Original Article

Nepal Journal of Neuroscience 2026;23(1):17-20

Functional Neurosurgery for Movement Disorders: Experience with Deep Brain Stimulation and Pallidotomy at a Tertiary Center in Nepal

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Date of Submission:4th January 2026 Date of Acceptance: 13thth March 2026 Date of Publication: 15th March 2026

Abstract

Background: Functional neurosurgery, particularly Deep Brain Stimulation (DBS) and ablative procedures like pallidotomy and thalamotomy, has emerged as a powerful tool in the treatment of medically refractory movement disorders. However, its application in low-resource countries like Nepal is limited. This study presents our early experience with surgical management of movement disorders at Bir Hospital using DBS and lesioning techniques.

Methods: This is a prospective study from the period of April 2024 to June 2025 at the National Neurosurgical Referral Center (NNRC), National Academy of Medical Sciences (NAMS) Bir Hospital. Patients with advanced Parkinson's disease or primary dystonia underwent surgical intervention. Four patients received bilateral Globus Pallidus internus (GPi) DBS, one patient received bilateral subthalamic nucleus(STN)DBS and three underwent unilateral radiofrequency pallidotomy. All surgeries were performed under local anesthesia except for IPG placement, which was done under general anesthesia. Patients were evaluated for improvement in tremor, rigidity, camptocormia, and dystonia. Clinical outcomes and complications were assessed over a follow-up period of up to one year.

Results: All patients demonstrated significant clinical improvement in motor symptoms postoperatively. Four patients with over 1-year follow-up maintained sustained benefits. The remaining four, with early 1 month follow-up, also showed encouraging results. The outcomes between DBS and pallidotomy groups were clinically comparable. All procedures were completed safely with no perioperative complications. Cost remains the major barrier to widespread DBS adoption in Nepal.

Conclusion: Both DBS and pallidotomy are effective and safe for the treatment of movement disorders. In resource-constrained settings, lesioning offers a viable and affordable alternative. Early surgical referral and government subsidy for DBS can improve access and patient outcomes in Nepal

Keywords: Movment Disorders, Functional Surgery, Parkinsonism, Deep Brain Stimulation.

Introduction

Movement disorders such as Parkinson's disease (PD), dystonia, and essential tremor affect a growing number of patients globally, including in Nepal. Parkinson's disease is a neurological disorder with arising incidence and prevalence, currently affecting

more than 1% of the world's population.[1] Parkinson's disease affects different parts of the brain, including the medulla oblongata, midbrain, and neocortex.[2]The pathophysiology includes a reduction in dopaminergic neurons leading to motor symptoms, such as bradykinesia, resting tremor, and rigidity, and non-motor symptoms, such as insomnia, depression, and dementia.[3,4] Currently, no cure for Parkinson's disease exists, and the primary treatment is antiparkinsonian drugs (commonly levodopa) and physical therapy.[5,6] For short term use, levodopa is effective in treating motor symptoms.[5-7,8] For long term use, levodopa can lead to unacceptable adverse effects, such as dyskinesias, and response fluctuations precluding an effective dose.[5-7,8] While pharmacological treatment remains the mainstay in early stages, disease progression often renders medications less effective or leads to intolerable side effects like dyskinesias or motor fluctuations.

Functional neurosurgery has revolutionized the treatment of these conditions, offering durable symptom control and improving quality of life. Deep Brain Stimulation (DBS) is now a globally accepted modality for movement disorders, particularly targeting the subthalamic nucleus (STN) or Globus

Access this article online

Website: https://www.nepjol.info/index.php/NJN

DOI: https://doi.org/10.3126/njn.v23i1.83579

HOW TO CITE
Jha, R., & Khadka, N. Functional Neurosurgery for Movement Disorders: Experience with Deep Brain Stimulation and Pallidotomy at a Tertiary Center in Nepal. NJNS. 2026;23(1):17-20

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ISSN: 1813-1948 (Print), 1813-1956 (Online)

Pallidus internus (GPi) in PD and dystonia. Lesioning procedures like pallidotomy, though older, continue to have relevance—especially in settings where cost or access to implantable devices limits the use of DBS.

In Nepal, the availability of these procedures has been limited to a few centers. This paper documents our initial experience with both DBS and lesioning at Bir Hospital, a major public neurosurgical center, and discusses the challenges and future directions for functional neurosurgery in Nepal.

Materials and Methods

This is a prospective study carried out at National Neurosurgical Referral Center (NNRC), National Academy of Medical Sciences (NAMS) Bir hospital. Institutional review board (IRB) approval was taken from the hospital for the study. Consent was taken from the patients if they were able to communicate and from the next of kin if they were not able to give consent Seven patients with advanced Parkinson's disease or primary dystonia underwent surgical intervention from January 2024 to June 2025. Four patients received bilateral Globus Pallidus internus (GPi) DBS, one patient received subthalamic nucleus(STN) DBS and three underwent unilateral radiofrequency pallidotomy. All surgeries were performed under local anesthesia except for IPG placement, which was done under general anesthesia. Patients were evaluated for improvement in tremor, rigidity, camptocormia, and dystonia. Clinical outcomes and complications were assessed over a follow-up period of up to one year.

Results

We reviewed eight patients with movement disorders who underwent either pallidotomy or deep brain stimulation (DBS) targeting the globus pallidus interna (Gpi), with notable symptomatic improvements in all cases.

The first patient was a 42-year-old male with a 10-year history of tremor. He underwent pallidotomy and experienced approximately 70% control of his tremor at 1-year follow-up. The second patient, a 47-year-old male with tremor for 7 years, also underwent pallidotomy, achieving around 80% tremor control over the same follow-up period.

The third patient, a 62-year-old female with tremor and camptocormia for 9 years, was treated with DBS in the Gpi. At 1 year, she reported about 80% improvement in her symptoms. The fourth patient, a 64-year-old male with a 10-year history of tremor, rigidity, and gait disturbance, also underwent DBS in the Gpi, resulting in approximately 80% symptom control at 1-year follow-up.

The fifth patient was a 46-year-old female with generalized dystonia of 5 years' duration. She underwent DBS in the Gpi and showed about 80% improvement in symptoms within 3 weeks of surgery. The sixth patient, a 60-year-old female with a 7-year history of tremor, rigidity, and cognitive decline, was also treated with DBS in the Gpi. She experienced 70% immediate tremor control, which improved to 80% in both tremor and rigidity by 3 weeks postoperatively.

The seventh patient was a 61-year-old female with severe tremor for 5 years. She underwent pallidotomy and demonstrated excellent tremor control, with a 90% improvement observed at the 3-week follow-up.

The eighth patient was a 54 year old female with severe dyskinesia for 6 years. She underwent DBS in subthalamic Nucleus and also demonstrated excellent dyskinesia control at 2 weeks follow up.

Overall, patients undergoing pallidotomy experienced faster and significant tremor control, particularly in tremor-dominant presentations. Those who underwent DBS had broader symptom improvement, including dystonia, camptocormia, and rigidity, with consistent 80% control across most cases, even in early follow-up.

Discussion

This early experience demonstrates the potential of functional neurosurgery to significantly improve the lives of patients suffering from debilitating movement disorders in Nepal. All seven patients in our series benefited from surgery, with marked improvements in rigidity, tremor, dystonia, and camptocormia. Notably, our outcomes align with internationally reported efficacy of both GPi DBS and pallidotomy [1,2].

Globus Pallidus internus (GPi) has emerged as an effective target for Parkinson's disease and dystonia, particularly in patients with levodopa-induced dyskinesias or motor fluctuations. DBS targeting the GPi can be titrated and adjusted over time, offering long-term disease control with lower risks of cognitive or speech-related side effects compared to subthalamic nucleus (STN) stimulation [3]. In our cases, GPi DBS produced consistent symptom relief, even in complex cases involving camptocormia, supporting its utility in a broad clinical spectrum.

Lesioning procedures, such as radiofrequency pallidotomy, though older, remain highly relevant in resource-constrained settings like Nepal. Several studies have shown unilateral pallidotomy to be effective in reducing contralateral rigidity, tremor, and dyskinesias with durable effects[4]. In our experience, the three patients who underwent pallidotomy had comparable short-term results to DBS patients, highlighting its value where affordability is a concern.

Performing the procedure under local anesthesia allowed real-time feedback and fine-tuning of electrode or lesion location, a vital step in maximizing efficacy and safety. This also minimized the risks associated with general anesthesia, particularly in elderly or comorbid patients, and reflects best practices in functional neurosurgery [5].

One of the most important aspects observed was the importance of early referral. Patients who are operated earlier in their disease course—before the development of severe postural deformities, advanced dyskinesias, or cognitive decline—tend to have better postoperative outcomes [6]. This has been reinforced by trials such as EARLY-STIM, which showed superior quality-of-life outcomes in patients who received DBS earlier in their disease trajectory [7]. Unfortunately, in Nepal, many patients are referred only after exhausting all pharmacological options, which may diminish the benefits of surgery.

The financial burden of DBS remains a major obstacle. At present, the cost of a full DBS system exceeds 20,000 USD, a prohibitive amount for most Nepali families. Without government support or health insurance schemes, access to this transformative technology remains restricted. We strongly recommend the inclusion of DBS in Nepal's essential health services and financial protection schemes, as has been advocated in other low-income countries [8].

Additionally, increasing awareness among neurologists, general practitioners, and the public about the benefits of functional neurosurgery is crucial. This includes not only recognizing suitable candidates early but also countering misconceptions about the safety and efficacy of neurosurgical interventions for movement disorders.

In summary, both DBS and pallidotomy are safe, effective, and feasible in Nepal when performed by trained teams. Our results underscore the need for policy reform, interdisciplinary collaboration, and public investment to scale access to functional neurosurgery in the country.

Conclusion

Our experience demonstrates that Both DBS and pallidotomy provided excellent outcomes in appropriately selected patients, with DBS showing more consistent results. UPDRS improvements were ≥70% in all patients, corresponding to Grade 3 or 4 improvements. Pallidotomy showed slightly greater variation in outcomes but included the highest single tremor control (90%).

Table 1.Patient clinical Profile and outcomes

Patient	Age/Sex	Symptoms	Duration	Intervention	Target	SymptomControl(%)	UPDRSPre/Post	UPDRS Grade
1	42/M	Tremor	10	Pallidotomy	GPi	70%	40/12	3
2	47/M	Tremor	7	Pallidotomy	GPi	80%	45/9	4
3	62/F	Tremor, Camptocormia	9	DBS	GPi	80%	60/12	4
4	64/M	Rigidity, Tremor	10	DBS	GPi	80%	65/13	4
5	46/F	Generelized Dystonia	5	DBS	GPi	80%	55/11	4
6	60/F		7	DBS	GPi	80%	60/12	4
7	61/F	Severe tremor	5	Pallidotomy	GPi	90%	50/5	4
8	54/F	Rigidity, Tremor	6	DBS	STN	80%	65/13	4

Table 2. Comparative Summary- Pallidotomy versus DBS

Parameter	Pallidotomy(n=3)	DBS(n=4)
Mean Age	50.0 years	58.0 Years
Mean Symptoms Duration	7.33 Years	7.75 Years
Mean Symptoms Control	80.0%	80.0%
Mean Pre-UPDRS	45.0	60.0
Mean Post-UPDRS	8.7	12.0
Mean % improvement	80.0%	80.0%
Median UPDRS Grade	4	4
Symptoms Control >Grade 3	3/3 (100%)	5/5 (100%)

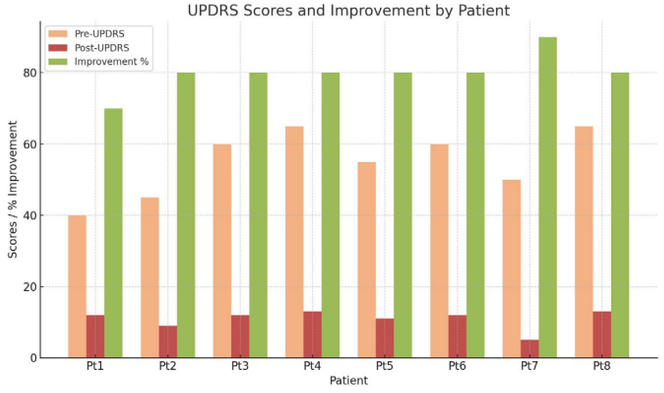

Figure:1 UPDRS Score and Improvement by Patient

ACKNOWLEDGEMENT
To all patient involved in this study

FUNDING: No funding was obtained for the study

DISCLOSURES: Author has nothing to disclose.

CONFLICT OF INTEREST: None.

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