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Radiosurgery

Gamma knife thalamotomy for multiple sclerosis tremor☆

David Mathieu, MD, Douglas Kondziolka, MD*, Ajay Niranjan, MCh, John Flickinger, MD, L. Dade Lunsford, MD

Department of Neurological Surgery, University of Pittsburgh, Center for Image-Guided Neurosurgery, Pittsburgh, PA 15213, USA
Department Radiation Oncology, University of Pittsburgh Medical Center, Pittsburgh, PA 15213, USA

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Abstract

Background: Some patients with MS suffer from disabling tremor. Improvement with medical treatment is modest, at best. Stereotactic surgery targeting the vim nucleus of the thalamus has been successful in alleviating MS tremor. Gamma knife radiosurgery represents a minimally invasive alternative to radiofrequency lesioning and DBS that can provide improvement in patients suffering from essential and parkinsonian tremor. We reviewed our experience with GK thalamotomy in the management of six consecutive patients suffering from disabling MS tremor.

Methods: The median age at the time of radiosurgery was 46 years (range, 31 to 57 years). Intention tremor had been present for a median of three years (range 8 months to 12 years). One 4-mm isocenter was used to deliver a median maximum dose of 140 Gy (range, 130-150 Gy) to the vim nucleus of the thalamus opposite the side of the most disabling tremor. Clinical outcome was assessed using the Fahn-Tolosa-Marin scale.

Results: The median follow-up was 27.5 months (range, 5-46 months). All patients experienced improvement in tremor after a median latency period of 2.5 months. More improvement was noted in tremor amplitude than in writing and drawing ability. In four patients, the tremor reduction led to functional improvement. One patient suffered from transient contralateral hemiparesis, which resolved after brief corticosteroid administration. No other complication was seen.

Conclusion: Gamma knife radiosurgical thalamotomy is effective as a minimally invasive alternative to stereotactic surgery for the palliative treatment of disabling MS tremor.

Keywords: Gamma knife; Radiosurgery; Thalamotomy; vim nucleus; Multiple sclerosis; Tremor

1. Introduction

Multiple sclerosis is a chronic central nervous system–demyelinating disease. Tremor is estimated to occur in approximately 25% of MS patients and can be severely disabling in 6% [20]. It is most often an intention tremor that affects the upper extremities, although a resting component is sometimes present. Medical treatment of tremor in MS patients is often disappointing. No drug clearly has emerged as superior to another, and those presently in use provide modest benefit at best [2]. Stereotactic radiofrequency thalamotomy and thalamic DBS of the vim nucleus have been shown to improve tremor in MS patients [2]. Drawbacks of those procedures include their invasiveness and the fact that a significant proportion of patients experience recurrence of tremor in the months after surgery. As a less invasive treatment modality, GK radiosurgery has proven effective in the treatment of parkinsonian and essential tremor, especially in patients who

Abbreviations: AC, anterior commissure; DBS, deep brain stimulation; FIR, fast inversion recovery; FU, follow-up; GK, gamma knife; MRI, magnetic resonance imaging; MS, multiple sclerosis; PC, posterior commissure; SPGR, Spoiled-Gradient Recalled Acquisition in Steady State; vim, ventralis intermedius; vop, ventralis oralis posterior; ZI, zona incerta.

☆ Douglas Kondziolka, MD, Ajay Niranjan, MCh, and L Dade Lunsford, MD, are consultants for Elekta Instruments, Atlanta, Ga.

* Corresponding author. UPMC Presbyterian Department of Neurosurgery, Pittsburgh, PA, 15213, USA. Tel.: +1 412 647 6782; fax: +1 412 647 8447.

E-mail address: kondziolkads@upmc.edu (D. Kondziolka).

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may not be good candidates for radiofrequency thalamotomy or thalamic DBS [15,18]. The goal of the present study is to report our experience with GK radiosurgery in the management of 6 patients suffering from disabling MS-related tremor.

2. Methods

Between May 1998 and August 2000, 6 consecutive patients with severe tremor related to MS had radiosurgery at the University of Pittsburgh Medical Center. Every patient was referred by a neurologist with expertise in the management of MS. They consisted of 3 male and three female individuals, all of white origin. The median age at the time of radiosurgery was 46 years (mean, 44.5 years; range, 31-57 years). Two patients suffered from primary progressive MS, 2 from secondary progressive MS, and 2 from relapsing progressive MS. Median time from the diagnosis of MS to radiosurgery was 16 years (mean, 14.8 years; range, 4.9-25 years). All patients were severely disabled by their disease, 5 of them being wheelchair-bound or bed-bound.

The tremor had been present for a median interval of 3 years before GK radiosurgery was undertaken (mean, 4.6 years; range, 10 months to 12 years). The tremor was characterized as intention (rubral) tremor in all patients. In addition, one patient had a resting tremor component. Tremor involved the bilateral upper extremities in all but 1 patient, who had only the right side involved. Head bobbing was also observed in 3 of 6 patients. Various trials of antitremor medications, including propranolol, baclofen, clonazepam, ondansetron, isoniazid and primidone, did not provide satisfactory control of the tremor in any of the patients. Preoperatively, the tremor was graded according to elements of the Fahn-Tolosa-Marin scale [9], which has proven to be reliable to evaluate MS-related tremor [13]. Tremor amplitude, writing, and drawing were evaluated on a scale of 0 (best) to 4 (worst). Tremor amplitude was evaluated by having patients perform the finger-to-nose test. For drawing ability assessment, patients were asked to draw an Archimedes spiral. Tremor was severe in every patient, with median values of 4 on every item of the scale. Typically, the tremor was coarse, jerking, and more severe than in essential tremor patients. It caused a significant impairment in the activities of daily living in every patient, interfering particularly with the ability to feed, drink, and dress.

Informed consent was obtained with the patients and their family, after reviewing the different management options, including radiofrequency lesioning and DBS. Gamma knife radiosurgery was preferred as a palliative measure in view of its noninvasiness. Patients were admitted the morning of the procedure. After adequate local anesthesia and sedation, the Leksell G frame (Elekta Instruments, Atlanta, Ga) was attached to the patient's head. Sagittal scout fast spin echo images were obtained first. After identifying the anterior and PC in sagittal images, high-resolution, 1-mm-thick contrast-enhanced SPGR volumetric images covering the entire thalamus in the axial plane were obtained. We next performed FIR images to differentiate basal ganglia from white matter tracts. The image series was transferred via Ethernet to the planning

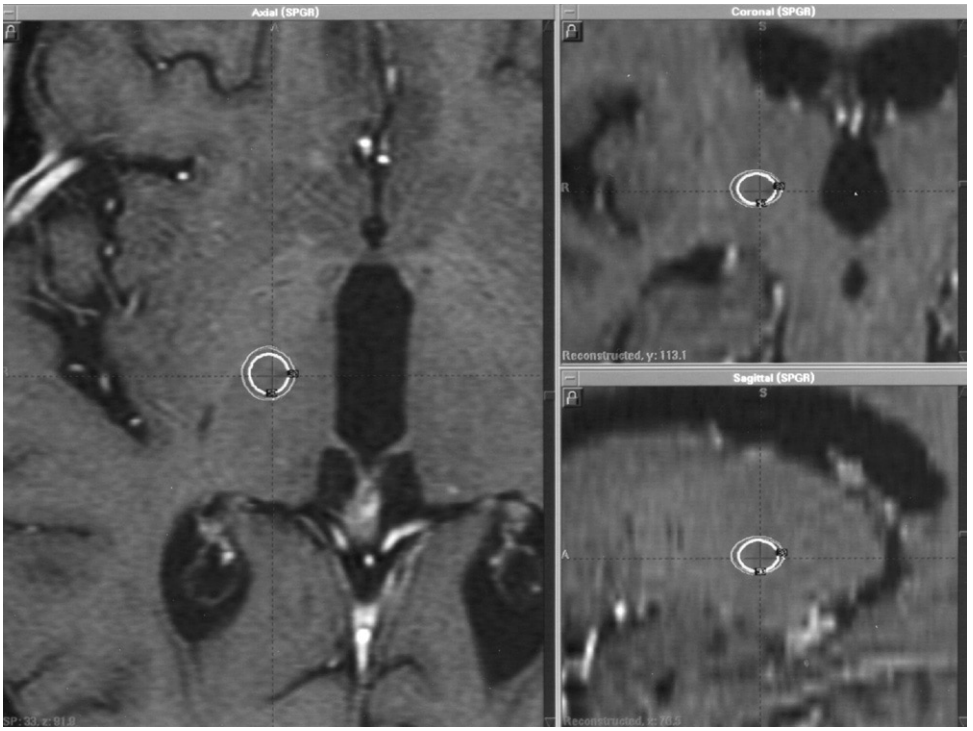

Fig. 1. GammaPlan software snapshot showing MRI SPGR images in axial poster (left) with coronal (upper right) and sagittal (lower right) reconstruction. Using stereotactic coordinates, the 50% isodose line of a single 4-mm collimator shot is placed to target the right vim nucleus.