Implantation of deep brain stimulation electrodes in unshaved patients

Technical note

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Although hair removal prior to neurosurgery may increase the risk of infection, the practice of shaving the patient’s entire head is still common, particularly in implant surgery. The authors describe a technique for implanting a deep brain stimulation electrode without shaving the patient’s hair and present a retrospective analysis of 261 implantations in 221 cases.

KEY WORDS • deep brain stimulation • implant surgery • hair • shaving

Deep brain stimulation, which has been developed as a powerful therapeutic tool for movement disorders, involves an intracerebral lead with quadripolar electrode contacts, a subcutaneous extension cable, and an IPG or neurostimulator. Stereotactic implantation of a DBS electrode is usually performed through a burr hole initially. In a second operation, an IPG is implanted in the chest and is connected to the lead by a subcutaneous extension cable stretching from head to chest. At present, electrode implantation is commonly performed after the entire head has been shaved.

Shaving the patient’s hair is a common preoperative procedure completed to reduce the risk of wound infection; however, there is no scientific rationale for this procedure. Since the reevaluation of hair removal in neurosurgery by Winston, some surgeons have opted to shave only around the operative area instead of the entire head. Cruse and Foord2 assert that surgeries involving shaving of the entire head are more likely to have wound infection than those devoid of shaving. There are no reports of leaving hair intact in DBS electrode implant surgeries, suggesting that there is still a belief that shaving hair decreases the infection rate associated with implants. Here we describe a technique for implanting a DBS electrode without shaving the patient’s head.

Perioperative and Operative Techniques

On the morning of the operation, the patient washed his or her hair with povidone iodine soap, rinsed it with sterile water, dried it with a clean towel, and covered it with a clean hair cap. Within a few hours, a stereotactic head frame was applied to the patient’s head and the patient underwent magnetic resonance imaging for preoperative localization of the target for stereotactic implantation of the DBS electrode. After magnetic resonance imaging, the patient was returned to the operating room and positioned on the operating table in a semisitting position. The patient’s scalp and hair were gently scrubbed with povidone iodine soap again. After scrubbing the hair, the soap was removed with clean gauze and the patient’s head and the four fixation posts of the stereotactic frame were painted with povidone iodine solution. Before this solution dried, the hair was parted along the line of the planned skin incision by using a clean comb (Fig. 1A). If the patient’s hair was rigid or overgrown, the hair was fixed and held to the side with sterilizing cream (chlorhexidine gluconate, 1% w/w) or clean hair clips. Otherwise, the hair just around the planned incision was trimmed short with scissors or cut with a razor, taking care not to touch the scalp directly with the razor. No adhesive drape was used to cover the operative field.

A sagittal incision measuring 20 to 25 mm was made in the frontal region at a point 25 to 35 mm lateral to the midline and 5 mm anterior to the coronal suture. The implantation of the DBS lead (model 3387; Medtronic, Inc., Minneapolis, MN) was performed with stereotactic cranial perforation by using a twist drill (Fig. 1B). The final target was physiologically confirmed by obtaining a microelectrode recording and performing a trial stimulation of the DBS electrode. Even if the contacts of the electrode were positioned at favorable coordinates on the intraoperative x-ray film, the final electrode was positioned where the tremor or rigidity was maximally alleviated. The electrode was secured with a titanium miniplate, according to the anchoring method of Favre, et al.,3 and the final position of the electrode tip was confirmed on an x-ray film. The other end of the electrode was moved subcutaneously to the parietal

Abbreviations used in this paper: DBS = deep brain stimulation; IPG = implantable pulse generator.
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A region by using a passer and was connected to the transcutaneous extension cable under the parietal scalp. If the trial stimulation was successful or if the microlesioning effect of merely inserting the lead in the target relieved the patient’s symptoms, a transcutaneous extension wire was not used for further trial stimulation after surgery. Instead, it was cut short and buried completely under the scalp, because transcutaneous exposure of the wire may increase the chance of infection. After implantation of the DBS electrode, the subcutis of the wound was closed using a buried continuous suture with No. 4-0 Vicryl thread. The skin was closed using a lock-stitch suture with No. 5-0 nylon thread to minimize the needle–skin penetrations. While closing the wound, great care was taken to match precisely the skin layers to prevent any oozing of blood and incrustation of the incision. The closed wound was closely examined and any hair trapped in the wound was carefully removed.

At the end of surgery, the patient was turned supine and his or her hair was rinsed with clean water to remove the sterilizing materials (soap, solution, and cream) completely, wiped with a clean towel, and dried using a hair dryer (Fig. 1C). The dried wound was sprayed and coated with an aseptic plastic dressing (Nobecutane L spray; Yoshitomi Pharmaceutical Ind., Ltd., Tokyo, Japan) and covered with a sterile dressing. When the dressing was complete, the patient’s head was released from the head frame. Prophylactic antibiotics (intravenous drip infusion of 1 g of cefotiam or flomoxef for 60 minutes twice/day) were administered until the 7th postoperative day. The No. 5-0 nylon stitches on the scalp were removed on the 5th postoperative day. In most cases, the neurostimulator with its extension cable was implanted on the 3rd day after electrode implantation if the test stimulation had been confirmed to be effective during surgery. Otherwise, the electrodes were removed or moved to another target.

Clinical Results

Stereotactic surgeries for movement disorders and intractable pain were performed in 670 cases between May 1995 and April 2001 in Kaizuka Hospital. Partial shaving or that of the entire head was performed in 423 cases between May 1995 and December 1997, and partial hair trimming (5 × 20 mm) was performed in 247 cases between January 1998 and May 2001. Until April 2001, there were 261 implantations in 221 cases (207 cases of Parkinson disease, three dystonia, nine essential tremor, and two intractable pain), with six cases involving replacement of DBS electrodes. Table 1 summarizes the number of cases, implantations (electrodes), and infections (and their rate) in each group. In 62 of 261 implantations, the patient’s head was shaved; in the remaining 199 implantations, the patient’s head was not shaved. Three electrodes (in one case of dystonia and two cases of intractable pain) were removed without implanting a neurostimulator because the postoperative trial stimulation was inefficient. Simultaneous bilateral implantation was performed in 40 cases. All implants were the products of Medtronic, Inc. Neurostimulators implanted

<table>
<thead>
<tr>
<th>Procedure</th>
<th>No. of Cases</th>
<th>No. Uni-lat</th>
<th>No. Bil-lat</th>
<th>No. Implants</th>
<th>No. Infections (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>shaved</td>
<td>39</td>
<td>16</td>
<td>23</td>
<td>62</td>
<td>1 (1.6)</td>
</tr>
<tr>
<td>unshaved</td>
<td>182</td>
<td>165</td>
<td>17</td>
<td>199</td>
<td>1 (0.5)</td>
</tr>
<tr>
<td>total</td>
<td>221</td>
<td>181</td>
<td>40</td>
<td>261</td>
<td>2 (0.8)</td>
</tr>
</tbody>
</table>

* Excluding three cases in which implants were removed because of their inefficiency following test stimulation. The Fisher exact test showed no statistical significance in infection rates when the procedures were compared.
in the chest included the following models: Matrixtc model 3272 (eight cases) and Xtrex model 3470 (106 cases) from May 1996 to March 2000; Itrel2 model 7424 (86 cases) from April 2000 to December 2000; and Soletra model 7426 (21 cases) from January 2001 to April 2001. Two cases in which an electrode was implanted in the patient’s head (0.8%) involved infected wounds. The infection rate of cases in which a neurostimulator or an IPG was implanted in the chest was slightly higher (1.4%). Both patients with head wound infections exhibited a superficial infection of the subgaleal layer and skin at the surgical site with a purulent discharge, pain, swelling, and redness; however, there was no evidence of intracranial infection. In one patient (1.6%) who had received bilateral implants after partial head shaving, infection occurred 3 months after implantation; and in another patient (0.5%) who had received a unilateral implant for tremor but had not been shaved, a wound infection developed 3 weeks after implantation. Both patients underwent removal of the implants and the wound infections were successfully treated with antibiotic agents. The infection in the unshaven patient occurred at the connector end in the parietal region while the patient was waiting to undergo the scheduled neurostimulator implantation. A bacteriological study of the pus from the infected wounds in both patients demonstrated Staphylococcus aureus.

Discussion

Bacterial infection is an important concern in implant surgery. There are two reasons for rejecting the practice of shaving the patient’s head in neurosurgery: 1) hair removal is unnecessary for sterile neurosurgery;1,5 and 2) it increases the risk of infection.6,7 The former opinion does not take into account the possibly harmful effect of shaving in implant surgery, whereas the latter suggests that leaving the hair intact decreases the infection rate in implant surgery. Intact skin works as a strong barrier against bacteria. Shaving the hair creates multiple microscopic injuries to the scalp,4 allowing resident or pathogenic flora to colonize around the wound and facilitating an invasion by the flora deep within the skin up to the foreign body.6

Because our comparison is based on a retrospective analysis, it lacks the synchrony that may have been achieved in comparing patients whose skin was prepared by shaving and those whose skin was not. Although leaving the hair intact in our study was not associated with any statistically significant lower infection rate, the procedure was proven to be at least as safe as that undertaken with conventional hair removal. One case of infection in a patient who had undergone shaving occurred 3 months after surgery; however, one cannot conclude that the hair removal procedure itself directly caused the infection. In this case, the infection rate in patients who did not undergo shaving seems higher than that in patients who were shaved. Nonetheless, taking into account that the infection rate (0.5%) in patients who were not shaved was equal to that in similarly treated patients who underwent ventriculoperitoneal shunt surgery,7 we believe that leaving the hair intact is safe enough and, in fact, safer than hair removal in implant surgery. Neurosurgical procedures in patients whose skin has not been prepared by shaving is still not widely accepted, and the hair removal procedure itself may seem complicated and time consuming.1 Our successful results in DBS electrode implant surgery during 199 implantations should promote the practice of leaving the hair intact in implant neurosurgeries as well as in general neurosurgery to prevent postoperative wound and/or implant-related infection.

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References


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