

S1-Reprogramming Guided by the Fused Images of MRI and CT in Subthalamic Nucleus Stimulation in Parkinson Disease

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Objective: To evaluate the usefulness of the visual information about the location of the contacts in deep brain stimulation (DBS) programming, we compared the outcomes of subthalamic nucleus (STN) stimulation before and after reprogramming guided by the fused images of MRI and CT.

Methods: Of the 65 patients with Parkinson's disease, who underwent bilateral STN-DBS surgery between March 2005 and September 2006 and had been managed for at least 6 months with conventional programming which was only based on the physiological responses from the patients, 54 patients were reprogrammed based on the 3D anatomical location of the contacts revealed by the fused images of preoperative MRI and post-operative CT scans taken at 6 months after surgery. A total 51 patients completed the evaluation after reprogramming.

Results: Reprogramming significantly improved the UPDRS part III scores during the on- and offmedication condition. The daily levodopa-equivalent dose was significantly reduced. Improvement in the UPDRS part III scores after reprogramming was greater in the patients with electrodes in the STN than the patients with electrodes off the STN.

Conclusions: CT-MR fusion images helped to reprogram stimulation parameters with ease and confidence in a time-saving manner and resulted in further clinical improvement. This method could complement the conventional method of adjusting stimulation parameters after bilateral STN-DBS.

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S2-Bilateral Subthalamic Deep Brain Stimulation in Parkinson Disease Patients With Severe Tremor

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Background: Previous studies have shown that subthalamic nucleus (STN) deep brain stimulation (DBS) improves tremor in Parkinson disease (PD). However, the patients included in those studies were unselected for tremor severity.

Objective: We specifically assessed the effect of STN DBS on tremor in selected PD patients with severe tremor.

Methods: Seventy-two PD patients who had received bilateral STN DBS were included.

The effects of STN DBS on the off-medication tremor, the on-medication tremor, and the off-medication action tremor in patients selected as the worst one-third in each category at baseline were evaluated after a mean duration of >2 years.

Results: In patients with severe off-medication tremor, off-medication tremor score improved from 12.28 ± 2.80 at baseline to 1.93 ± 2.85 at the last follow-up ($p < 0.001$). The off-medication tremor in the off-stimulation state at the last follow-up was less severe than the preoperative off-medication tremor. In patients with severe on-medication tremor, on-medication tremor score improved from 6.17 ± 2.45 to 1.35 ± 2.58 ($p < 0.001$). In patients with severe off-medication action tremor, off-medication action tremor score improved from 5.08 ± 1.35 to 1.24 ± 1.42 ($p < 0.001$).

Conclusion: STN DBS is effective for severe off- and on-medication tremor and offmedication action tremor in PD. Our findings suggest that STN DBS reduces PD tremor through, at least in part, its effect on the tremorgenerating mechanism independent of dopaminergic transmission and that long-term electrical stimulation of STN might induce a structural or neurochemical change leading to the improvement of tremor.

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S3-The Effect of Combined Bilateral Globus Pallidus Internus Deep Brain Stimulation Plus Ventralis Oralis Thalamotomy for Patients with Cerebral Palsy

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Introduction: Cerebral palsy (CP) is a non-progressive syndrome of severely abnormal posture and motor impairment that results from irreversible insult to the developing central nervous system.

The features of CP are similar to those of early onset dystonia, however, surgical outcomes after lesioning or deep brain stimulation (DBS) are less effective in CP than in idiopathic generalized dystonia. We believe that CP is difficult to treat because it is caused by a variety of motor disorders and multiple regions of the brain. We compared bilateral globus pallidus internus (GPi) DBS and bilateral GPi DBS with ventralis oralis (Vo) thalamotomy to analyze the effect of combined Vo thalamotomy.

Materials and Methods: Between March 2003 and December 2008, 10 patients underwent DBS or/and lesioning for treatment of cerebral palsy in the Neurosurgery Department of our institute. Four patients received bilateral posteroventral GPi DBS in group I and six patients received the Gpi DBS plus thalamotomy in group II.

Results: The periodic change in the Burke-Fahn-Marsden Dystonia Rating Scale (BFMDRS) movement and disability score had the greatest width within 1 month in both treatment groups. The groups had distinct patterns; in group I, the effects decreased after 1 month, and then the effect increased gradually from 6 months onward, while in group II, the effect was maximized at 1 year and showed little decrease afterward. The BFMDRS-movement subscores of group II demonstrated statistically significant improvement in contralateral arm ($p=0.042$) compared to group I. Body pain ($p=0.042$), vitality ($p=0.042$) and mental health ($p=0.043$) seemed to improve significantly in group II in terms of health related quality of life (SF-36).

Conclusions: Combined bilateral GPi DBS plus unilateral Vo thalamotomy for CP patients with fixed states in the upper extremities is useful not only for secondary dystonic movement, but also to improve quality of life. In the future, studies should focus on analyses of the movement circuit and pathophysiology of CP and how to correct body balance.

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S4-Securing Technique of Deep Brain Stimulation Connector by Placing a Trough in the Cranial Bone

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Introduction: The functional neurosurgeon should be aware of the possibility of hardware related complications including infection and/or erosion, and migration of deep brain stimulation (DBS) devices. Connectors sometimes have been a problem in patients with DBS implants. The authors report on case analysis of a surgical method to secure the lead-extension connector of DBS for the way of avoiding complications.

Materials and Methods: A vertical skin incision was made about 6 cm in length at the posterior parietal area. We drilled a trough in the posterior parietal bone to decrease the profile of the connector and also to indwell an excess lead-extension line. Multiple side holes (47 procedures) were made along the trough edge to anchor them. After then, galea closure was done. This technique has been used to secure 67 DBS connectors implanted for movement disorder including Parkinson's disease (18 patients), dystonia (13 patients), and essential tremor (3 patients). The follow-up period was 27.9 ± 7.2 months (range 20-37).

Results: The severe complication was not related to this technical process. Dura exposure was noted in 5.8% of 67 procedures, but dural tearing did not occur. The connector was seldom noticeable in appearance. Tolerable discomfort at site of the skin incision occurred transiently in the most cases. There were no harm in wearing glasses or in lying down on the bed. Neither scalp infection and/or erosion at the connector site nor migration of the connector developed at follow-up in long-term.

Conclusion: The securing technique of DBS connector using a trough in the cranial bone demonstrated to be a safe and effective method to avoid the connector related complications.

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S5-The Safety Method for Tunneling the Lead in Deep Brain Stimulation

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Introduction: Deep brain stimulation (DBS) has been known as most effective technique for treatment of movement disorders. DBS procedure has divided by 2 stages such as electrode insertion under stereotactic frame and IPG insertion under general anesthesia. Since the authors experienced painful complication during the tunneling procedure, it is necessary to develop the safe surgical technique. In the present study, authors present the safety method to tunnel the lead.

Methods: From Feb. 2004 to Jul. 2010, DBS was performed in 34 patients with 64 electrodes for management of movement disorders. Among them, 28 IPG insertion procedures were performed according to modified safety method.

Description of technique: The first skin is incised by vertical or round shape for electrode implantation. According to routine procedure, electrode is inserted into the target point. Before temporary closure, the distal end is covered with protective boot and cap, and imbedded into the subgaleal pocket of the dorsal end of skin incision. Computed tomogram is scanned to identify the proper electrode implantation, general anesthesia is inducted. After preparation of IPG pocket in the chest wall, second skin incision is made at the distal 1 cm of the first skin incision. Tunneling procedure performed as routine procedure, and distal end of the first skin incision is open for only extrusion of distal end of electrode. And then, the distal end of electrode is connected with proximal end of IPG lead. Finally, the first skin incision is fully open and tightly closed with anchoring of connection portion into the subgaleal pocket.

Results: Although 2 electrode dislocation and extrusion were found during IPG insertion when conventional procedure (5%), there was no intra-operative complication in modified method (0%).

Conclusions: We suggest a modified method with simple technique for the safer tunneling of a DBS electrode. The possibility of the dislocation of the lead during the surgery is low. Although papers about IPG insertion related complication, the authors' method should be afforded more safety during tunneling procedures.

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S6-Bilateral Combined Nucleus Accumbens Deep Brain Stimulation and Anterior Cingulotomy for Refractory Obsessive Compulsive Disorders

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Purpose: Even though conventional behavioral and drug therapies are generally effective to the patients with obsessive compulsive disorder, there are still a significant number of patients with obsessive compulsive disorder that are not aided by either intervention. For these patients, various neurosurgical interventions were attempted and showed good clinical outcomes, especially with bilateral nucleus accumbens deep brain stimulation and bilateral anterior cingulotomy.

Under assumption that combination of these two procedures may have additive effect to the patients with obsessive compulsive disorder, we performed combined bilateral nucleus accumbens deep brain stimulation and anterior cingulotomy for these patients.

Materials and Methods: Three patients with refractory obsessive compulsive disorders were underwent combined bilateral nucleus accumbens deep brain stimulation and anterior cingulotomy. All patients met the inclusion criteria for the Korean guideline of deep brain stimulation for obsessive compulsive disorder. Base line Yale-Brown obsessive compulsive disorder scale (Y-BOCS), Hamilton depression rating scale (HAM-D), and Global assessment of Functioning (GAF) were evaluated and these scores were serially estimated for more than twenty four months after surgery with the interval of three months.

Result: Mean value of base line Yale-Brown Obsessive compulsive scale score was 34.7 (30-38) and the mean value was decreased significantly as 23 (20-25) at postoperative three months and it was maintained until two years after surgery with mean value of 19 (18-20). Mean value of preoperative HAM-D and GAF were 18.3 (15-22) and 51.7 (50-55), respectively. These mean values were also improved at 24 months after surgery as 10.7 (HAM-D; 9-14) and 63.3 (GAF; 60-65), although the time courses of improvement were different.

Conclusion: According to the previous surgical result, we postulated that combination of two procedures which targeted different pathway might have additive effect for obsessive compulsive disorder. However, our result showed that the combination of two therapies did not result in clinical improvement better than the improvement by nucleus accumbens deep brain stimulation, although surgical results were still satisfactory.

S7-Psychosurgery for Schizophrenia with Obsessive-compulsive and Aggressive Behavior

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We report the short term result of anterior capsulotomy for schizophrenia with obsessive-compulsive and aggressive behavior in a single male patient. He had mental retardation with autistic characteristics and has developed schizophrenia since age 13 with increased symptoms of delusion and auditory hallucination. He underwent repeated hospital care due to self-injury, aggressive movement and obsessions. The symptoms were refractory to the medications; therefore, he underwent anterior capsulotomy at age 27. Although the medications were decreased to less than fifty percent of the usual dose after the operation, his behavior problem was improved markedly. Positive and negative syndrome scale (PANSS) of the patient was decreased during one month postoperative; however, there was a little side effect such as morning drowsiness. We concluded that treatment-refractory schizophrenia with obsessive-compulsive and aggressive behavior could be alleviated by anterior capsulotomy because the operation had incredible effects on symptoms of obsessive-compulsive and aggressive behavior although longer follow-up periods and larger cases were needed.

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