A Strange Case of Downward Displacement of a Deep Brain Stimulation Electrode 10 Years Following Implantation: The Gliding Movement of Snakes Theory

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Key words
- DBS complications
- Electrode displacement
- Parkinson disease

Abbreviations and Acronyms
CT: Computed tomography
DBS: Deep brain stimulation
STN: Subthalamic nucleus

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■ BACKGROUND: **Despite the best efforts to ensure stereotactic precision, deep brain stimulation (DBS) electrodes can wander from their intended position after implantation. We report a case of downward electrode migration 10 years following successful implantation in a patient with Parkinson disease.**

■ METHODS: **A 53-year-old man with Parkinson disease underwent bilateral implantation of DBS electrodes connected to a subclavicular 2-channel pulse generator. The generator was replaced 7 years later, and a computed tomography (CT) scan confirmed the correct position of both leads. The patient developed a gradual worsening affecting his right side 3 years later, 10 years after the original implantation. A CT scan revealed displacement of the left electrode inferiorly into the pons. The new CT scans and the CT scans obtained immediately after the implantation were merged within a stereotactic planning workstation (Brainlab).**

■ RESULTS: **Comparing the CT scans, the distal end of the electrode was in the same position, the proximal tip being significantly more inferior. The size and configuration of the coiled portions of the electrode had not changed. At implantation, the length was 27.7 cm; after 10 years, the length was 30.6 cm.**

■ CONCLUSIONS: **These data suggests that the electrode had been stretched into its new position rather than pushed. Clinicians evaluating patients with a delayed worsening should be aware of this rare event.**

INTRODUCTION

Despite the best efforts to ensure stereotactic precision, deep brain stimulation (DBS) electrodes can wander from their intended position after implantation. In many cases, the migration occurs before closure of the operative wound and is likely due to an inadvertent movement of the electrode during the procedure. However, several centers reported late migration of electrodes occurring months or years after the initial surgery. Most of these displacements are in the upward direction and are thought to be related to a tenuous attachment of the electrode to the skull that allows the electrode to slide as the head and neck are turned. However, Susatia et al. (12) described a patient with cervical dystonia in which the displacement was in the downward direction and hypothesized that the electrode was driven deeper into the brain by the vigorous dystonic movements. We report a patient with Parkinson disease discovered to have downward electrode migration 10 years after successful implantation.

CASE REPORT

A 53-year-old man with a 16-year history of Parkinson disease was evaluated for DBS implantation. His tremor, bradykinesia, and postural instability worsened despite maximal medical therapy, and he developed on-off fluctuations, off-state freezing, and severe on-state dyskinesias. He underwent bilateral microelectrode-guided placement of DBS electrodes into the subthalamic nucleus (STN) according to our standard protocol (6, 7). The DBS electrodes were fixed to the skull by a silicone burr hole ring and cap supplied by the manufacturer of the DBS equipment (Medtronic Inc., Minneapolis, Minnesota, USA). The excess length of electrode was coiled under the scalp. A postoperative computed tomography (CT) scan showed that the electrodes were appropriately placed in the STN region and that there had been no intraparenchymal hemorrhage (**Figure 1**). A 2-channel pulse generator (Kinetra; Medtronic, Inc.) was implanted in the subclavicular region 1 week later and connected to the intracranial electrode; the generator was activated the next day. The patient was discharged 3 days after implantation.

After implantation and activation of the DBS 2 weeks later, the patient's motor scores on the Unified Parkinson's Disease Rating Scale significantly improved from 54 to 43, and his medication doses could be gradually reduced. Both distal contacts were activated (contacts 0 and 4 negative; case positive), and parameters of voltage, width, and frequency were 2.5 V, 60 µ, and 130 MHz. The left generator became depleted 7 years later and was replaced. A new CT scan was obtained that confirmed the position of both leads at the original site (**Figure 2**).

The patient developed a gradual worsening of right-sided rigidity, bradykinesia, and tremor 3 years later, 10 years after the

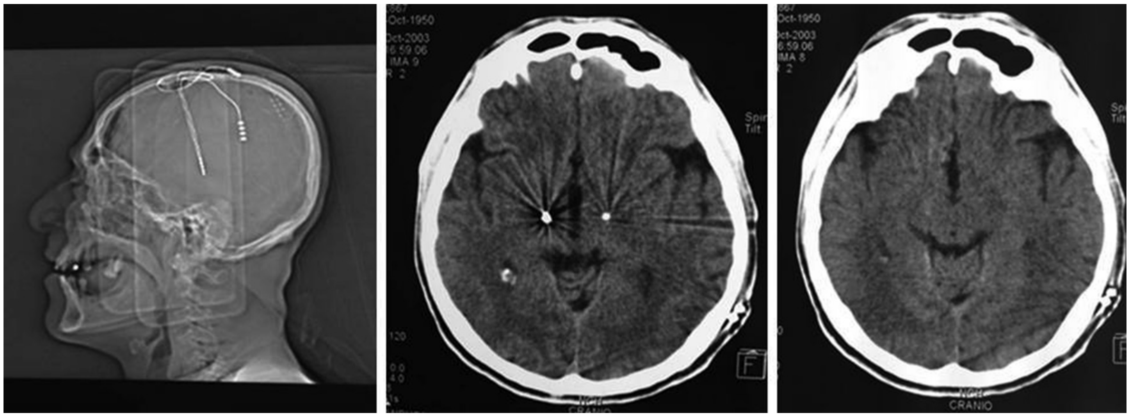

Figure 1. Computed tomography scan performed in 2003 immediately after the first surgical procedure documents the correct position of both deep brain stimulation electrodes in the subthalamic nucleus.

original implantation. A CT scan revealed that the right electrode was in its original position, but that the left electrode appeared to be displaced inferiorly into the pons (Figure 3). There was no history of trauma to the head or neck. Changing the stimulation parameters to activate the most superior electrode contact (contact 7) reestablished improvement in his motor symptoms.

After a few months, the patient presented with evidence of a skin infection along the connecting lead on the left side of the neck. To prevent the infection from spreading intracranially, the lead and the DBS electrode were removed. A significant resistance was encountered as the electrode was pulled through the burr hole, and a linear, calcific mass was found adherent to the terminal 2 cm of the electrode (Figure 4). Microbiologic cultures were negative, and pathologic examination showed a partially calcified pseudocyst bordered by a chronic xanthogranulomatous process. Laboratory studies showed no abnormality of calcium metabolism. The patient was discharged after medical therapy for Parkinson symptoms was optimized.

The CT scans obtained immediately after the implantation and CT scans obtained after 10 years were merged within a stereotactic planning workstation (Brainlab AG, Feldkirchen, Germany) and used to construct three-dimensional renderings of the electrode at the 2 points in time. Although the position of the distal end of the electrode at its attachment to the wire leading to the generator had not changed between scans, the proximal tip of the electrode was located significantly more inferior within the brain (Figure 5). The size and configuration of the coiled portions of the electrode in the vicinity of the burr hole had changed only minimally to an extent that would not explain the length of descent of the straight portion of the electrode. The connector anchoring the electrode in the neck did not shift in position (Figure 6). The length of the electrode was measured from each of the CT datasets by dividing the electrode into short segments, using the workstation software to measure the length of each segment and adding the results. At implantation, the electrode measured 27.7 cm; after 10 years, the electrode measured 30.6 cm. The leads were provided by the manufacturer (Medtronic) with a length of 28 cm. Because the distal end of the electrode and the configuration of the coiled segment had not changed, these

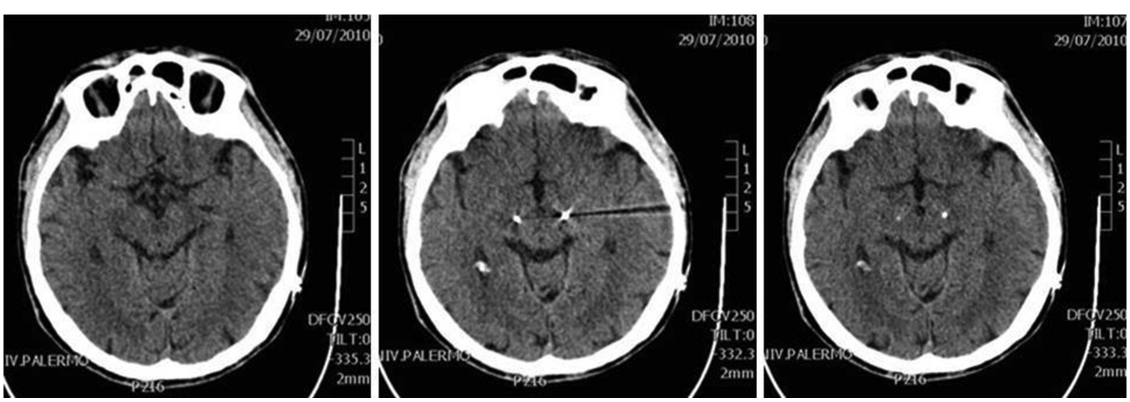

Figure 2. Computed tomography scan performed in 2010 does not show migrations of deep brain stimulation leads.