



Successful subthalamic stimulation after failed gamma-knife thalamotomy in the treatment of tremor-dominant Parkinson's disease

Michał Sobstyl¹, Marcin Konopka², Marta Aleksandrowicz³, Tomasz Pasterski³, Mirosław Ząbek⁴

¹Institute of Psychiatry and Neurology, Department of Neurosurgery, 9 Sobieskiego Str., 02-957 Warsaw, Poland

²Bródno Regional Hospital, Department of Sports Cardiology and Noninvasive Cardiovascular Imaging, Second Faculty of Medicine, Medical University of Warsaw, Kondratowicza 8 Str., 03-242 Warsaw, Poland

³Bródno Regional Hospital, Department of Neurosurgery, Kondratowicza 8 Str., 03-242 Warsaw, Poland

⁴Gamma-Knife Center, Kondratowicza 8 Str., 03-242 Warsaw, Poland

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Here, we present the case of a 63 year-old right-handed man with an 11-year history of a tremor-dominant Parkinson's disease (PD) with severe rest and postural tremor in the right extremities, especially in the right hand. The initial response to pharmacological treatment was good. Levodopa test performed one year after diagnosis was positive. The motor part of Movement Disorders Society - Unified Parkinson's Disease Rating Scale (MDS-UPDRS) was 12 scores in medication off condition and 5 scores in medication on condition [1]. The patient's daily levodopa dose was 400 mg. He took rasagiline 4 mg daily and trihexyphenidyl 2 mg per day. Trihexyphenidyl was soon stopped due to severe dizziness. This daily levodopa dose also caused dizziness, lightheadedness, and weakness symptoms indicating low blood pressure. His blood pressure ranged between 90/60 or even below. Moreover, he also experienced falls due to orthostatic hypotension. These side effects constituted the main reason to discontinue levodopa intake. He had significant cardiac comorbidity with congestive cardiomyopathy and end-stage heart failure functional class IV according to the New York Heart Association (NYHA) functional classification. At the age of 56 he underwent successful orthotropic heart transplantation.

Over the following years, his untreated PD symptoms progressed on both sides of the body, especially the right-sided tremor and the right-sided rigidity, making eating, drinking, and washing as well as shaving impossible. Efforts to introduce levodopa or dopamine agonists again were unsuccessful, due to a burning pain in the chest occurring immediately after the medication consumption. The patient scored 33 points in medication off condition on the MDS-UPDRS part III. In an effort to reduce tremor and improve quality of life, a left Vim GKT (Gamma-Knife Thalamotomy) was performed using a Leksell Gamma Knife Perfexion system after obtaining informed consent (Figure 1A). Over the following 12 months the right-sided tremor persisted and handicapped him in the performance of daily living. 18 months after the radiosurgical treatment he was scored 28 points on the MDS-UPDRS part III. Magnetic resonance imaging showed typical good demarcated lesion with ring contract enhancement (Figure 1B). Because of persistent and severe right-sided tremor, the patient opted for a Deep Brain Stimulation (DBS) procedure. The left subthalamic nucleus (STN) was selected as the stereotactic target.

Address for correspondence: Michał Sobstyl, Institute of Psychiatry and Neurology, Department of Neurosurgery 9 Sobieskiego Str., 02-957 Warsaw, Poland, e-mail: mrsob@op.pl

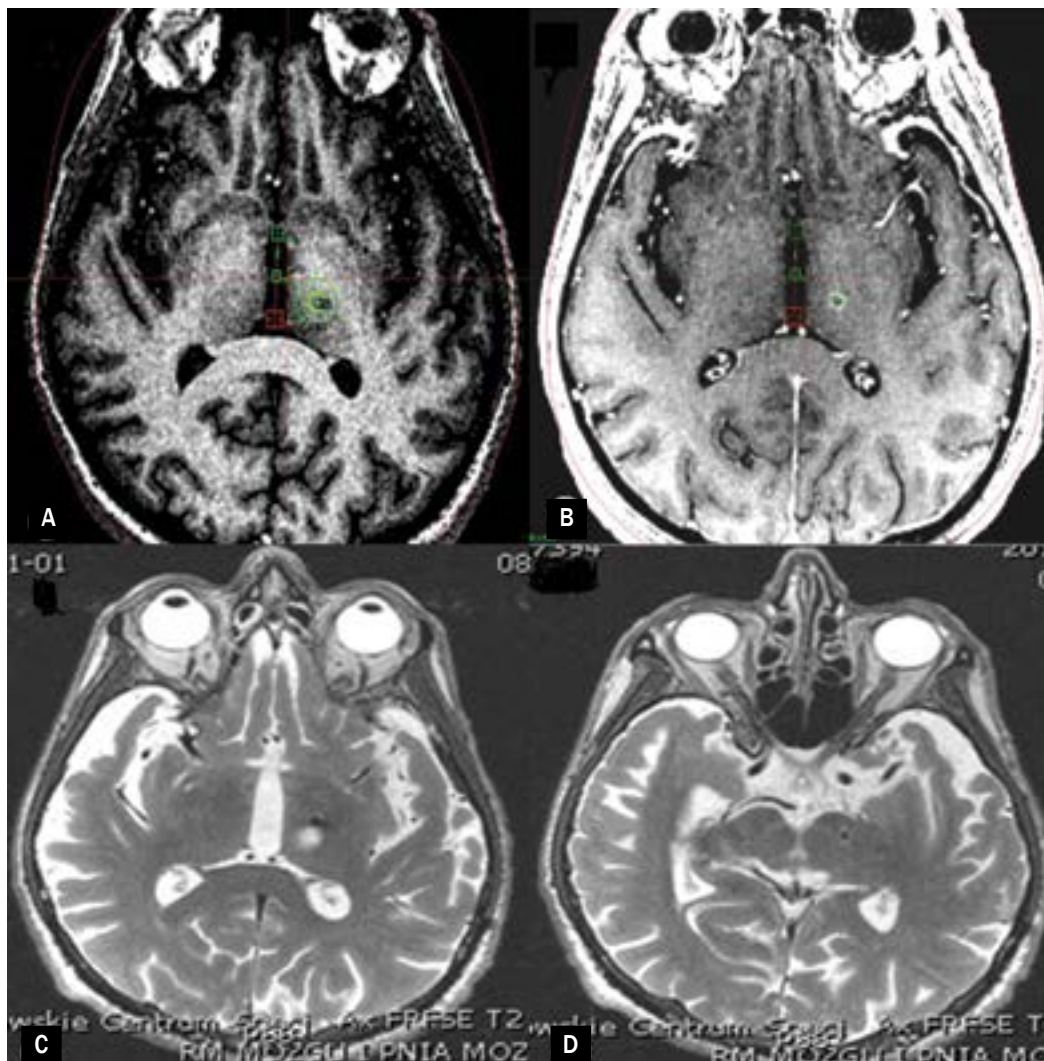


Figure 1. The Leksell Gamma Plan version 10 was applied to perform the left Vim gamma-knife thalamotomy. **A)** a 1.5 Tesla contrast-enhanced magnetic resonance images (MRI) were obtained to set the target coordinates using the Leksell Gamma Plan version 10. **B)** the postoperative contrast enhanced MRI performed 6 months after the radiosurgical Vim gamma-thalamotomy showed 6 x 6 mm lesion located in the left thalamus, **C)** the axial MRI shows the DBS lead anteriorly located to the largest diameter of left radiosurgical lesion. **D)** the axial MRI visualizes the contact 1 of St Jude's electrode in the left STN which was chosen for permanent stimulation

Following the administration of local anaesthesia, a stereotactic Leksell G head frame (Elekta Instrument AB, Stockholm, Sweden) was attached to the patient's head. DBS lead implantation was performed under local anaesthesia. The stereotactic STN planning adjusted to the patient's individual anatomy was done using direct magnetic resonance imaging targeted using a neuronavigation device (Stealth Station S7, Medtronic, Minneapolis, MN, USA) and software Framelink 4. He was on anti-platelet therapy due to his heart transplant and coronary disease with a stent placement. After obtaining cardiac consultation, the anti-platelet medication was stopped 10 days before the DBS procedure. Our patient was on a low dose of aspirin, taking only 75 mg once a day. He was

given intra-venous unfractionated heparin using an initial bolus of 5,000 units two days before scheduled surgery. The partial thromboplastin time (APTT) was checked, with values ranging between 1.5 and 2.5. This was accomplished by checking the APTT again six hours after starting the infusion and adjusting the rate accordingly. The day before surgery the APTT was checked again. Moreover, the International Normalised Ratio (INR) was checked twice before surgery (48 hours and 24 hours before planned DBS procedure). If the INR was below 1.2 it was deemed safe to operate in this challenging patient. The unfractionated heparin was stopped 10 hours prior to surgery. The DBS procedure was uneventful. No microrecording was used and single pass for a permanent

DBS lead was used to decrease the possible incidence of haemorrhagic complications. Stereotactic computed tomography revealed proper lead placement without intracerebral haemorrhage. The patient was given unfractionated heparin for four days after surgery, and by day 5 the preoperative low-dose of anti-platelet therapy was recommended. He was followed at our ambulatory clinic every six months and has been followed for 40 months since the DBS surgery. His MDS-UPDRS motor scores improved to 16, with no tremor in the right hand (motor score impacted by the untreated left body side). (Suppl. Video 1) Examination of the patient's hands showed visible deformities of the left hand with a so called striatal hand due to longstanding Parkinson's disease. (Suppl. Video 2) The right hand is free of such deformities. He is completely independent in performing daily living activities with his tremor-free right hand. Turning off the stimulation results in the reappearance of a right sided tremor. (Suppl. Video 3) The imaging of the patient's brain shows the DBS lead in relation to the gamma-knife induced lesion (Figure 1C) with the lead in the left STN (Figure 1D)

Here, we have presented, to the best of our knowledge, the first case of a patient who had a severe congestive cardiomyopathy who underwent previously successful heart transplantation, having had thereafter functional neurosurgical procedures to ameliorate his disabling PD tremor.

In general, patients on life-long anti-platelet or anti-coagulation therapy due to atrial fibrillation or valvular heart disease are considered to be at high risk of developing perioperative intracranial haemorrhage, and are not offered a DBS procedure. Some reports have highlighted the strict perioperative management necessary for those who undergo a DBS procedure and are on anti-platelet therapy [2]. Our patient also had a positive cardiac history and had been on anti-platelet therapy for nearly 10 years. He had an initially positive response to levodopa, but severe side effects caused by low blood pressure and a burning pain in the chest resulted in withdrawal of levodopa, levodopa agonists, and anticholinergic. He was first treated with a less invasive neurosurgical procedure, mainly Vim GKT rather than a DBS procedure. Because of persistent and incapacitating symptoms, he was subsequently successfully treated with a DBS procedure.

A literature review revealed only three papers reporting the application of DBS in patients after unsatisfactory GKT, and none of these patients had had heart transplantation [3–5]. Terao et al. described a 64 year-old woman with PD and severe resting tremor that was not completely abolished by right-sided GKT [3]. A similar report describing the feasibility of DBS after the previous GKT was published by Tuleasca et al. [4]. Finally, an interesting case of ventroposteromedial thalamic nucleus DBS was presented by Yamgoue et al. in the treatment of a recurrent facial pain [5].

The above mentioned cases, and our described case, highlight the observation that a neuromodulation procedure can be effective after failure of Vim GKT.

Acknowledgement

The patient signed a written informed consent for filming and posting it on line. The patient also agreed to be the subject of scientific observation and of scientific publication.

References

1. Postuma RB, Berg D, Stern M, et al. MDS Clinical Diagnostic Criteria for Parkinson's Disease. *Movement Disorders*. 2015; 30(12): 1591–1601, doi: [10.1002/mds.26424](https://doi.org/10.1002/mds.26424).
2. Ashkan K, Alamri A, Ughratdar I. Anti-Coagulation and Deep Brain Stimulation: Never the Twain Shall Meet. *Stereotact Funct Neurosurg*. 2015; 93(6): 373–377, doi: [10.1159/000441232](https://doi.org/10.1159/000441232), indexed in Pubmed: [26575836](https://pubmed.ncbi.nlm.nih.gov/26575836/).
3. Terao T, Yokochi F, Taniguchi M, et al. Microelectrode findings and topographic reorganisation of kinaesthetic cells after gamma knife thalamotomy. *Acta Neurochir (Wien)*. 2008; 150(8): 823–7; discussion 827, doi: [10.1007/s00701-008-1606-x](https://doi.org/10.1007/s00701-008-1606-x), indexed in Pubmed: [18615234](https://pubmed.ncbi.nlm.nih.gov/18615234/).
4. Tuleasca C, Pralong E, Najdenovska E, et al. Deep brain stimulation after previous gamma knife thalamotomy of the Vim for essential tremor is feasible! Clinical, electrophysiological and radiological findings. *Acta Neurochir (Wien)*. 2017; 159(7): 1371–1373, doi: [10.1007/s00701-017-3227-8](https://doi.org/10.1007/s00701-017-3227-8), indexed in Pubmed: [28540443](https://pubmed.ncbi.nlm.nih.gov/28540443/).
5. Yamgoue Y, Pralong E, Levivier M, et al. Deep Brain Stimulation of the Ventroposteromedial (VPM) Thalamus 10 Years after VPM Thalamotomy to Treat a Recurrent Facial Pain. *Stereotact Funct Neurosurg*. 2016; 94(2): 118–122, doi: [10.1159/000444762](https://doi.org/10.1159/000444762), indexed in Pubmed: [27096946](https://pubmed.ncbi.nlm.nih.gov/27096946/).