



# Evaluation of the Effectiveness of Trigeminal Ganglion Ablation Using Pulse Radiofrequency in the Treatment of Trigeminal Neuralgia

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## ARTICLE INFO

### Article history:

Received 22 October 2022

Revised 12 November 2022

Accepted 26 November 2022

### Keywords:

Triple nerve neuralgia;

Radiofrequency;

Pulse radiofrequency

## ABSTRACT

**Background:** Trigeminal neuralgia is a sudden, severe condition characterized by stabbing and recurrent pain. Radiofrequency thermocoagulation (RFT) and pulsed radiofrequency (PRF) are common surgical interventions used to treat trigeminal neuralgia. This study aimed to investigate the therapeutic effects and associated complications of PRF in the treatment of trigeminal neuralgia.

**Methods:** Pulsed radiofrequency was performed on 20 patients with primary trigeminal neuralgia. One month later, pain relief and complication status were evaluated. All patients who referred to the pain clinic of Amir Alam Hospital with a diagnosis of primary TN and after failure of conservative treatment or intolerance to drug side effects were candidates for trigeminal ganglion destruction by PRF method were the study population.

**Results:** In this study, the female to male ratio was 1.5. The mean age of patients was 50.70 years. The highest prevalence was reported in 50-75 years (45%). 7 patients (35%) had pain in the right and 13 patients (65%) had pain in the left. In 18 patients there was involvement in one nerve root and in 2 patients there was involvement in 2 nerve roots. 1 patient (5%) had V1 root involvement, 13 patients (65%) had V2 root involvement and 8 patients (40%) had V3 root involvement. The mean pain score of patients before the procedure was 8.8. The mean pain of patients one hour after surgery was 3.95 and on days 7 and 30 after surgery were 3.3 and 4.25, respectively. One hour after the operation, effective pain relief was observed in 75% of patients. The effective response rate was observed one week after the procedure in 80% of patients and one month later in 60% of patients. There was no significant relationship between patients' gender and the effectiveness or ineffectiveness of the procedure after one month. With age, the effective response to treatment in patients increases. In 2 patients, infection was reported at the procedure site. Four patients reported paresthesia at the procedure site one month after surgery.

**Conclusion:** PRF treatment was an effective, safe and non-destructive method for patients with TN. Primary PRF treatment can be considered as a first-line option before more invasive treatments, such as neurodegenerative procedures and MVD surgery.

The authors declare no conflicts of interest.

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**T**rigeminal neuralgia (TN) symptoms are repeated episodes of unilateral electric shock-like pain attacks which occur in quick successions. It occurs by distribution in one or more parts of the fifth cranial nerve (trigeminal nerve), which is usually stimulated by harmless stimuli [1]. Mucous and Skin irritations in trigeminal nerve innervate areas of the skin, eg. gentle touch in the area, shaving the area, washing the skin, brushing the teeth, chewing, swallowing, and even a gentle breeze [2-3]. Trigeminal neuralgia was introduced at the end of the 1st century and was later referred to as "Tic Douloureux" due to its hemifacial spasm that often accompanies the attack. The International Headache Society has published primary and secondary criteria for diagnosing trigeminal neuralgia. In primary trigeminal neuralgia, vascular pressure is the only cause of trigeminal neuralgia symptoms. For the secondary trigeminal neuralgia, the clinical criteria are similar; however, another underlying cause is responsible for the symptoms. Trigeminal neuralgia can irritate one or more branches of the trigeminal nerve. In most cases, the maxillary nerve branch will be more irritated compared to the ophthalmic nerve branch. The irritation occurs more on the right than the left side of the face (Two to one ratio), which may be due to the narrower foramen rotundum and the foramen ovale on the right side [4]. This is a rare disease with an annual prevalence of 4 to 13 per 100,000 individuals [5-6]. TN has a low incidence ratio; however, it is one of the most common neuralgias in the elderly population which gradually increases with age. Most idiopathic cases (with no evidence in electrophysiological tests and MRI) began at the age of 50, even though it may occur when you are in the second and third decades or even in children [7]. Male to female ratio incidence of 1: 1.5 to 1: It is reported to be 1.7 [8-9]. Women are more susceptible which could be because life expectancy in women is much higher compared to men. Rare familial cases have been reported, but the vast majority of patients are sporadically infected [10]. The most common and known cause is vascular pressure on the nerve at the angle of the pons [3]. In some cases, demyelinating disorders are the cause of TN. Other rare causes include nerve root infiltration, the ganglion Gasserian is caused by a tumor or amyloid [11]. The trigeminal nerve is the largest cranial nerve. The trigeminal nerve in the brainstem starts from the trigeminal nucleus, moves between the lateral forebrain surface, and passes through the subarachnoid area until it enters the temporal bone. In the temporal bone, the ganglion Gasserian forms at the Meckel cave [12-13]. Relative distribution of pain in the Trigeminal nerve: 1) Ophthalmic nerve (V1) relative distribution of neuralgic pain: 36%, 2) maxillary nerve (V2) relative distribution of neuralgic pain: 44%, 3) mandibular nerve (V3) relative distribution of neuralgic pain: 20 %.

## Methods

This is a cross-sectional study on patients referred to the pain clinic in Amir A'lam Hospital in Tehran from 2018 to 2020. All patients with primary TN diagnosis referred to the pain clinic of Amir A'lam Hospital experiencing conservative treatment failure, drug intolerance side effects, or individuals who refused to accept the side-effects of traditional trigeminal neurodegeneration (such as facial anesthesia) were candidates for trigeminal ganglion neurodegeneration using PRF method, and they were chosen to be the population of this study. The following equation is used to calculate the sample size.

$$n = \frac{\left(Z1 - \frac{\alpha}{2} + Z1 - \beta\right)^2 (\sigma_1^2 + \sigma_2^2)}{(\mu_1 - \mu_2)^2}$$

SD1=0.5; SD2=0.8; Alfa=0.05; Beta=0.2;  $\mu_1=9$ ;  $\mu_2=1$

Mean and standard deviation values were extracted according to serdarerdin study comparing pain before and after the procedure, which is estimated to be below 5, because of significant differences in the mean regarding the two groups. So, the researchers added 30 samples to the procedure. In this study, 30 patients referred to the pain clinic of Amir Alam Hospital in 2018, 2019, and 2020 answered a questionnaire and signed a declaration of consent. Due to the special circumstances regarding the Covid pandemic in the country, 10 patients did not show any interest in continuing post-surgery follow-ups and were eliminated from the study. As a result, only 20 patients were examined and followed up. Data collection tools were questionnaires and face-to-face interviews and telephone interviews. The information was recorded and collected using questionnaires. If the patient was unable to read or write, the questions were read aloud and the patient answered them orally, otherwise, the patient would complete a questionnaire by themselves. Patients diagnosed with TN referred to the pain clinic of Amir A'lam Hospital experiencing conservative treatment failure, drug intolerance side effects were candidates for trigeminal ganglion neurodegeneration using PRF method, before starting the procedure, patients were examined and interviewed, and after explaining the intervention and advantages and disadvantages of the procedure and alternative treatments, a declaration of consent was prepared and patients were included in the study. The intensity of the pain was measured before the surgery based on NRS criteria, plus the involved V1, V2, V3 branches were examined and recorded in patients. NRS is a quantitative rating scale for pain ranging from 0 to 10, -0 indicating no pain and 10 indicating intense pain. Patients were asked to score their pain intensity on a scale from 0 to 10 at the time of evaluation. Under the fluoroscope guide, the patient underwent a diagnostic block of the trigeminal ganglion, and if the pain decreased by more than 50%, they would be a suitable candidate for PRF. Then, under the guide of fluoroscope with RF needle with 22gauge with blunt tip, active tip 5mm, the patient underwent ablation under 42 pulse RF

periods for 120 seconds at 42 degrees after positive sensory and motor stimulation. After ablation, 0.5 cc of contrast agent was injected (after ensuring the correct location of the needle and negative blood aspiration and CSF) then, 1.5 cc of 1% Lidocaine solution + 4 mg Dexamethasone was injected and the needle was removed. One hour after surgery, an examination was conducted on the patient in the recovery room based on NRS criteria. Moreover, on the 7th day, 30th day, and 6th month after surgery, patients' pain was determined based on NRS criteria. A 50% reduction, at least, in the NRS criterion is an indication of significant pain reduction in patients.

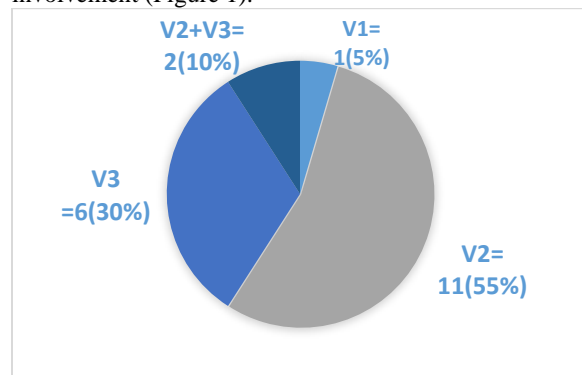
**Table 1- Characteristics of patients**

Gender	Frequency	percentage
Female	(12)	(60)
Male	(8)	(40)
Total	(20)	(100)

The age distribution in the population was between 21 and the 80. The mean age of the patients was 50.7 years, and the highest prevalence occurred between 50-75 years (45%).

The frequency of trigeminal neuralgia in the nerve pathway was investigated among the population - 7 patients (35%) had pain in the right side of the face and 13 patients (65%) had pain in the left side of the face.

The prevalence of trigeminal nerve in different patients was investigated. In 18 patients, one nerve root was involved and in 2 patients 2 nerve roots were involved. 1 patient (5%) was experiencing V1 root involvement, 11 patients (55%) were experiencing V2 root involvement, 6 patients (30%) were experiencing V3 root involvement, and two patients were experiencing V2 and V3 root involvement (Figure 1).



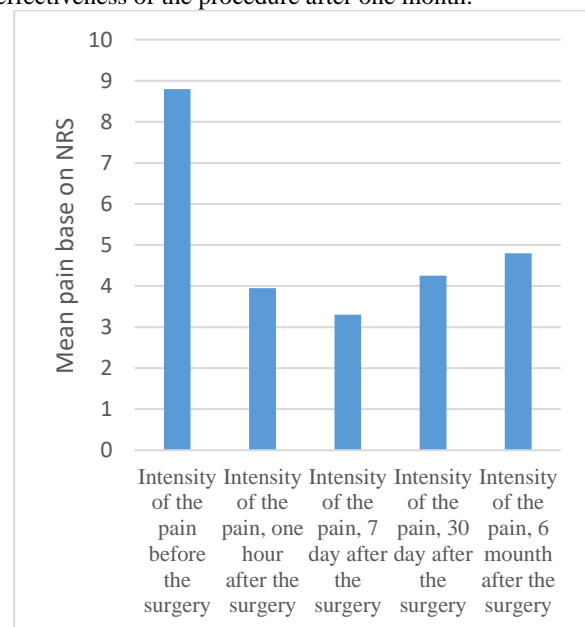
**Figure 1- Trigeminal nerve branches involvement**

The highest pain intensity frequency before the procedure was 10 which was reported on 7 patients (35%) regarding NRS criteria. The mean pain score of the patients before the procedure was 8.8. Although, the average pain in patients, one hour after the surgery, was reported to be 3.95, plus the highest frequency of reported pain was 4. Also, the mean pain of the patients on the 7th day, 30th day, and 6th month after surgery were 3.3, 4.25,

## Results

In this study, 30 patients referred to the pain clinic of Amir A`lam Hospital in 2018-2022 answered a questionnaire and signed a declaration of consent. Due to the special circumstances regarding the Covid pandemic in the country, 10 patients did not show any interest in continuing post-surgery follow-ups and were eliminated from the study. As a result, only 20 patients were examined and followed up. (Table 1) indicated gender appropriateness in the study.

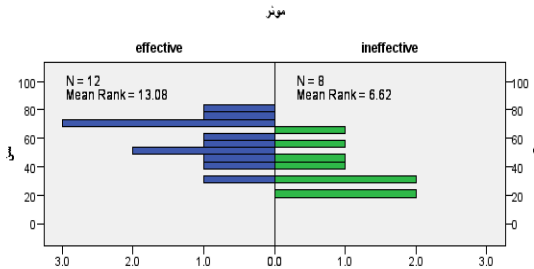
and 4.8 respectively. A comparison between mean pain before and after the surgery is shown in (Figure 2). One hour after surgery, effective pain relief was reported in 75% of the patients. In 80% of patients, the effective response rate was reported one week after the procedure. In addition, in 60% of patients, the effective response rate was reported one month/6month after the procedure. Moreover, there was no significant relationship between patients' gender and the effectiveness or non-effectiveness of the procedure after one month.



- \* Intensity of the pain, 6 months after the procedure
- \* Intensity of the pain 30 days after the procedure
- \* Intensity of the pain 7 days after the procedure
- \* Intensity of the pain one hour after the procedure
- \* Intensity of the pain before the procedure

**Figure 2- Comparison of the patients' pain based on NRS criteria before and after surgery**

There was a significant relationship between patients' age and the effectiveness or non-effectiveness of the procedure, which shows that the effective response to treatment increases with age. (p value= 0.016) concerning normal age distribution of the patients, Mann-Whitney test was used to measure the relationship between the parameters (Figure 3).



**Figure 3- The relationship between the effective procedure and the age.**

## Discussion

According to this study, 60% of patients suffering from trigeminal neuralgia who did not respond well to medication received, showed an effective response to PRF, which was defined as a 0% or 50% reduction in the NRS criteria. Since 2003 and for the first time, Van Zundert et al. [14] have reported that the PRF method was successful in reducing pain in five patients with TN. A series of vast-scale prospective studies have reported a long-term result in the treatment of TN patients with a success rate of 97.6% to 99%. As PRF is considered to be a non-destructive, minimally invasive technique, it is easily accepted by patients for open surgery and neurodegeneration treatment. Whether PRF therapy can be considered as an alternative treatment for patients with trigeminal neuralgia, deserves further evaluation. In this study, the response rate to PRF once a month was 60%, which remained at this level for up to 6 months after surgery. However, in other studies, the response rate to one block of nerve block was reported to be very low [15-16], consequently 75% of the patients had to re-block the nerve due to the pain relapse after one year of follow-up. In contrast, the pain relief effect after a single PRF treatment is promising and has the potential to act as a first-line TN treatment. This treatment is well tolerated even for the elderly and weaker patients with various medical issues, plus PRF treatment was painless and could be performed without anesthesia. None of the patients needed hospitalization. However, in post-surgery examinations, a patient with mild local infection was reported, which resolved with appropriate antibiotic follow-up. Based on previous studies, PRF is a safe procedure and no serious complications or any complications were detected during or after the surgery [17-18]. As a result, PROF treatment was an effective, safe, and non-destructive method for patients with TN.

Primary PRF treatment can be considered as a first-line option before more invasive treatments, such as neurodegeneration and MVD surgery in patients who are unable to have surgery or do not accept the side-effects of neurodegeneration procedures such as CRF. At only one center, this study showed that PRF treatment was effective in idiopathic trigeminal neuralgia that has not responded to medication. However, clinical trials with higher quality such as randomized controlled studies are still needed to evaluate the efficacy and safety of the PRF method. For example, further research is needed to compare the effectiveness of the frequency of nerve block or other neurodegeneration treatment options in drug-resistant TN patients. In addition, more investigation is needed for larger sample sizes to compare differences between patients who responded to PRF and those who did not. Pain is just a mental experience; For example, the quality of life, depression and, anxiety in the hospital should be evaluated in the population. In addition to Perception Indices, visual appraisal methods such as electrophysiological examinations require more investigations to obtain information about trigeminal nerve changes. Other parameters, such as PRF treatment duration, waveform, frequency, and combinatorial treatment should also be considered in the future. There was a significant decrease in patients referred to the medical center and also restrictions regarding the procedure, due to the simultaneous implementation of the plan and the Covid 19 pandemic in the country. Therefore, we were able to enroll only 20 patients. The effects of PRF were followed up for only six months after the surgery. More population and long-term follow-up could provide more acceptable results regarding the effectiveness of PRF treatment in TN.

## Conclusion

PRF treatment was an effective, safe and non-destructive method for patients with TN. Primary PRF treatment can be considered as a first-line option before more invasive treatments, such as neurodegenerative procedures and MVD surgery.

## References

- [1] Arnold M. Headache classification committee of the international headache society (IHS) the international classification of headache disorders. *Cephalalgia*. 2018;38(1):1-211.
- [2] Truini A, Galeotti F, Cruccu G. New insight into trigeminal neuralgia. *J Headache Pain*. 2005;6(4):237-9.
- [3] Love S, Coakham HB. Trigeminal neuralgia: pathology and pathogenesis. *Brain*. 2001;124(Pt 12):2347-60.
- [4] Hess B, Oberndorfer S, Urbanits S, Lahrman H, Horvath-Mechtler B, Grisold W. Trigeminal

- neuralgia in two patients with glioblastoma. *Headache*. 2005;45(9):1267-70.
- [5] Katusic S, Williams DB, Beard M, Bergstralh EJ, Kurland LT. Epidemiology and clinical features of idiopathic trigeminal neuralgia and glossopharyngeal neuralgia: similarities and differences, Rochester, Minnesota, 1945-1984. *Neuroepidemiology*. 1991;10(5-6):276-81.
- [6] MacDonald B, Cockerell O, Sander J, Shorvon S. The incidence and lifetime prevalence of neurological disorders in a prospective community-based study in the UK. *Brain*. 2000;123(4):665-76.
- [7] Childs A, Meaney J, Ferrie C, Holland P. Neurovascular compression of the trigeminal and glossopharyngeal nerve: three case reports. *Arch Dis Child*. 2000;82(4):311-5.
- [8] Katusic S, Beard CM, Bergstralh E, Kurland LT. Incidence and clinical features of trigeminal neuralgia, Rochester, Minnesota, 1945-1984. *Ann Neurol*. 1990; 27(1):89-95.
- [9] Maarbjerg S, Gozalov A, Olesen J, Bendtsen L. Trigeminal neuralgia—a prospective systematic study of clinical characteristics in 158 patients. *Headache*. 2014; 54(10):1574-82.
- [10] Fleetwood IG, Innes AM, Hansen SR, Steinberg GK. Familial trigeminal neuralgia: Case report and review of the literature. *J Neurosurg*. 2001; 95(3):513-7.
- [11] Krafft RM. Trigeminal neuralgia. *Am Fam Physician*. 2008; 77(9):1291-6.
- [12] Burchiel KJ. Abnormal impulse generation in focally demyelinated trigeminal roots. *J Neurosurg*. 1980; 53(5):674-83.
- [13] Williams CG, Dellon AL, Rosson GD. Management of chronic facial pain. *Craniomaxillofac Trauma Reconstr*. 2009;2(2):67-76.
- [14] Zundert JV, Brabant S, de Kelft EV, Vercruyssen A, Buyten JV. Pulsed radiofrequency treatment of the Gasserian ganglion in patients with idiopathic trigeminal neuralgia. *Pain*. 2003;104(3):449-52.
- [15] Lan M, Zipu J, Ying S, Hao R, Fang L. Efficacy and safety of CT-guided percutaneous pulsed radiofrequency treatment of the Gasserian ganglion in patients with medically intractable idiopathic trigeminal neuralgia. *J Pain Res*. 2018; 11:2877-85.
- [16] Fraioli B, Esposito V, Guidetti B, Cruccu G, Manfredi M. Treatment of trigeminal neuralgia by thermocoagulation, glycerolization, and percutaneous compression of the gasserian ganglion and/or retrogasserian rootlets: long-term results and therapeutic protocol. *Neurosurgery*. 1989;24(2):239-45.
- [17] Chua NHL, Vissers KC, Sluijter ME. Pulsed radiofrequency treatment in interventional pain management: mechanisms and potential indications—a review. *Acta Neurochirurgica*. 2011;153(4):763-71.
- [18] Fang L, Tao W, Jingjing L, Nan J. Comparison of High-voltage- with Standard-voltage Pulsed Radiofrequency of Gasserian Ganglion in the Treatment of Idiopathic Trigeminal Neuralgia. *Pain Pract*. 2015; 15(7):595-603.