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Implementation of a Multidisciplinary Stereotactic Radiosurgery Protocol for Essential Tremor and Parkinson's Disease

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Published 03/04/2026

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Categories: Radiation Oncology
Keywords: essential tremor and parkinson's disease, stereotactic radiosurgery

How to cite this abstract
Lovo E E, Pena S L (March 04, 2026) Implementation of a Multidisciplinary Stereotactic Radiosurgery Protocol for Essential Tremor and Parkinson's Disease. Cureus 18(3): a1636

Abstract

Objectives: To describe the development and outcomes of a multidisciplinary program for functional stereotactic radiosurgery using Gamma Knife in patients with essential tremor and Parkinson's disease. The objective was to standardize the selection, planning, and follow-up of candidates for radiosurgery, ensuring safety and optimizing clinical outcomes within an integrated neurological and neurosurgical workflow.

Methods: A structured protocol was implemented in 2025 at the Centro Internacional contra el Cáncer (CIC). Candidates included patients with confirmed essential tremor or Parkinson's disease according to international diagnostic criteria, who presented with severe, medication-refractory tremor or dyskinesias, or contraindications for open surgery or deep brain stimulation. All cases were reviewed by a multidisciplinary team (neurologist, neurosurgeon, radiation oncologist, neuropsychologist). The evaluation includes a complete medical history, video recording, neurological examination, motor scales (UPDRS III, Hoehn & Yahr, Fahn–Tolosa–Marín, or TETRAS), neuropsychological testing, and neuroimaging. Radiosurgical planning combined MRI and stereotactic CT fusion using a 4-mm isocenter delivering up to 130 Gy to the ventral intermediate nucleus (VIM), optimized with diffusion tensor imaging (DTI) tractography to delineate motor pathways and minimize radiation exposure to the internal capsule. Clinical follow-up was performed at 1, 3, 6, and 12 months and radiological a 3,6 and 12 months, assessing motor response, medication needs, adverse events, and quality of life (PDQ-39, ADL).

Results: During 2025, Neurology evaluated 109 patients, of whom 85 had Parkinson's disease and 21 had essential tremor. Based on clinical criteria, 22 patients (15%) met selection criteria for advanced therapies such as Gamma Knife radiosurgery and are currently under multidisciplinary evaluation and follow-up. The first five treated cases have shown reduction in tremor and functional improvement, and no major immediate complications.

Conclusion(s): The implementation of a multidisciplinary Gamma Knife protocol for movement disorders represents a significant step toward standardized functional radiosurgery in Latin America. This approach improves patient selection accuracy, ensures procedural safety, and supports the generation of local evidence on the efficacy and safety of stereotactic radiosurgery for Parkinson's disease and essential tremor. Continued longitudinal follow-up will further define optimal candidate characteristics and long-term outcomes.