

PULSED RADIOFREQUENCY THERAPY IN ELDERLY PEOPLE WITH TRIGEMINAL NEURALGIA: A CASE REPORT

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ABSTRACT

Introduction: Trigeminal neuralgia (TN) is a neuropathic pain disorder involving the trigeminal nerve and is recognized as one of the most severe forms of facial pain. Pulsed radiofrequency (PRF) is a minimally invasive intervention that delivers short bursts of radiofrequency current while limiting thermal tissue injury. It may be an alternative for patients with inadequate pain relief from pharmacological treatment. **Case:** An older man presented with severe pain involving the right upper and lower jaws and was clinically diagnosed with suspected atypical trigeminal neuralgia. Fluoroscopy-guided PRF was performed on the right trigeminal nerve using a C-arm, with a temperature limit of 42°C, voltage of 45 V, pulse width of 20 ms, frequency of 2 Hz, and duration of 8 minutes. One week after the procedure, the visual analog scale (VAS) pain score decreased from 8 to 0. Oral pharmacological therapy was continued. **Discussion:** Conventional radiofrequency (CRF) can provide pain relief but may cause thermal injury and sensory complications. PRF has been investigated as a neuromodulatory approach. Experimental studies suggest that PRF may alter neuronal activity through mechanisms involving reduced extracellular signal-regulated kinase phosphorylation, decreased calcium influx, and changes in mitochondrial membrane potential and intracellular ATP levels. These effects may contribute to reduced neuronal excitability and pain sensitization. However, evidence regarding the comparative efficacy and safety of PRF and CRF in trigeminal neuralgia remains limited, and optimal PRF parameters have not been established. The short-term pain relief in this case should be interpreted cautiously because pharmacological therapy was continued and follow-up was limited to one week. **Conclusion:** Fluoroscopy-guided PRF was followed by complete pain relief at one-week follow-up in a patient with clinically suspected trigeminal neuralgia. Further controlled studies with longer follow-up are needed to evaluate its efficacy, safety, and optimal treatment parameters.

Keywords: Trigeminal neuralgia, Pulsed radiofrequency, Facial pain, Neuromodulation

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INTRODUCTION

Trigeminal neuralgia (TN) is a neuropathic pain disorder characterized by recurrent, unilateral, severe, brief, electric shock-like or stabbing pain restricted to one or more divisions of the trigeminal nerve (cranial nerve V). The pain is typically triggered by innocuous stimuli, such as talking, chewing, washing the face, or touching the affected area. According to the International Classification of Headache Disorders, third edition (ICHD-3), the diagnosis of TN is primarily based on its characteristic clinical presentation, including the distribution, duration, intensity, and triggering factors of pain (Zakrzewska et al., 2021). TN predominantly affects the maxillary (V2) and mandibular (V3) divisions and is more frequently encountered in older adults (Lambru et al., 2021). Although the clinical manifestations may be characteristic, identifying the underlying etiology is important to distinguish classical, idiopathic, and secondary TN and to guide appropriate treatment.

Pharmacological therapy is the initial treatment of choice for TN, with carbamazepine and oxcarbazepine being the principal first-line medications. However, adequate pain control may not be achieved in all patients, and treatment may be limited by adverse effects, drug interactions, inadequate response, or the need for escalating doses. These limitations are particularly relevant in older adults, in whom comorbidities and medication tolerability must be considered when selecting treatment. For patients with persistent pain despite medical therapy or those who cannot tolerate adequate medication doses, interventional procedures may be considered. Available options include microvascular decompression, percutaneous radiofrequency procedures, and other ablative techniques. The choice of intervention should be individualized according to the patient's clinical condition, treatment response, procedural risks, and preferences (Turton and Malan-Roux, 2019; Lambru et al., 2021).

Conventional radiofrequency thermocoagulation (CRF) is an established percutaneous intervention for TN that produces thermal injury to targeted trigeminal nerve fibers to interrupt pain transmission. Although CRF can provide substantial pain relief, its neurodestructive mechanism may also cause sensory disturbances, including facial numbness, dysesthesia, and, in some cases, masticatory weakness or corneal sensory impairment. These potential complications are important considerations when treating older patients and when preservation of trigeminal nerve function is desired (Eskandar et al., 2023; Smulders et al., 2021). Pulsed radiofrequency (PRF), in contrast, delivers intermittent bursts of radiofrequency current with intervening periods that allow heat dissipation, generally maintaining the electrode temperature at or below 42 °C. PRF is therefore intended to produce neuromodulatory effects while limiting thermal tissue destruction. Experimental studies suggest that PRF may influence neuronal excitability, intracellular calcium signaling, and pain-related molecular pathways (Erdine et al., 2007; Laksono et al., 2023). Nevertheless, the proposed mechanisms and the extent to which these experimental findings translate into clinical outcomes remain incompletely established. PRF should consequently be considered a potential nerve-preserving intervention rather than an established equivalent or universally safer replacement for CRF.

Despite increasing interest in PRF for TN, important uncertainties remain regarding the optimal treatment parameters, including stimulation frequency, pulse width, voltage, exposure duration, and target location. Previous clinical studies have reported pain improvement following PRF applied to the trigeminal or Gasserian ganglion, but the protocols and follow-up periods have varied, limiting the establishment of a standardized treatment regimen (Chua et al., 2012; Erdine et al., 2007). In particular, the clinical relevance of lower-frequency stimulation and treatment durations exceeding those commonly reported in earlier clinical studies remains insufficiently characterized. Experimental evidence from Laksono et al. (2023) indicates that PRF at 2 Hz can modulate sensitized dorsal root ganglion neurons and that its effects on selected cellular parameters do not significantly differ from those observed at 4 Hz. Their subsequent experimental study also suggested that 2-Hz PRF may better preserve selected physiological characteristics of dorsal root ganglion neurons than 4-Hz PRF under the investigated conditions (Laksono et al., 2023). However, these findings were obtained from experimental models and cannot directly establish the clinical superiority or optimality of 2-Hz stimulation in patients with TN.

The treatment duration is another parameter requiring further clinical evaluation. Chua et al. (2012) reported favorable pain outcomes following PRF treatment delivered for six minutes, while experimental evidence suggests that extending PRF exposure may influence its analgesic effects. However, the clinical efficacy and safety of extending the treatment duration to eight minutes, particularly when combined with a stimulation frequency of 2 Hz, have not been adequately established in patients with TN. Thus, the combination of 2-Hz stimulation and an eight-minute exposure represents an exploratory treatment protocol rather than a validated optimal regimen. Reporting the clinical response and procedural outcomes associated with this combination may contribute preliminary clinical information to the ongoing discussion regarding PRF parameter selection.

This case report describes the clinical presentation, diagnostic assessment, and treatment outcome of an older adult with unilateral trigeminal-distribution facial pain involving the right maxillary (V2) and mandibular (V3) divisions who underwent fluoroscopy-guided PRF. The report specifically documents the use of a stimulation frequency of 2 Hz, a pulse width of 20 ms, a voltage of 45 V, a temperature limit of 42 °C, and an exposure duration of eight minutes. The novelty of this report lies in the clinical documentation of this particular combination of PRF parameters in an older patient with TN and the description of short-term pain outcomes and medication adjustment following the procedure. By presenting this case, we aim to provide preliminary clinical information on the feasibility and short-term outcome of this protocol and to highlight the need for further controlled studies to establish its efficacy, safety, and optimal treatment parameters.

RESEARCH METHOD

Case

A 72-year-old man presented to the Pain Clinic of Soedono Regional General Hospital, Madiun, Indonesia, with a chief complaint of right-sided facial pain. The patient reported a seven-month history of severe pain involving the right upper and lower jaws. Before referral to the pain clinic, he had visited a dentist and undergone extraction of all teeth in the right upper and lower dental quadrants. However, the facial pain persisted following the dental extractions. The pain was described as sharp, electric shock-like, and

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extremely severe, with each episode lasting less than one minute. During severe attacks, the patient cried because of the intensity of the pain. The pain was confined to the right facial region, predominantly involving the maxillary and mandibular areas, without involvement of the supraorbital region. Attacks were triggered by everyday activities, including talking, eating, washing the face, and gargling. The patient denied associated lacrimation, facial twitching, nausea, or vomiting during the attacks. He also denied a history of facial skin disorders, recent trauma, or symptoms of an upper respiratory tract infection. The patient had previously received medication prescribed by his dentist, but the pain persisted and progressively increased in frequency. Due to the worsening symptoms, he sought further evaluation and treatment at the Pain Clinic. No comorbidities were reported in the available medical history.

On general examination, no significant abnormalities were documented. The Numeric Pain Rating Scale (NPRS) score was 8/10 during pain attacks. Local examination revealed no specific abnormalities of the face. All teeth in the right upper and lower dental quadrants had been extracted. Masticatory movements were within normal limits. Based on the characteristic clinical presentation, including unilateral, brief, severe, electric shock-like facial pain triggered by innocuous stimuli, trigeminal neuralgia was considered the primary clinical diagnosis. The differential diagnoses included classical trigeminal neuralgia, idiopathic trigeminal neuralgia, secondary trigeminal neuralgia, sphenopalatine neuralgia, maxillary sinusitis, temporomandibular joint disorders, cluster headache, and migraine based in figure 1. No neuroimaging or other supporting diagnostic examinations were performed. Consequently, the underlying etiology of the trigeminal-distribution pain could not be established, and classical, idiopathic, and secondary trigeminal neuralgia could not be reliably distinguished. The diagnosis was therefore based on the clinical presentation, with the etiological subtype remaining undetermined.

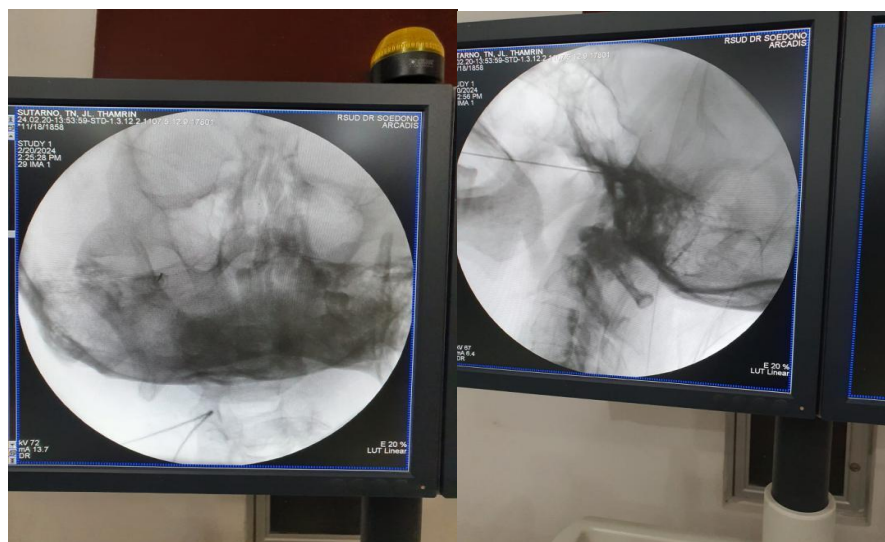


Figure 1. Submental obliq view PRF needle entering foramen ovale (left)

Figure 2. Lateral view needle through petrosus line (right)

The patient underwent fluoroscopy-guided pulsed radiofrequency (PRF) treatment targeting the right trigeminal nerve at the V2–V3 level. The procedure was performed using C-arm fluoroscopic guidance to facilitate needle placement toward the intended target. The PRF parameters were as follows: a temperature limit of 42 °C, voltage of 45 V, pulse width of 20 ms, stimulation frequency of 2 Hz, and treatment duration of eight minutes. The fluoroscopic images documented the needle trajectory and positioning during

the procedure. The submental oblique view demonstrated the PRF needle approaching the foramen ovale, while the lateral view demonstrated the needle trajectory in relation to the petrous region. Following the procedure, the patient was prescribed paracetamol 500 mg orally three times daily and carbamazepine 200 mg orally twice daily.

Immediately after the PRF procedure, the patient's pain score decreased from 8/10 to 3/10. At the one-week follow-up, the pain score had further decreased to 0/10. The patient reported being able to resume his usual daily activities without pain. In view of the reported clinical improvement, the carbamazepine dose was reduced from 200 mg twice daily to 100 mg twice daily. No longer-term follow-up data were available to assess the durability of pain relief or the occurrence of recurrent symptoms.

DISCUSSION

This case describes an older patient with severe unilateral facial pain involving the right maxillary (V2) and mandibular (V3) divisions of the trigeminal nerve who experienced a reduction in pain intensity following fluoroscopy-guided pulsed radiofrequency (PRF). The patient's pain decreased from a Numeric Pain Rating Scale score of 8/10 before the procedure to 3/10 immediately after the intervention and 0/10 at the one-week follow-up. The patient also reported being able to resume normal daily activities without pain. These findings represent a favorable short-term clinical response in this individual; however, the contribution of PRF to the observed improvement cannot be established definitively from a single case.

The clinical presentation was characterized by unilateral, brief, electric shock-like pain triggered by innocuous stimuli, including talking, eating, washing the face, and gargling. These features are consistent with the clinical phenotype of trigeminal neuralgia described in the International Classification of Headache Disorders, third edition (ICHD-3) (Zakrzewska et al., 2021). The involvement of the V2 and V3 distributions and the short duration of individual attacks further support this clinical consideration. Nevertheless, the diagnostic interpretation requires caution. The patient's pain developed in the context of previous dental pain and extraction of the right-sided teeth, and no brain MRI or other neuroimaging examination was performed. Consequently, classical TN associated with neurovascular compression, secondary TN, and painful post-traumatic trigeminal neuropathy could not be adequately distinguished. The absence of documented sensory abnormalities or a detailed neurological examination also limits the exclusion of other trigeminal neuropathic pain conditions. Therefore, the diagnosis in this case is best interpreted as clinically suspected trigeminal neuralgia involving the right V2 and V3 divisions, with the etiological subtype remaining undetermined. This diagnostic uncertainty is an important limitation when comparing the patient's response with outcomes reported in studies involving more clearly characterized TN populations.

The reduction in pain following PRF may be related to modulation of nociceptive transmission within the targeted trigeminal pathway. Unlike conventional radiofrequency thermocoagulation, which relies on thermal injury to interrupt sensory nerve conduction, PRF is delivered in intermittent bursts intended to limit tissue heating while producing neuromodulatory effects. Experimental studies have suggested that PRF can influence neuronal excitability and pain-related signaling pathways. In particular, Laksono et al. (2023) reported that PRF reduced phosphorylated extracellular signal-regulated kinase

(pERK) and altered intracellular calcium influx, mitochondrial membrane potential, and cytosolic ATP levels in sensitized dorsal root ganglion neurons. These findings provide a potential biological framework for understanding the clinical response observed in the present case.

However, the relationship between these experimental findings and the patient's reduction in pain remains hypothetical. The present case did not include electrophysiological measurements, biochemical biomarkers, or other assessments of neuronal activity. Furthermore, the experimental study involved dorsal root ganglion neurons rather than direct measurements of the human trigeminal ganglion. Although both structures are sensory ganglia, the experimental results cannot establish the specific mechanism responsible for analgesia in this patient. Accordingly, the observed reduction in pain is compatible with a neuromodulatory effect of PRF but does not constitute direct evidence of the underlying mechanism.

The clinical response should also be interpreted in the context of the patient's concurrent pharmacological treatment. Following the procedure, the patient continued paracetamol at 500 mg three times daily and carbamazepine at 200 mg twice daily. At the one-week follow-up, the carbamazepine dose was reduced to 100 mg twice daily. Because medication was continued after PRF, the relative contributions of the intervention and pharmacological therapy cannot be separated. In addition, the available clinical information does not establish whether the patient had previously received an adequate trial of carbamazepine or another first-line medication before the procedure. Therefore, the case does not demonstrate PRF efficacy in pharmacologically refractory TN. The improvement should instead be understood as a clinical response observed after PRF in the setting of continued medication.

The PRF parameters used in this case also warrant consideration. Treatment was performed under C-arm fluoroscopic guidance at the right trigeminal nerve V2–V3 level, using a temperature limit of 42 °C, a voltage of 45 V, a pulse width of 20 ms, a frequency of 2 Hz, and an exposure duration of eight minutes. The selection of these parameters was informed by previous clinical and experimental studies, although the combined protocol has not been established as an optimal regimen for TN.

Chua et al. (2012) reported pain improvement following PRF of the Gasserian ganglion using 45 V, a temperature limit of 42 °C, a pulse width of 10 ms, a frequency of 4 Hz, and a treatment duration of six minutes. Their study reported sustained reductions in pain scores during follow-up; however, it was retrospective and involved a relatively small sample. In comparison, the present case used the same voltage and temperature limit but a longer pulse width of 20 ms, a lower frequency of 2 Hz, and a longer exposure duration of eight minutes. Although both reports describe favorable pain outcomes, their different designs, patient populations, treatment parameters, and outcome assessment periods prevent direct comparison of treatment efficacy. In particular, the one-week outcome in the present case cannot establish whether the response would be comparable to the longer-term improvements reported by Chua et al.

Erdine et al. (2007) compared PRF with conventional radiofrequency in patients with idiopathic TN, providing clinical evidence relevant to the distinction between neuromodulatory and thermocoagulative approaches. Their study used PRF parameters that differed from those employed in the present case, including a six-minute exposure and a frequency of 4 Hz. Although the study provides a basis for considering PRF as an interventional option, its findings cannot validate the specific combination of 2 Hz and eight minutes used here. Moreover, differences in diagnostic classification and treatment

protocols limit the applicability of its results to this patient, whose etiological diagnosis was not confirmed by neuroimaging.

Other studies have reported improvements in pain following PRF. Navani et al. (2018), as cited in the original manuscript, described sustained pain improvement following treatment and subsequent repeat intervention. Vanelderren et al. (2018) also reported improvements in pain-related outcomes, including sleep, mood, and daily activities. These findings provide a broader clinical context for the potential benefits of PRF. Nevertheless, differences in patient selection, procedural protocols, repeat treatment, and follow-up duration mean that the outcomes cannot be directly extrapolated to the present case. Similarly, the meta-analysis by Zhang et al. (2022) reported that combining pulsed and conventional radiofrequency was associated with improved outcomes compared with conventional radiofrequency alone. However, the results of a combined intervention cannot establish the independent effect of PRF or determine the optimal PRF parameters. The present case therefore adds a description of a particular treatment protocol rather than comparative evidence of superiority over conventional radiofrequency.

The use of a 2-Hz stimulation frequency was informed by the experimental work of Laksono et al. (2023), which investigated the effects of 2-Hz and 4-Hz PRF on sensitized dorsal root ganglion neurons. The study reported no significant differences between the two frequencies in selected measures of neuronal modulation and suggested that 2-Hz stimulation better preserved certain physiological characteristics of neurons under the experimental conditions. These findings provide a rationale for investigating lower-frequency PRF, particularly when preservation of sensory neuronal function is a treatment consideration. However, the experimental observations do not demonstrate that 2-Hz PRF produces greater analgesia in patients with TN. In the present case, the reduction in pain cannot be attributed specifically to the 2-Hz frequency because no alternative frequency was tested and no comparative treatment group was available.

The eight-minute exposure duration was selected in the context of previous evidence using shorter PRF protocols and experimental observations suggesting that treatment duration may influence neuromodulatory effects. Chua et al. (2012) reported clinical improvement following a six-minute protocol, while earlier experimental work cited in the original manuscript suggested that extending PRF exposure could enhance its anti-allodynic effect. Nevertheless, experimental findings regarding exposure duration cannot be assumed to predict clinical outcomes in TN. Extending the duration from six to eight minutes may alter the total delivered electrical exposure, but the magnitude and clinical significance of this difference cannot be determined from the present report. Furthermore, treatment duration should not be interpreted independently of other parameters, including voltage, pulse width, frequency, electrode position, and tissue characteristics. Thus, the combination of 2 Hz and eight minutes represents an exploratory protocol, and its clinical response in this patient should not be interpreted as evidence of an optimal or superior treatment regimen.

Regarding safety, the patient had no documented immediate procedural complications in the available case record. However, the absence of reported complications in a single patient and a short observation period is insufficient to establish the safety of the procedure. Conventional radiofrequency has been associated with complications such as facial sensory disturbances, masticatory weakness, and corneal sensory impairment, as

described in previous studies (Eskandar et al., 2023; Smulders et al., 2021). Although PRF is designed to limit thermal injury, it cannot be assumed to eliminate procedural or neurological risks. In addition, the present case did not include a standardized assessment of facial sensation, corneal reflexes, or masticatory function during extended follow-up. Therefore, no comparative safety conclusion can be drawn between PRF and conventional radiofrequency from this case.

The principal limitation of this report is the short follow-up period. Pain was assessed immediately after the procedure and at one week, with no subsequent assessment of recurrence, duration of analgesia, long-term medication requirements, or delayed adverse events. Trigeminal neuralgia is characterized by variable periods of remission and recurrence, and early pain relief does not necessarily indicate sustained disease control. Consequently, the reduction in pain to 0/10 at one week should be interpreted as a short-term clinical outcome rather than evidence of durable treatment success. The lack of neuroimaging, incomplete documentation of previous pharmacological treatment, absence of objective neurological outcome measures, and inability to separate the effects of PRF from concurrent medication further limit the interpretation of the findings.

In summary, this case documents a favorable short-term clinical response following fluoroscopy-guided PRF using a frequency of 2 Hz and an exposure duration of eight minutes in an older patient with clinically suspected trigeminal neuralgia involving the right V2 and V3 divisions. The findings provide preliminary clinical information regarding the application of this particular parameter combination but do not establish its efficacy, superiority, or long-term safety. Prospective studies with standardized diagnostic criteria, clearly documented medication histories, comparative PRF protocols, objective neurological assessments, and longer follow-up are required to determine the clinical relevance of stimulation frequency and exposure duration in the management of TN.

CONCLUSION

Fluoroscopy-guided pulsed radiofrequency (PRF) using a frequency of 2 Hz and an exposure duration of eight minutes was followed by a reduction in pain intensity from NPRS 8/10 to 0/10 at one-week follow-up in an older patient with clinically suspected trigeminal neuralgia involving the right V2 and V3 divisions. This case provides preliminary clinical information regarding the short-term response to this specific PRF protocol. However, the absence of neuroimaging, continued pharmacological treatment, and limited follow-up prevent definitive conclusions regarding treatment efficacy, safety, or long-term pain relief. Further studies with confirmed diagnostic classifications, comparative treatment protocols, and longer follow-up are required to evaluate the clinical relevance of these PRF parameters.

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