Surgery for Parkinson's Disease

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To Sarah, your lifelong love and support have been essential to all that I have accomplished.

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I am extremely grateful to my colleagues, who have contributed to the chapters in this book. I greatly appreciate their hard work and patience, in sharing their knowledge and experience with those who share our interest, in offering surgery to benefit patients with disabling PD.

Introduction

The surgical treatment of Parkinson disease has been a focus of my neurosurgical practice since 1993. The practice has evolved significantly, over the past 25 years, transitioning from lesioning to deep brain stimulation therapy and with the development of various stereotactic techniques/options. For instance, my own practice has changed from using the traditional reusable stereotactic frame to a single-use custom-made 3D-printed plastic platform, to accurately guide electrodes to the chosen brain targets. I believe that my years of practice have taught me to appreciate the keys to the successful application of DBS therapy, for the treatment of patients with Parkinson disease. The most important of these is for the surgeon to be able to identify appropriate candidates for DBS therapy, specifically that means PD patients whose quality of life would be significantly improved, by the reduction of motor fluctuations or tremors. In addition, the surgeon must recognize that the single biggest morbidity of DBS implantation is the exacerbation of a preexisting cognitive decline/impairment. The second most important factor is for PD patients to have appropriate expectations for DBS therapy. Patients must understand that DBS therapy can improve management of dopa-responsive symptoms (e.g., motor fluctuations) and/or to reduce disabling hand tremors. It is equally important for patients to understand what DBS therapy is not expected to accomplish. That would include prevention of disease progression and improvement of non-dopa-responsive symptoms (e.g., on-freezing, deteriorating best on function, cognitive decline, and gait/balance dysfunction).

With the identification of appropriate DBS candidates and appropriate patient expectations, the key to successful DBS therapy depends on selecting the proper target and accomplishing accurate DBS lead implantation, without producing significant morbidity. In my own practice, I have favored the VIM thalamic target, for tremor-dominant patients and the STN target for patients disabled by motor fluctuations. I recommend the GPi target for a minority of patients, particularly those disabled by dopa-induced dyskinesias and or dystonias, who have not tolerated substantial escalation of dopa medication. I favor staged bilateral implantation for older patients and for patients with a concern for even mild or minor preoperative cognitive decline. I have found that the above can only be accomplished by a neurosurgeon working closely with movement disorder neurologists who have taken an interest in the surgical treatment of patients with PD.

Meticulous identification of the planned brain target is critical. This is dependent on obtaining proper imaging, which is facilitated by the elimination of patient movement during MR imaging. Over the past 7 years, I have obtained my preoperative MRIs with patients under general anesthesia. This guarantees excellent quality imaging. MRI is merged with a CT scan, to eliminate any concern about MRI distortion and to image the skull fiducial markers (used for the stereotactic platform). Proper targeting requires precise identification of the anterior and posterior commissures, correction of tilt, and adjustment based on individual patient anatomy. Trajectories are carefully planned, to avoid surface veins, or the traversing of sulci below the cortical surface or of the lateral ventricle. At surgery, I use a hair sparing prep. Patients greatly appreciate this, and it has not been associated with a significant infection rate. I have made two technical modifications to the implantation procedure, which I have found advantageous. I use a titanium plate to secure the lead to the skull (see Fig. 1). A groove is drilled into the outer table of the skull, adjacent to the burr hole, to allow this to be a very low-profile technique. I place a clip on the lead, while the lead is still held by the stereotactic apparatus, to allow me to confirm that the desired lead depth is maintained, until the lead is secured to the skull. A rectangular plate is used, to anchor the lead to the skull and to repair the burr hole defect. A silastic collar is placed over the lead, at the point of plate contact, to secure the lead. A second modification relates to the extension wire connection to the DBS lead. I drill a trough into the outer table of the skull (see Fig. 2a), to allow the extension to have a lower profile, and use a titanium mini-plate (see Fig. 2b), to secure the extension into the trough, to prevent migration into the soft tissues of the neck. I have found that patients appreciate both of these modifications.

Another important aspect of DBS therapy is to accurately identify the lead location, after implantation. I routinely obtain a post-implant thin-section head CT scan

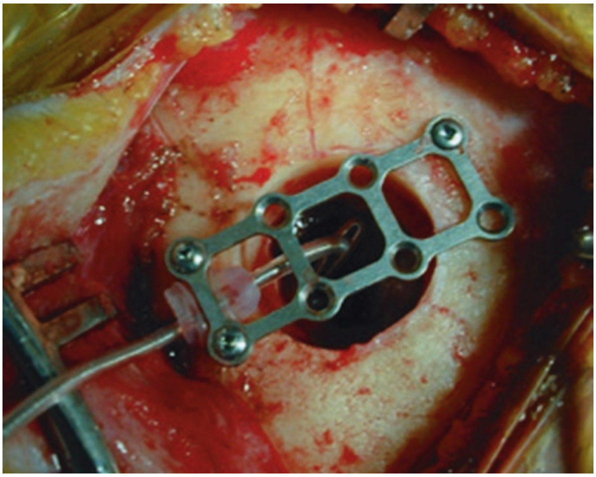

Fig. 1 The intraoperative photo depicts the titanium plate serving to anchor the DBS lead and to be a low-profile repair of the bur hole defect. Also seen are the clip on the lead (to maintain desired depth) and the silastic collar on the lead (to protect the lead from the titanium plate)

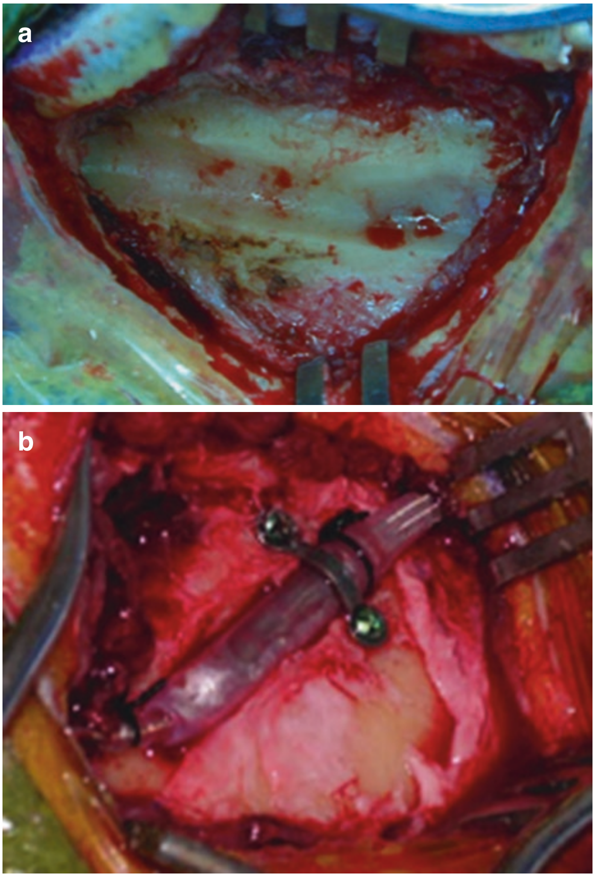

Fig. 2 Intraoperative photos demonstrate the trough drilled in the skull (to lower the profile of the connector) and the use of a titanium plate to secure the connector in the trough

and merge it with the planning MRI, to confirm the location of the lead, relative to the planned target. This can also be accomplished with a postoperative brain MRI. In general, the lead must be within 2 mm of the planned target, to achieve the desired clinical benefit. If it is not within this margin, and clinical benefit is suboptimal, revision must be considered. Also, with my lead anchoring technique, if the depth is not as desired, the anchoring plate can be loosened and the depth easily adjusted, at the surgery for extension wire and IPG implantation.

It is important for DBS surgeons to monitor their results and to confirm that they are similar to results in the literature. In my own case, our group analyzed and reported the results of my first 100 STN DBS-implanted patients [1]. This is a very useful exercise, since it could identify issues that should be addressed.

Finally, one of my main reasons for creating this book is that I am convinced that surgical treatment, when performed properly, is extremely beneficial to appropriate patients with PD. Although surgical therapy has grown significantly over the last 20 years, I believe that it is an underutilized intervention, and I hope that its application will expand greatly, in the coming years. I am hopeful that this book will achieve its goal, to be a practical guide for neurosurgeons pursuing DBS therapy, and other modalities, for the treatment of patients with PD.

Reference

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