Deep-brain stimulation is a widely accepted therapy for a variety of neurologic disorders. However, results of deep-brain stimulation for chronic pain have been variable. The periventricular gray region (PVG) and the ventralis caudalis of the thalamus have been the primary targets either alone or in combination. We recently implanted electrodes in the nucleus accumbens, a new target, in combination with the PVG for central post-stroke pain in three patients. Here, we present extended follow-up.

Methods
We compared visual analog pain scale (VAS) scores prior to implantation and in the perioperative period with follow-up VAS scores. fMRI studies were conducted in two of the patients. A formal pain disability index and patient satisfaction questionnaire also were administered.

Results
Short-term results at 3 to 11 months demonstrated a sustained reduction in VAS scores from a baseline of 9 to 4 in all three patients. All three saw improvement in activities of daily living and social interaction after surgery. Two of the patients have been implanted for more than 2.5 years; one continues to have significant benefit with maintained reductions in VAS ratings (a VAS score of 5) and a significant reduction in the pain disability index from 46 to 29 (out of 70). The other experienced a subsequent stroke that has resulted in further debility and a recurrence of pain between follow-up intervals (with VAS score of 10). fMRI studies of two of the patients indicated BOLD signal in the insular and pre-frontal regions, suggesting potential involvement of these neural structures in pain reduction.

Conclusion
The nucleus accumbens may be an effective adjunctive target for central post-stroke pain as improvements were seen with respect to the pain disability index and VAS in all three patients, with one patient showing sustained benefit more than 2.5 years after surgery. Our imaging findings suggest that downstream signals to the insular and pre-frontal regions may underlie the benefit of nucleus accumbens deep-brain stimulation in central post-stroke pain. However, further prospective studies are warranted to verify these results.