

Commentary to the controversy: Should asleep deep brain stimulation in Parkinson's disease be preferred over the awake approach?

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Deep brain stimulation (DBS) of the subthalamic nucleus is a mainstay device-aided treatment in Parkinson's disease with refractory motor complications such as wearing-off fluctuations and dyskinesias [1]. Optimal target localisation is essential for a successful outcome. Therefore, in patients able to properly participate, the procedure has been preferably performed as an *awake DBS* surgery allowing intraoperative assessment of the correct electrode position by testing clinical improvement and side-effects during test stimulation. However, this practice is strenuous and inconvenient for patients, sometimes leading to anxiety and even acute panic reactions during the operation. Furthermore, demanding assessments of clinical responses during test stimulation render awake approaches more time-consuming, thereby prolonging surgeries and increasing associated costs. With the advent of advanced imaging methods, the possibility emerged to perform DBS surgery under general anaesthesia, referred to as *asleep DBS*. The advantages of asleep DBS are apparently appealing: more convenience for the patients and possibly similar outcomes at lower costs [2]. However, which approach should be finally preferred has been disputed by the experts for several years. Based on the initiative of the Swiss Movement Disorders Society (SMDS), the experts of two large and experienced DBS centres in Switzerland agreed to provide *pro* and *con* arguments of the awake and asleep approaches in their respective "Controversy" articles in the present issue [3, 4].

On behalf of the SMDS, we consider the option of asleep DBS an important advancement in the field. Nonetheless, anatomical precision based on imaging accuracy alone may not be sufficient to convey the optimal treatment outcome in every case. It should be kept in mind that asleep and awake DBS may be combined with imaging (both pre- and intraoperatively) and measures of physiology in various ways [5]. For instance, asleep DBS still allows functional assessments of targets using microelectrode recordings. Furthermore, awake surgery using intraoperative

monitoring is still considered the better method for controlling lead displacements due to brain shifts associated with dural opening [5]. On the other hand, in asleep DBS, real-time visualisation by interventional MRI may well handle shifts of basal ganglia related to the loss of CSF [6]. The heterogeneity of applied methods and combination of different technologies made it challenging to directly compare the clinical benefits and drawbacks of the different approaches. Although awake and asleep DBS may be equivalent [2] in terms of outcome and safety, final confirmation will be provided by the results of ongoing randomised controlled phase 3 trials investigating both approaches prospectively in similar settings.

We think that the decision to operate a Parkinson's disease patient awake or asleep must be made individually also considering the patient's wish as well as the preference and experience of the interdisciplinary (neurologists and neurosurgeons) treatment team. Awake surgery is at present generally recommendable for younger and less fragile patients, who can cooperate well during surgery. An off state with an acceptable level of inconvenience and as short a duration as possible must be the rule [2]. In contrast, older and frail patients, and patients known to experience severe off states with painful dystonia or burdensome non-motor symptoms (anxiety, depression) should be offered asleep DBS. Overall, asleep DBS is now well established and is expected to be favoured by most of these Parkinson's disease patients. Since several studies only used imaging-based electrode placement, asleep DBS should in our opinion also incorporate microelectrode recording, with possible impact on the anaesthesia used, and at least cursory test stimulation to exclude frank capsular contraction at low stimulation levels. Nevertheless, the SMDS's advice is that the expertise for awake DBS should be preserved until further technical progress unambiguously favours asleep DBS more independently of clinical skill and experience. Awake DBS may be offered, particularly in younger pa-

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tients, and when demands on precision are challenging, such as in small targets neighbouring critical structures regarding side-effects. A residual risk of misplacing electrodes remains in DBS that may not be compensated for by directional stimulation. Therefore, regardless of whether performed awake or asleep, intraoperative neurophysiological and clinical validation of the targets may increase accuracy and therefore likely enhance the outcome of DBS surgery.

Potential competing interests

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflict of interest related to the content of this manuscript was disclosed.

References

1. Lozano AM, Lipsman N, Bergman H, Brown P, Chabardes S, Chang JW, et al. Deep brain stimulation: current challenges and future directions. *Nat Rev Neurol*. 2019 Mar;15(3):148–60. <http://dx.doi.org/10.1038/s41582-018-0128-2>.
2. Holewijn RA, Verbaan D, van den Munckhof PM, Bot M, Geurtsen GJ, Dijk JM, et al. General Anesthesia vs Local Anesthesia in Microelectrode Recording-Guided Deep-Brain Stimulation for Parkinson Disease: The GALAXY Randomized Clinical Trial. *JAMA Neurol*. 2021 Oct;78(10):1212–9. <http://dx.doi.org/10.1001/jamaneurol.2021.2979>.
3. Tinkhauser G, Pollo C, Debove I, Nowacki A, Krack P. Should asleep deep brain stimulation in Parkinson's disease be preferred over the awake approach? – Pros. *Swiss Med Wkly*. 2024;154:3823. <http://dx.doi.org/10.57187/s.3823>.
4. Büchele F, Stieglitz L, Baumann CR. Should asleep deep brain stimulation in Parkinson's disease be preferred over the awake approach? – Cons. *Swiss Med Wkly*. 2024;154:3855. <http://dx.doi.org/10.57187/s.3855>.
5. Verhagen Metman L, Slavin KV, Rosenow JM, Vitek JL, van den Munckhof P. More than just the level of consciousness: comparing asleep and awake deep brain stimulation. *Mov Disord*. 2021 Dec;36(12):2763–6. <http://dx.doi.org/10.1002/mds.28806>.
6. Lee AT, Han KJ, Nichols N, Sudhakar VR, Burke JF, Wozny TA, et al. Targeting Accuracy and Clinical Outcomes of Awake versus Asleep Interventional Magnetic Resonance Imaging-Guided Deep Brain Stimulation for Parkinson's Disease: The University of California, San Francisco Experience. *Neurosurgery*. 2022 Nov;91(5):717–25. <http://dx.doi.org/10.1227/neu.0000000000002111>.