Technical Note: Preemptive Surgical Revision of Impending Deep Brain Stimulation Hardware Erosion

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■ BACKGROUND: **While deep brain stimulation (DBS) is a relatively safe procedure, skin erosion is a commonly reported hardware complication that can threaten the DBS system. Patients with Parkinson disease are especially at risk for this complication due to their autonomic dysregulation and impaired nutrition. Early detection of impending skin erosion allows for intervention that may prevent hardware destruction. Here we report a novel technique to address this complication preemptively. We describe the use of an acellular dermal matrix to prevent skin erosion in 20 patients with Parkinson disease who were treated with DBS and showed signs of impending skin erosion.**

■ METHODS: **Twenty patients with signs of impending hardware erosion were identified. An acellular dermal matrix was surgically placed under the at-risk skin overlying the DBS lead.**

■ RESULTS: **None of the 20 patients treated with this technique went on to require further revision surgery or removal of hardware.**

■ CONCLUSIONS: **Surgical placement of acellular dermal matrix in patients identified as having impending hardware erosions is a safe and cost-effective way to prevent hardware complications.**

INTRODUCTION

Deep brain stimulation (DBS) is a safe and effective form of adjunctive therapy for alleviating motor symptoms in a variety of movement disorders.[1-5] Between 2002 and 2011, there were an estimated 23,713 surgical installations of DBS in the United States, with roughly 3500 of these performed in 2011 alone.[6] Although implantation of a DBS system is a relatively low-risk procedure,[7] hardware complications occur with reported rates ranging from 1.7% to 8.4% per electrode year.[8-10] Over the patient's lifetime, skin infection and hardware erosion through the skin can occur with reported rates of 1.0%–24.7% (**Table 1**),[8,9,11-23] causing potentially avoidable financial and emotional burdens to patients and their caregivers. Hardware erosion through the skin, in particular, can be a treatment challenge and, in severe cases, require closure with a musculocutaneous flap.[24] With the increasing volume of DBS procedures performed annually, minimizing rates of complications and improving early detection of these complications to avoid device removal are paramount.

Various techniques have been investigated to prevent hardware erosion including countersinking the DBS cap,[25] using C-shaped incisions,[11,26] sine-wave-shaped incisions,[27] and adjusted burr holes.[26] Countersinking prevents protrusion of the DBS hardware, though this technique can add significant time and challenge to the operation. C-shaped and sine-wave-shaped incisions add the benefit of protecting the vascular supply to the scalp, but they run the risk of facilitating the spread of infection from one side of the scalp to the other. Furthermore, patients with Parkinson disease (PD) who undergo DBS surgery are inherently at risk of wound infection due to poor nutrition[28] and autonomic dysregulation of perfusion to the skin.[29] When impending hardware erosion is diagnosed early, clinicians are presented with a rare opportunity to surgically intervene and potentially prevent removal. In this manuscript, we report our experience using a simple and novel wound revision technique for patients with impending DBS hardware erosion. To date, this procedure has been performed successfully in 20 patients with impending hardware erosion without any subsequent complications.

ILLUSTRATIVE CASE

The patient was an 80-year-old woman with idiopathic PD who underwent bilateral subthalamic nucleus DBS 2 years before

Key words
- Deep brain stimulation
- Parkinson disease
- Skin erosions

Abbreviations and Acronyms
ADM: Acellular dermal matrix
DBS: Deep brain stimulation
PD: Parkinson disease

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Table 1. Review of Studies Reporting Skin Complications in Deep Brain Stimulation Patients

Study	Year	Number of Patients	Erosion	Infection	Erosion + Infection	Number of Revision Surgeries (Total System Removals)
Constantoyannis	2005	144	1.4%	6.2%	—	—
Falowski	2015	422/527*	0.4%/0.8%*	2.6%/1.3%*	—	—
Fenoy	2012	728	—	—	3%	9
Hamani	2006	922 (review)	1.3%	—	6.1%	—
Kenney	2007	319	—	—	4.4%	8 (7)
Oh	2002	80	1.25%	—	—	—
Paluzzi	2006	96	2.1%	5.2%	—	7
Patel	2015	510	2.5%	—	—	—
Peña	2008	55	16.3%	—	—	8 (5)
Sillay	2008	420	—	4.5%	—	18 (4)
Sixel-Döring	2010	85	—	—	24.7%†	8 (8)
Umemura	2011	180	2.8%	—	—	—
Umemura	2003	109	0.9%	—	4.6%	—
Vergani	2010	140	0.7%	2.1%	1.4%	6 (0)
Voges	2006	262	—	5.7%	—	10 (7)

*Number of leads placed before/after implementing new technique described in "Discussion."
†Called "skin complications," not specifically erosion or infection.

presentation. Thinning of the scalp skin surrounding the frontal burr hole incision overlying the StimLoc (Medtronic, Minneapolis, Minnesota, USA) was noted by her movement disorder neurologist. She was subsequently referred to our clinic for evaluation. In order to avoid the complications of potential wound erosion, she was recommended for preemptive revision surgery.

METHODS

After informed consent was obtained, the patient was brought to the operating room and positioned in a well-padded supine position. Following the induction of general anesthesia and endotracheal intubation, the proposed incision was marked and the area injected with 0.5% lidocaine with 1:200,000 epinephrine. As previously described, we typically use an arcuate incision for the frontal electrode burr holes. The scalp was prepped and draped in the usual sterile fashion. The prior arcuate burr hole incision was reincised with a No. 15 scalpel to the level of the subcutaneous fat (Figure 1). A plane above the implant was created with Metzenbaum scissors and toothed Adson forceps past the posterior extent of the

Figure 1. Prior arcuate burr-hole incision is reincised.

Figure 2. Plane above implant is created.

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