

## Outcome of Essential Tremors with Stereotactic Thalamotomy: Noble Art of Lesioning

AURANGZEB KALHORO<sup>1,2</sup>, ABID SALEEM<sup>1</sup>, ABDUL SATTAR M. HASHIM<sup>1</sup>

<sup>1</sup>Neurospinal & Cancer Care Institute, <sup>2</sup>Jinnah Medical and Dental College, Karachi – Pakistan  
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### ABSTRACT

**Objective:** Objective of study is to identify the effects of Stereotactic thalamotomy of the nucleus ventral intermediate (VIM) for treatment of essential tremor.

**Material and Methods:** This is a descriptive study. It was performed at NCCI, Karachi, duration of study was 7 years, from 2-10-2012 to 7-10-2019. Those patients were included who were with tremors refractory to medication, their duration of disease was > 3 years, and with grade 4 tremors. The thalamotomy was performed in all cases, and follow-up was conducted at 3, 6, and 12 months respectively. The success of the surgery was measured in the form of a reduction in medication number and reduction in dose >50% and by calculating the Essential Tremor Rating Assessment Scale (tetras).

**Results:** Total of 26 patients were included. All patients showed remarkable improvement post-procedure at 12 month follow-up. 20 (77%) patient required no medications. In 6 (23%) patients, the dose of medication was reduced to less than half post-treatment. The tetras score showed marked improvement in all a patient; 4 (15%) patients who had grade 4 tremor, showed the symptoms of minimal tremors graded 0.5 on last visit 3rd visit. Side effect post-procedure were mild transient numbness on the contralateral side was observed in 11 (42.3%) patient, 1 (3.8%) patient had dysarthria.

**Conclusion:** We concluded that stereostatic Ventral intermedius nucleus thalamotomy was effective in reducing tremor grades and improved all functionality with few mild side effects.

**Keywords:** Essential Tremor, Stereotactic Thalamotomy, Nucleus Ventralis Intermedius.

**Abbreviations:** ET: Essential Tremor. VIM: Ventral Intermediate.

### INTRODUCTION

Essential tremor (ET) is considered standard among the known movement disorders; having prevalence is 0.5% to 5% worldwide. It can present in an early or late stage of life, which makes it bimodal and sometimes essential tremor can be associated with other movement disorders.<sup>1,2,5</sup> Regarding tremors, upper extremity is involved more commonly than lower, and other associated symptoms include bradykinesia, rigidity, rest tremor, and gait disturbance. The patient must be appropriately examined to exclude other movement disorder.<sup>2,3</sup> Symptoms can be the motor, non-motor and mood swings, which affects the quality of life.<sup>4</sup> If an essential tremor patient was not able to

perform an everyday task, they were kept on medication, standard first-line medication include beta-blockers and primidone. Lesioning of the ventral intermediate nucleus of the thalamus is the optimal choice to vanish the symptoms when the medication is ineffective, while it can excellently be performed unilaterally, but can be performed bilaterally or staged for both sides, Gama knife radiosurgery and deep brain stimulation are among premier possibilities.<sup>5,6</sup> For measuring the improvement, the Essential Tremor Rating Assessment Scale is an effective tool.<sup>7</sup>

Thalamotomy rarely has complication if performed by the experienced surgeon, mortality is rare with thalamotomy, but chances of morbidity

increased if lesion area of thalamotomy is increased, it may cause deterioration in speech fluency, cognitive function and memory.<sup>8,9,10</sup> Other mode of treatment for essential tremor can be Gamma Knife surgery, Magnetic Resonance-guided focused ultrasound, Radiofrequency.<sup>11</sup>

**MATERIAL AND METHODS**

**Study Design:** A descriptive study.

**Place and Duration:** Duration of study was 7years. The following study was performed at the neuro-spinal & cancer care institute, Karachi, from 2-10-2012 to 7-10-2019.

**Inclusion Criteria:** Patient with Tremor refractory to medication, duration of disease more than three years and tremors affecting daily life activity.

**Exclusion Criteria:** Patient who had bilateral hand tremors. Patients who already had cranial surgery or stereotactic surgery, the patient who had neurodegenerative conditions like Alzheimer's disease or Parkinson's disease and patient with the previous history of radiation, brain tumor.

**Data Collection:** 26 patients were enrolled who went for thalamotomy, the VIM nucleus of the thalamus was selected for the Stereotactic target lesioning. The pre-consents were taken from all patients or their attendances. Data was recorded on preformed proforma include number and dose of medication before and after surgery, tetra score was calculated before and after surgery on every follow-up, complication after surgery were recorded by neurologist.

**SURGICAL PROCEDURE**

Each patient was admitted one day before surgery, and MRI Brain 1.5 Tesla was being done as per protocol. On the next day, we put the stereotactic head frame to the patient under local anesthesia.

After scanning the images, pre-frame and post-frame were diffused, and thalamic landmarks were identified with the help of anterior commissure and posterior commissure, by using well-programmed SurgiPlan by Elekta. SurgiPlans shows the accurate location of the thalamic nucleus VIM, x-y-z coordinates were measured on AC-PC line 5mm

anterior to posterior commissure, 11.5mm distance in laterality from a wall of the 3<sup>rd</sup> ventricle although every patient has a different calculation on a different axis. Then the patient was shifted to Operation Theater with frame for head holding stereotactic in situ, and specialized stereotactic apparatus was used while patient lie was supine, sedation was not given to the patient during the procedure.

A burr hole (3cm anterior to the coronal suture and 3cm lateral to the midline) was made, and frame arc is placed in position. Calculated coordinates values were adjusted in X laterality, Y anteroposterior, and Z in depth. A fine probe was used to pass through an arc, then via burr hole deep VIM ablation was made. The attempt of lesion procedure was performed by heating the probes to 40-degree voltage for about 60 seconds, and then permanently lesion probe was heated to 70-degree voltage for another one minute. Neurological examination of the involved side was performed based on power, sensation, speech, and pyramidal function also the patient was observed in the awake state and asked about rigidity and tremor disappearance per operatively; after completely ablating the tremor, the probe was taken off, and sutures were placed at wound site.

**RESULTS**

Twenty-six patients fulfilled the inclusion criteria.

**Age Incidence**

All patients were aged between 56 to 72 years.

**Gender Distribution**

19 were male, and 17 were female, male to female ratio was 1.2:1.

**Table 1:** Enlisted Characteristics.

Characteristics	Number	Percentage
<b>Gender</b>		
Male	19	73%
Female	17	27%
Right-hand tremors	17	65.38%
Left-hand tremors	09	34.6%
Upper extremity involved	21	80.7%
Upper & lower ipsilateral	05	19.2%
Family history	11	42.3%

**Table 2:** Effects of Pre and Post Thalamotomy Parameters.

Characteristics	Rating 2	Rating 3	Rating 4	Post-operative	3 months	6 Months	12 Months
Tremor upper limb	03	13	05	0	0	00	03*
Ipsilateral UP& LL	02	02	01	0	0	0	01*
Tongue	01	4	0	00	00	0	
Hand writing	04	11	08	00	00	02	4*
Standing	01	02	02	00	00	01	
Spirals	07	11	04	00	00		3*
DOTS	11	02	00	00	00	00	00

\*Followed the results text below:

\*Initial grade 4 after year developed 0.5 grade at 12 months follow-up

### Clinical Presentation

Seventeen patient had right-hand tremor and 9 had left-hand tremors. In 16 patients, only upper limb involved and in 10 patients, the lower limb was also involved. Family history of the tremor was positive in 11 patients. All 26 patients of essential tremor went through thalamotomy and follow-up examination was conducted at 3 months, 6 months, and 12 months. All patients showed clinical improvement post-surgically. 20 (77%) patient required no medications, 6 (23%) patients who were on a high dose of medications for tremor before thalamotomy, their doses were reduced to less than half post-treatment. The tetra's score showed marked improvement shown in **table 2**. Four (15%) patients with grade 4 tremors showed the symptoms of minimal tremors graded 0.5 on last visit 3rd visit. Mild transient numbness on the contralateral side was observed in 11 (42.3%) patients, 1 (3.8%) patient had dysarthria.

### DISCUSSION

It was keenly observed that due to the limitation of drug therapy and their severe side effect, impacting the lifestyle and cognitive function of the patient, this has caused renaissance for the minimally invasive treatment options of movement disorders as well as the need of the hour. Zaaroor et al<sup>12</sup> has done a study on in focused ultrasound guided lesioning (MRgFUS) for tremors' treatment, he took essential tremors and Parkinsonian disease tremors.

At one month post-treatment, the mean CRST score of the patients with ET diminished from 40.7 ( $p < 0.001$ ) and was  $8.2 \pm 5.0$  compared to baseline

while assessment at follow-up of 6–24 months duration, tremor revert, in six patients (2 with Essential Tremor, two with Parkinsonian Disease, and two with Essential Tremor-Parkinsonian Disease), to a lesser level than before the method in 5. Antagonistic activities that transient occasions prone to happen during sonication remembered cerebral pain for 11 patients, vertigo in 4 and wooziness in 4, queasiness and consuming scalp sensation in 3, lip paresthesia, and ailment in 2. While in an investigation directed at our centre, 26 patients had just basic tremor result, torment with the improved size of tremor with four patients with grade 4 returned to 0.5 evaluation in a year with five patients had a transient headache, 1 having dysarthria, 8 with transient numbness with no death.

Goldman et al<sup>13</sup> showed that upper-extremity tremor was completely gone in eight patients, thalamotomy was done in nine patients. On follow-up, ranging from 1 to 50 months, we observed no tremor in relevant appendage in 4 of the patients, while stamped tremor decreased in 3 patients under the procedure of unilateral thalamotomy. Some patients had staged bilateral thalamotomies. They also showed improvement on 50-month follow-up, and all seven patients who had voice tremor, they had left brain side thalamotomy and they were dominated on right side hand. On follow-up, the voice tremor vanished after thalamotomy. In contrast to this study, we had 12 months follow up only four patients of grade four had become 0.5-grade tremor, all other also showed improvement in function and reduced dose and number of medications. We did not report have any voice tremors in our series.

As stated by Zirh et al,<sup>14</sup> the thalamotomy done among 21 patients having essential tremor. In 11 patients, the family history of essential tumor was positive. Three of the patients needed to rehash thalamotomy, and it was performed more than one year contralateral to the first procedure (staged procedure). Complications such as transient dysarthria of the cerebellar sort happened in one patient. The improvement post-thalamotomy was seen in Handwriting and drawing appraisals. Similarly, in our study, one had transient dysarthria, 11 had a positive family history, but neither mouth numbness, nor did we perform a bilateral procedure due to its related complications.

Niranjan et al<sup>15</sup> study was based on gamma blade thalamotomy, tremor relief was seen in 96% of patients. Mean improvement was seen in handwriting score and drawing score. Three patients (4%) experienced brief unfavorable radiation impacts. While, in our study all patients improved post-surgically, notable improvement was seen at follow-up of 12 months and 20 (77%) patient required no medications, 6 (23%) patient who was on a high dose of medication for tremor before thalamotomy, their dose was reduced to less than half post-treatment.

Tasker (1983)<sup>16</sup> conducted a prospective review of Parkinson's patients undergoing one-sided thalamotomy and were followed for 2 years postoperatively, were prepared. No tremor in the opposite hand in 82% over, while and only reflecting the abolition of the tremor was observed in 7%. No expiry was seen, but significant persistent complications were observed in 8%. Nucleus Ventralis Intermedius thalamotomy remnants the management of ideal for Parkinsonian tremor having severe drug-resistant. But in the study at neuro-spinal cancer care institute conducted at our centre, no permanent complications were observed in 12 months while almost similar outcome concerning the tremor free life was showed in both.

McClelland and Jaboin<sup>17</sup> did extensive literature compared different aspects of treatment involved VIM treatment that is Gamma knife, deep brain stimulation, and thalamotomy and found out that the thalamotomies more cost-effective, 40% less expensive in series performed, Deep Brain Stimulation was done without microelectrode recording intraoperative. We performed only thalamotomies in our study and they were cost effective in developing countries.

Voller (2014)<sup>18</sup> used tetras as their research accelerometry and the Essential Tremor Rating Assessment Scale had a high effect of time point using repeated-measures analysis of variance. With a 95% confidence interval and concluded that the Essential Tremor Rating Assessment Scale functional scale after using as therapeutic, this potential validity for utilized in research settings and clinics. And in another study by Ondo (2018),<sup>19</sup> kinetic tremor plus upper limb postural. FTM Fahn-Tolosa-Marin ratings of kinetic and postural tremor highly similar with those of the Essential Tremor Rating Assessment Scale and concluded that of tremor severity could be assessed better with TETRAS. It has the edge over FTM in following (1) inclusion of wing-beating tremor (2) severe Essential Tremor having an absence of a ceiling effect in patients.

Tasker (1997)<sup>20</sup> had 35 patients for thalamotomies, out of which 8 (22%) cases are repeated for thalamotomies. In contrast, in our study, we did not have any repeat cases in one year nor previously done thalamotomy case came with such an aim.

## CONCLUSION

From the following study, we concluded that stereostatic Ventral intermedius nucleus thalamotomy was effective and accurate in reducing tremor grades and improved our all functionality with few mild side effects.

## LIMITATIONS

This study was from a single centre and a limited number of the patient was included. No univariate analyses were done. Only limbs tremors were operated during the study period.

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#### Additional Information

**Disclosures:** Authors report no conflict of interest.

**Ethical Review Board Approval:** The study was conformed to the ethical review board requirements.

**Human Subjects:** Consent was obtained by all patients/participants in this study.

#### Conflicts of Interest:

In compliance with the ICMJE uniform disclosure form, all authors declare the following:

**Financial Relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

**Other Relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

*Address for Correspondence:*

*Dr Aurangzeb Kalhoro*

*Neurosurgery Jinnah Medical Dental College, Karachi*

*Neurospinal and Cancer Care Institute, Karachi*

*Email: draurangzebkalhoro@gmail.com*

**AUTHORS CONTRIBUTIONS**

<b>Sr.#</b>	<b>Author's Full Name</b>	<b>Intellectual Contribution to Paper in Terms of:</b>
1.	Aurangeb Kalhoru	Study Design and Methodology. Paper Writing, Referencing,
2.	Abid Saleem	Analysis of Data and Interpretation of Results etc.
3.	Abdul Sattar Hashim	Analysis of Data and Quality Insurer

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