Treuer H, Herholz K, Klein JC, Klosterkötter J: The nucleus accumbens: a target for deep brain stimulation in obsessive-compulsive and anxiety disorders. *J Chem Neuroanat* 2003;26:293–299.
- 4 Schlaepfer TE, Cohen MX, Frick C, Kosel M, Brodesser D, Axmacher N, Joe AY, Kreft M, Lenartz D, Sturm V: Deep brain stimulation to reward circuitry alleviates anhedonia in refractory major depression. *Neuropsychopharmacology* 2008;33:368–377.
- 5 Kuhn J, Lenartz D, Huff W, Mai JK, Koulousakis A, Maarouf M, Lee SH, Klosterkoetter J, Sturm V: Transient manic-like episode following bilateral deep brain stimulation of the nucleus accumbens and the internal capsule in a patient with Tourette syndrome. *Neuromodul Technol Neural Interface* 2008;11:128–131.
- 6 Aouizerate B, Cuny E, Bardinet E, Yelnik J, Martin-Guehl C, Rotge JY, Rougier A, Bioulac B, Tignol J, Mallet L, Burbaud P, Guehl D: Distinct striatal targets in treating obsessive-compulsive disorder and major depression. *J Neurosurg* 2009;111:775–779.
- 7 Neto LL, Oliveira E, Correia F, Ferreira AG: The human nucleus accumbens: where is it? A stereotactic, anatomical and magnetic resonance imaging study. *Neuromodul Technol Neural Interface* 2008;11:13–22.
- 8 Mavridis I, Anagnostopoulou S: The human nucleus accumbens as a target for deep brain stimulation: anatomical study of electrode's target point and stereotactic coordinates. *Minim Invasive Neurosurg* 2009;52:212–215.

Ioannis Mavridis
 Mikras Assias Street 75, Goudi
 GR-11527 Athens (Greece)
 Tel. +30 210 74 62 404, Fax +30 210 74 62 398
 E-Mail pap-van@otenet.gr