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Modified Cement-Based Fixation of the Deep Brain Stimulation Electrode

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Deep brain stimulation (DBS) is becoming an increasingly performed surgery in daily neurosurgical practice. There are several important steps in DBS, such as patient selection, planning of the target, type of anesthesia, microelectrode recording if performed, and the fixation of the final electrode (lead). Suboptimal fixation can result in electrode migration shortly after the surgery. Unintended migration, and consequently displacement of the electrodes, occurs in up to 10% of the cases and is a serious complication in DBS surgery [1, 2]. This may result in no or suboptimal therapeutic effects, making a second surgery necessary [1, 3].

There are generally two methods for the fixation of the electrode to the skull. The first is using a burr-hole device provided by the hardware manufacturers. For this, the form of the burr hole has to be tailored to allow the placement of the burr-hole device [3–5]. The second is acrylic-based cementation [5, 6]. This provides the surgeon with a certain degree of freedom in the choice of the form and size of the burr hole. Some of the acrylics contain antibiotics and may form a barrier against infections. In the past 15 years, we have been using antibiotic-containing acrylic [7]. Besides some of its advantages, as outlined above, we experienced a disadvantage, which is the low degree of attachment of the acrylic to the bone, even with undercutting of the tabula interna to achieve a sandwich construction of the cement versus the burr hole. Frequently, we observed small movements of the acrylic construction related to the cerebrospinal fluid/parenchyma pulsations intraoperatively. To overcome this issue, we applied one to two anchoring titanium screws before applying the acrylic. This experience was derived from our laboratory studies, where we implanted cannulas and electrodes for long-term experiments and found out that anchoring screws are crucial in achieving a robust construction [8]. Here, we describe a rather simple modification of our previously reported antibiotic-containing cement-based fixation technique [7] to achieve rigorous anchoring of the DBS electrode.

After having determined the optimal implantation site during DBS surgery, the microelectrode recording/test stimulation electrode is removed and fluoroscopy is performed. Then, the final DBS electrode is lowered to the optimal stimulation site. After placing two layers of oxidized cellulose polymer (Surgicel®), one or two titanium screws (2 × 5 mm, the size might depend on individual preferences) are placed close to the burr hole and the acrylic is applied. Finally, the internal guide is removed, a second layer of acrylic is used to fix the electrode.

We have performed 8 surgeries (16 electrode fixations) with this method and have not observed any movements of the acrylic construct related to cerebrospinal fluid/parenchyma pulsations. The construction was extremely solid. This was independent of whether one or two screws were used.

Adequate fixation of the DBS electrode is essential to prevent postoperative migration. The acrylic-based fixation method has been our method of choice for the last 15 years for several reasons. We modified this method by adding anchoring screws to increase the robustness. This change is in line with other attempts in the field to improve DBS surgery.

Disclosure Statement

The authors declare no conflicts of interest.

References

- Baizabal Carvallo JF, Mostile G, Almaguer M, Davidson A, Simpson R, Jankovic J: Deep brain stimulation hardware complications in patients with movement disorders: risk factors and clinical correlations. *Stereotact Funct Neurosurg* 2012;90:300–306.
- Doshi PK: Long-term surgical and hardware-related complications of deep brain stimulation. *Stereotact Funct Neurosurg* 2011;89:89–95.
- Wharen RE Jr, Putzke JD, Uitti RJ: Deep brain stimulation lead fixation: a comparative study of the Navigus and Medtronic burr hole fixation device. *Clin Neurol Neurosurg* 2005;107:393–395.
- Ray CD: Burr-hole ring-cap and electrode anchoring device. Technical note. *J Neurosurg* 1981;55:1004–1006.
- Lee MW, De Salles AA, Frighetto L, Torres R, Behnke E, Bronstein JM: Deep brain stimulation in intraoperative MRI environment – comparison of imaging techniques and electrode fixation methods. *Minim Invasive Neurosurg* 2005;48:1–6.
- Favre J, Taha JM, Steel T, Burchiel KJ: Anchoring of deep brain stimulation electrodes using a microplate. Technical note. *J Neurosurg* 1996;85:1181–1183.
- Kocabicak E, Temel Y: Deep brain stimulation of the subthalamic nucleus in Parkinson's disease: surgical technique, tips, tricks and complications. *Clin Neurol Neurosurg* 2013;115:2318–2323.
- Tan S, Vlamings R, Lim L, Sesia T, Janssen ML, Steinbusch HW, Visser-Vandewalle V, Temel Y: Experimental deep brain stimulation in animal models. *Neurosurgery* 2010;67:1073–1079; discussion1080.