

# The Evaluation of Targeting Retrogasserian versus Root Entry Zone in Gamma Knife Radiosurgery for Trigeminal Neuralgia

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## **ABSTRACT:**

### **BACKGROUND:**

The advantage of gamma knife radiosurgery is lack of major side effects. It is preferred over microvascular decompression in elderly patients who are poor candidates for general anesthesia or those unwilling to undergo an open neurosurgical procedure.

### **PATIENTS AND METHODS:**

This is a comparative study conducted at Dr. Saad Alwitary Neuroscience Hospital, Gamma Knife Department. 20 patients were included in the study, divided into 2 groups in which 10 are treated with dorsal root entry zone DREZ and the another 10 treated with retrogasserian RG, starting from July 2019 to March 2020. The new target (retrogasserian zone) was targeted for the first time in Iraq, were compared to those patients treated with root entry zone as their target. The follow up time was 4 months. The DREZ target received 80 Gray in 50% isodose, while the RG target received 90 Gray in 50% isodose.

### **RESULTS:**

The mean age is 54.3 years for DREZ and 59 years for RG, most of the treated patients are female with male to female ratio 2.2-1, pain intensity was assessed by BNI scale pre and post Gamma Knife that targeted both DREZ and RG, pain intensity with DREZ, mean improvement is 3.2. Pain is significantly improved.

Pain intensity with RG, mean improvement is 3.2, pain is significantly improved. Pain frequency was less in postGK for both the DREZ & RG with mild superiority in the RG.

### **CONCLUSION:**

GK is considered as being both a safe and effective procedure to treat medically resistant trigeminal neuralgia. GK is the least invasive procedure in treating medically resistant trigeminal neuralgia MRTN, with the least and less serious complications. GK targets (DREZ & RG) both can achieve a good pain control with decrease in medication and improving overall life quality. RG target shows slight further reduction in pain frequency than DREZ.

**KEYWORDS:** Gamma Knife, Retrogasserian, Dorsal Root Entry Zone.

## **INTRODUCTION:**

### **Trigeminal Neuralgia:**

It refers to recurrent lancinating pain that occurs in the distribution of one or more branches of the fifth cranial nerve. It is one of the commonest types of craniofacial pain disorders. The pain perception is typically unilateral, abrupt in onset, brief in duration, and usually starts after trivial stimuli<sup>(1)</sup>.

Different target options may be close proximity to either the root entry zone (REZ) or to the gasserian ganglion, slight anteriorly. The pain relief has been suggested to be better when the GK isocenter is placed closer to the brainstem<sup>(2)</sup>.

The pain may arise spontaneously, or may be triggered by innocuous mechanical stimuli and movement<sup>(3)</sup>.

The pain relief rate in a large population of type I TGN patients 1 year after radiosurgery ranged from 75% to 90% of patients (Barrow Neurological Institute (BNI) grades I to IIIB)<sup>(4)</sup>.

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Table 1: Barrow neurological institute pain scale<sup>5</sup>

BNI Pain Intensity Score	Definition
I	No trigeminal pain, no medication required
II	Occasional pain not required medication
III	Some pain adequately controlled with medication
IV	Some pain not adequately controlled with medication
V	Severe pain, no pain relief

BNI: Barrow Neurosurgical Institute

In GK the collimator diameter options available are 4, 8, and 16 mm. A single shot of 4-mm beam collimator diameter is used in TGN. A single isocenter is used as the target which is very small. The isocenter is placed on the trigeminal nerve in such a way that 20% iso-dose line just touches the brainstem. The final step is delivery of the radiation by the GK machine<sup>(6)</sup>.

GKRS is also preferred in whom vascular aetiology cannot be identified like in multiple sclerosis, and the ones who have failed MVD<sup>(7)</sup>.

Pain relief is predicted to be faster when GKRS is performed as initial procedure, within 3 years of pain onset<sup>8</sup>.

**AIM OF THE STUDY:**

To study the outcome of trigeminal neuralgia patients in term of pain control and frequency treated by Gamma Knife Radiosurgery targeting the retrogasserian zone versus the dorsal root entry zone.

**PATIENT AND METHOD:**

This is a comparative study conducted at Dr. Saad Alwitary Neuroscience Hospital, Gamma Knife Department.

A total of 20 patients were included in the study, divided into 2 groups in which 10 are treated with DREZ and the other 10 treated with RG starting from July 2019 to March 2020. The new target (retrogasserian zone) was targeted for the first time in Iraq starting from October 2019 were compared to those patients treated with root entry zone as their target. The follow up time was 4 months from December 2019 to March 2020.

All patients were referred from the Neurology Department with diagnosis of Medically Refractory Trigeminal Neuralgia was based on the History, clinical examination and treatment history. All patients were sent for routine investigations in form of bleeding profile, virology screen,

complete blood count, renal function test and 1.5 Tesla Brain MRI with Gamma Protocol was done.

Patients were interviewed and detailed history according to pain onset, frequency, duration, medical treatment, response to Gamma Knife and complications were recorded.

All selected patients have no history of previous MVD or percutaneous procedure.

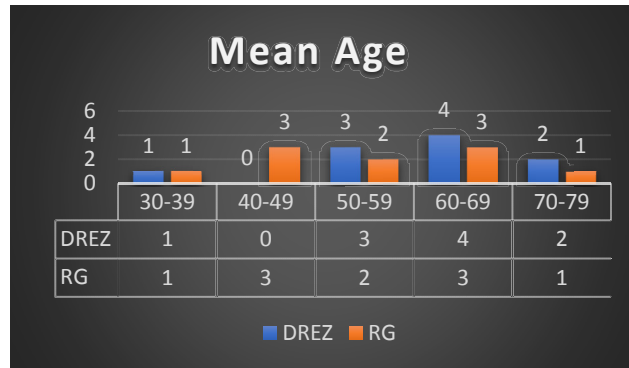
**Procedure**

Following are the steps in radiosurgery with the Gamma Knife Perfexion:

1. Stereotactic frame placement after Patients were injected with local anesthesia, xylocaine with adrenaline 0.4% (3M) injected in the scalp in screws area.
2. Frame adaptor and frame cap measurement check
3. Stereotactic brain imaging with magnetic resonance imaging (MRI), computed tomography (CT) with indicators.
4. Coregistration of neurological images with computed tomography (CT) and importation to radiosurgical software
5. Treatment planning
6. Dose prescription: 80 Gy in 50% isodose for DREZ or 90 Gy in 50% isodose for RG.
7. Dose limitations to critical structures: shielding and plugging technique
8. Conformal radiosurgical dose planning by the radiosurgery team
9. Stereotactic delivery of radiation to the target volume by positioning of the patient's head inside a collimator system
10. Removal of the stereotactic guiding device.

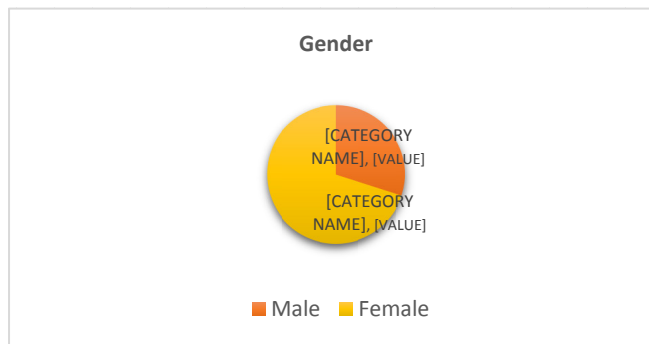
**RESULTS:**

The mean age for DREZ groups is ±59 years, (range 36-72 years), and for RG ±54.3 years (range 38-76 years) the distribution of the age groups illustrated in **Figure 1**.



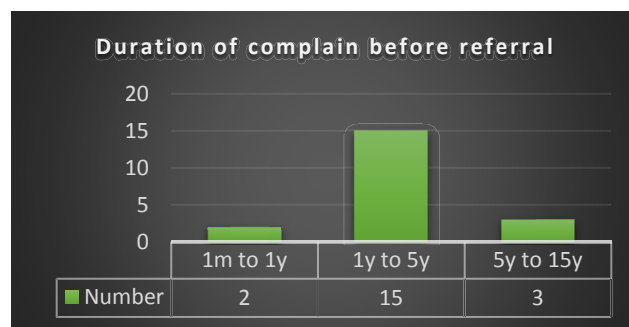
**Fig. 1: Age Distribution**

Most of the treated patients are female, male to female ratio illustrated in **Figure 2**



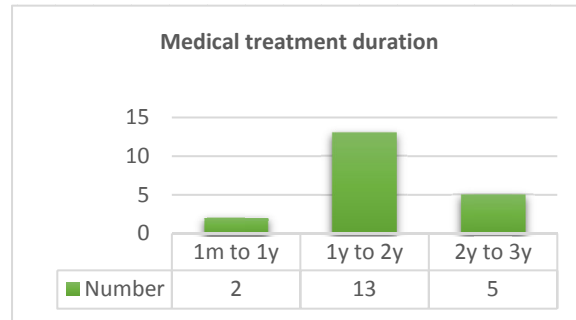
**Fig. 2: Gender Distribution.**

Duration to diagnosis is between 1 month to 5 years in most of the cases, illustrated in **Figure 3**.



**Fig. 3 :Duration of complain before referral.**

Medical treatment was used for at least 1 month to 3 years before consultation to neurosurgery department was done to control pain, illustrated in **Figure 4**.



**Fig. 4 : Medical treatment duration.**

Pain intensity was assessed by BNI scale pre and four months post Gamma Knife that targeted both DREZ and Retrogasserian, illustrated in tables 2-3. Regarding **tables 2**, the pain intensity with DREZ, two patients grade 4 BNI preGK, one became grade 3 postGK, and the other one became grade 2

postGK. Eight patients grade 5 BNI preGK with DREZ, one became grade 2 postGK, three became grade 3 postGK and four became grade 4 postGK. The Mean improvement is 3.2. 60% of patients have pain improvement Pain is significantly improved.

**Table 2: BNI pain intensity scale prior to Gamma Knife.**

BNI scale	1	2	3	4	5	Target
No.				2	8	DREZ
No.				4	6	RG

**Table 3 :BNI pain intensity scale four months after Gamma Knife that targeted both DREZ and RG.**

BNI scale	1	2	3	4	5	Target
No.		2	4	4		DREZ
No.			9		1	RG

Regarding **tables 3** the pain intensity with RG, four patients grade 4 preGK, all became grade 3 postGK, six patients grade 5 preGK of retrogasserian, five became grade 3 postGK while one still grade 5 postGK. 90% of patients have pain improvement

The mean improvement is 3.2, pain is significantly improved. Pain frequency was less in postGK for both the DREZ & RG with mild superiority in the RG. Pain frequency prior to GK for both groups is illustrated in table 4. Pain frequency postGK is illustrated in table 5.

**Table 4: Pain frequency per day prior to Gamma Knife.**

	Pain frequency per day		
	1-3	4-6	7-12
DREZ	2	5	3
RG	0	6	4

**Table 5: Pain frequency per day post GK.**

DREZ		RG	
Pain frequency per day	No.	Pain frequency per day	No.
1-3	8	1-3	9
4-6	2	4-6	1
7-12	0	7-12	0
Mean decrease in frequency per day	2.3	Mean decrease in frequency per day	2.4

Complications for Leksell frame application is three patients having pinhole site infection, while complications according to target of GK is the

same for both groups which is permanent facial numbness, two patients in each group, illustrated in table 6.

**Table 6: Complications.**

Complication	Facial numbness	Pinhole site infection
DREZ	2	3
Retrogasserian	2	

**DISCUSSION:**

In accordance to age, the mean age group for DREZ groups is 59 years, and for RG 54.3 years which is younger than those in Matsuda et al<sup>9</sup> which is 74 years, and Tuleasca et al<sup>10</sup> which is 68.3 years.

Most of the treated patients are female (14 females, 6 males), same as Matsuda et al<sup>9</sup> which is female predominance (63 females, 37 males), Marshall et al<sup>3</sup> (211 females, 142 males).

Duration of TN symptoms to treatment is least 1 month to 3 years while it is 7 years according to Kondziolka et al<sup>11</sup>, 7 to 9 years according to Matsuda et al<sup>9</sup>, this variability in duration is due to use of others interventions for TN before doing GK.

Pain is significantly improved at 4-months interval for both groups, 60% in the DREZ group, 90% for the RG group, same pain control is achieved by Matsuda et al<sup>7</sup> while Tuleasca et al<sup>10</sup> achieved better pain control at 1-month interval to decrease after that period. Kondziolka et al<sup>11</sup> (89%) responded to GKS at a median latency of 1 month, 11% had poor pain relief (BNI Score IV or V) after this procedure, Marshall et al<sup>3</sup> (88%) pain control at 3 months interval while 12 % had poor pain control.

High-dose irradiation to the proximal nerve root is potentially dangerous and that the anterior targeting method is preferable for avoiding complications and providing superior pain control<sup>14</sup>.

GKRS using the RG targeting technique appeared to provide better pain control and a lower complication rate than the DREZ technique; the RGZ targeting technique is easier and more accurate than DREZ; GKRS using RG targeting is an effective option for patients that have failed MVD or GKRS using the DREZ targeting technique<sup>(15)</sup>.

Pain frequency was less in postGK for both the DREZ & RG with mild superiority in the RG group, same results were obtained by Young et al<sup>12</sup>.

Leksell frame application is complicated by pinhole site infection in 3 cases while the complication specific to the GK in both groups is facial numbness (two patients in each group). Massager et al<sup>13</sup> had 2 patients with bothersome facial numbness out of 70 patients treated with GK, this due to smaller sample studied

**CONCLUSION:**

GK is considered as being both a safe and effective procedure to treat medically resistant trigeminal neuralgia (MRTN). It is the least invasive procedure in treating MRTN, with the least and less serious complications. The targets (DREZ & RG) both can achieve a good pain control with decrease in medication and improving overall life quality. RG target shows slight reduction in pain frequency than DREZ.

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