Securing Dual Ipsilateral Leads through a Single Burr Hole in Deep Brain Stimulation Surgery: Technical Note

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Key Words

Deep brain stimulation · Burr hole · Dual leads · Stimloc

Abstract

Deep brain stimulation (DBS) surgery typically involves placement of a single lead through a burr hole, either unilaterally or bilaterally. Rare indications, however, call for placement of 2 ipsilateral leads. To date, there have been no technical descriptions of how best to secure dual ipsilateral leads to the skull. We describe a method of placing and securing 2 ipsilateral DBS leads through a single burr hole using standard cranial plating equipment and a simple modification to a burr hole-mounted anchoring ring. This method has been used safely in 6 patients without detectable displacement of the first lead during implantation of the second lead.

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Introduction

Deep brain stimulation (DBS) involves implantation of a single unilateral lead or 1 lead within each hemisphere for bilateral placement. Each lead is stereotactically implanted through a separate burr hole and then secured in place with a burr hole-mounted anchoring

ring. Prior to definitively securing the lead, care must be taken to prevent altering the lead's position while removing it from the micropositioner and guide tube. Once the lead is free, it is pressed into a notch on the side of the anchoring ring and then locked into place with a cap that also prevents further access to the burr hole.

Rarely, certain conditions call for placement of 2 DBS leads within the same hemisphere [1–5], although the technical aspects of placing and securing dual ipsilateral leads has not been well described. This could be done through 2 separate burr holes, but such a technique would increase the size of the skin incision and the amount of implanted foreign material, potentially increasing surgical infection risk [6]. Here, we describe a technique by which 2 separate DBS leads can be placed through a single burr hole and secured into place using common, commercially available devices. This method allows for the first DBS lead to be secured without the use of the anchoring ring cap so that there is still access to the burr hole for placement of the second lead.

Methods

Pre-operative DBS target planning is performed with the entry points for each lead set in the same location or within millimeters from one another to allow them to be placed through a single burr

Fig. 1. Method of securing 2 DBS leads implanted through a single burr hole. **a** The Stimloc device is comprised of 3 components: a base ring (left), a clip (middle), and a cap (right). **b** A straight titanium plate cut to a width of 5 holes is given a slight bend in the center and then placed over the first DBS lead just outside the anchoring ring. The plate is then fastened to the skull with a screw placed in the outermost hole on either side. A gen-

tle tug on the DBS lead is used to determine if it is secure and additional screws can be placed in the next outermost screw holes if the plate needs to be further tightened. **c** With the first DBS lead secure, the second lead can be placed. **d** Once implanted, the second DBS lead is placed in the second anchoring ring notch and secured to the skull with a second straight titanium plate.

hole. A 14-mm perforator bit (Acra-cut, Acton, Mass., USA) is used to make the burr hole, which accommodates the Stimloc burr hole-mounted anchoring ring (Medtronic, Inc., Minneapolis, Minn., USA) that is used exclusively for this technique. The Stimloc device is comprised of 3 components: a base ring, a clip, and a cap (fig. 1a). The Stimloc base ring has a notch on 1 side to accommodate a DBS lead. After securing the ring to the skull with the supplied self-tapping screws, a second notch in the ring opposite the first is made using a Midas Rex Legend F1/8TA15 1.5-mm tapered drill bit (Midas Rex; Medtronic, Inc.). Care must be taken to make the second notch no wider than the drill bit itself, otherwise the lead may not be held securely by the Stimloc cap when it is placed at the end of the procedure. This is best accomplished by making the notch with no more than 1 or 2 linear passes of the drill. It is also desirable to replicate the depth of the existing notch in the base ring as closely as possible and to not make the new notch all the way through the base ring, which would compromise the integrity of the device. Some of the base ring

polymer material will be partially melted and adherent to the edges of the new notch after drilling; this is easily removed with a curette.

Once the first lead has been stereotactically implanted, the Stimloc clip is temporarily snapped into place to hold the lead in place while its proximal end is carefully removed from the micropositioner and guide tube. The Stimloc clip is a circular device that fits into the center of the burr hole anchoring ring. It has a notch that allows for the lead to pass through it. It also contains a small door on 1 side of the notch that can be rotated toward the lead and fastened against it to hold the lead in place. While the lead is removed from the micropositioner and guide tube, it is marked at the level of the clip with a surgical marker to better monitor its position and ensure there is no displacement. It is then pressed into 1 of the notches on the side of the base ring and the cap is temporarily snapped into place. With single lead placement, the cap would serve as the definitive method of anchoring the lead, but this would prevent further access to the burr hole. In-

stead, a low-profile straight titanium plate (Leibinger Universal Neuro; Stryker Corp., Kalamazoo, Mich., USA) is used, cut to a width of 5 holes to secure the lead to the skull just beyond the base ring. The plate is given a shallow bend in the center to allow for the lead to sit underneath it when it is fastened to the skull without compressing and damaging the lead. The plate is placed over the lead and fastened to the skull with screws placed in the outermost holes on either side (fig. 1b). Once fastened, the lead is given a gentle tug to ensure that it is secure. If there is still some movement in the lead beneath the plate, a third screw can be placed in the next outermost hole on 1 side of the plate to further tighten the plate against the lead. A fourth screw can also be placed if necessary. In this manner, the lead is gently and progressively secured in place and the burr hole can still be accessed by carefully removing the Stimloc cap and clip to allow for implantation of the second lead. The cap is best removed by using the tip of a small straight cervical curette to elevate 1 of the tabs that snaps into the base ring. The clip is removed by fully opening the small door, elevating the clip from its secured position in the base ring, and then rotating it as needed such that it can be removed without pulling up on the brain lead. At the end of this maneuver, the burr hole is free to accommodate placement of the second guide tube for placement of a second lead (fig. 1c). After implantation, the second lead is secured in place in a similar fashion. The Stimloc clip is placed around both leads and the door is closed. The second lead is then pressed into the second notch opposite the first, and the Stimloc cap is placed over the anchoring ring to secure the leads in place. A second titanium plate can then be placed as described above (fig. 1c) to further secure the second lead. Once both leads are secured, they can be tunneled together into the subcutaneous space. Intraoperative fluoroscopy with either a C-arm or O-arm (Medtronic, Inc.) was used after placement of each lead to confirm position.

Results

To date, 6 patients have undergone dual-lead DBS placement through 1 burr hole at our institution. All patients underwent DBS for tremor (essential tremor, Holmes tremor, or tremor related to multiple sclerosis). In 5 cases, the dual leads were both placed into the thalamus. In 4 of these patients, 1 lead was placed at the border of the ventralis intermedius (Vim) and ventralis oralis posterior (Vop) nuclei and the second at the border of the ventralis oralis anterior (Voa) and Vop nuclei. In the fifth patient, the dual leads were placed side by side (medial-lateral to each other) in the Vim. A sixth patient had 1 lead placed into the Vim while a second lead was placed into the subthalamic nucleus. In 5 patients, both leads were placed during the same operation. In a sixth patient, a Vim lead was initially placed but did not sufficiently control the patient's tremor. A second lead was then placed at the Voa/Vop border through the same burr hole 5 months later. Intraoperative fluoroscopy confirmed no

gross movement of the first lead during placement of the second lead. No morbidity or mortality was observed from these procedures, including wound infections.

Discussion

In this technical report, we describe a method of easily securing a DBS lead while placing a second lead through the same burr hole. While there have been several reports of dual DBS lead placements [1–5], prior studies have not described the technical aspects of placing 2 leads. Our solution involves a simple modification to the commonly used Stimloc burr hole-mounted anchoring device and titanium cranial plates. An alternative to this technique is to simply make a second burr and use a separate anchoring device for the second lead. We have done this in cases where the target can be reached by using a significantly different trajectory, such as placing a lead in the pedunculopontine nucleus in a patient previously implanted in the subthalamic nucleus. Although the DBS lead kit comes with an older device (the Medtronic burr hole ring) that does have 2 slots to potentially accommodate 2 leads simultaneously, many surgeons prefer the more contemporary Stimloc device, which is designed only to secure 1 lead. We have performed this in 6 patients without any significant lead displacement or other morbidity.

This method employs the use of a titanium plate to secure the first DBS lead while the second lead is being placed. This is necessary because placement of the second lead requires removal of the Stimloc clip and locking cap. These devices, however, may be sufficient to secure the second lead without placement of a second titanium plate. Use of a second titanium plate is therefore at the discretion of the surgeon and may depend upon how well the second lead fits into the notch on the Stimloc anchoring ring (assuming the second lead is placed into the newly-made notch). In addition, if both leads are sufficiently secured by the Stimloc clip and locking cap, it is also an option to remove the titanium plates altogether prior to closure in order to minimize implanted hardware.

Conclusions

Current DBS lead anchoring methods do not allow for secure placement of 2 DBS leads through a single burr hole. The method described here uses standard cranial plating equipment and a simple modification to a burr

hole-mounted anchoring ring to secure an implanted DBS lead while a second lead is implanted. As the uses of DBS increase, there will be more indications for dual ipsilateral lead placement and this method will allow this to be done safely and effectively.

Disclosure Statement

Dr. Larson has received honoraria in the past from Medtronic, Inc., the company who manufactures the DBS hardware described in this article. Dr. Potts has no conflicts to disclose.

References

- 1 Yamamoto T, Katayama Y, Fukaya C, Oshima H, Kasai M, Kobayashi K: New method of deep brain stimulation therapy with two electrodes implanted in parallel and side by side. *J Neurosurg* 2001;95:1075–1078.
- 2 Foote KD, Seignourel P, Fernandez HH, Romrell J, Whidden E, Jacobson C, et al: Dual electrode thalamic deep brain stimulation for the treatment of posttraumatic and multiple sclerosis tremor. *Neurosurgery* 2006;58(4 suppl 2):ONS-280–ONS-285; discussion ONS-285–ONS-286.
- 3 Yu H, Hedera P, Fang J, Davis TL, Konrad PE: Confined stimulation using dual thalamic deep brain stimulation leads rescues refractory essential tremor: report of three cases. *Stereotact Funct Neurosurg* 2009;87:309–313.
- 4 Lim DA, Khandhar SM, Heath S, Ostrem JL, Ringel N, Starr P: Multiple target deep brain stimulation for multiple sclerosis related and poststroke Holmes' tremor. *Stereotact Funct Neurosurg* 2007;85:144–149.
- 5 Houeto JL, Karachi C, Mallet L, Pillon B, Yelnik J, Mesnage V, et al: Tourette's syndrome and deep brain stimulation. *J Neurol Neurosurg Psychiatr* 2005;76:992–995.
- 6 Park YS, Kang JH, Kim HY, Kang DW, Chang WS, Kim JP, et al: A combination procedure with double C-shaped skin incision and dual-floor burr hole method to prevent skin erosion on the scalp and reduce postoperative skin complications in deep brain stimulation. *Stereotact Funct Neurosurg* 2011;89:178–184.