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ORIGINAL ARTICLE

Peripheral nerve pulsed radiofrequency for trigeminal neuralgia treatment: Is it an effective method?

Trigeminal nevralji hastalarında periferik sinirlere pulse radyofrekans uygulaması: Etkili bir yöntem mi?

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Summary

Objectives: Trigeminal neuralgia is a paroxysmal and shock-like pain in the trigeminal nerve area. Various treatment options have been used for trigeminal neuralgia such as medical treatment, interventional procedures, and surgical operations. Pulsed radiofrequency (PRF) is a minimally invasive percutaneous technique which seems to be safer and easier to perform. This retrospective study aims to evaluate the analgesic effect, duration of efficacy, and side effects of PRF procedures in the peripheral branches of the trigeminal nerve.

Methods: The data of the patients with trigeminal neuralgia who were followed up in our hospital's algology clinic from 2016 to 2018 were reviewed retrospectively. Patients aged between 18 and 70 who did not respond to medical treatment or could not use medication due to side effects were treated with PRF procedure for peripheral branches of trigeminal nerve that was selected for this study. Demographic profile, clinical presentation, pain intensity, duration of efficacy, and complications were evaluated from their files.

Results: Twenty-one patients who underwent ultrasonography guided PRF procedures were included the study. Mean visual analog scale value of the patients was found to have decreased from 9.25±0.63 to 1.55±0.88 at the end of the 1st month ($p<0.001$). The painless period for the patients lasted up to 12 (9–21) months and no complications occurred.

Conclusion: PRF procedure seems to be an effective and safe method in patients who respond to block of the peripheral branches of the trigeminal nerve.

Keywords: Infraorbital nerve; mental nerve; pulsed radiofrequency; supraorbital nerve; trigeminal neuralgia.

Özet

Amaç: Trigeminal nevralji; trigeminal sinir bölgesinde tek taraflı, paroksismal, şok benzeri bir ağrıdır. Trigeminal nevralji için medikal tedavi, girişimsel prosedürler ve cerrahi operasyonlar gibi çeşitli seçenekler tedavide kullanılmaktadır. Pulse radyofrekans (PRF), daha güvenli ve uygulaması daha kolay görünen minimal invaziv bir perkütan tekniktir. Bu retrospektif çalışmada, trigeminal sinirin periferik dallarında PRF işlemlerinin analjezik etkisinin, etkililik süresinin ve yan etkilerinin değerlendirilmesi amaçlandı.

Gereç ve Yöntem: Bu çalışmada, 2016–2018 yılları arasında hastanemiz algoloji kliniğinde takip edilen trigeminal nevraljili hastaların verileri retrospektif olarak incelendi. Medikal tedaviye yanıt vermeyen veya yan etkilerden dolayı ilaç kullanamayan, tedavi için trigeminal sinirin periferik dallarına PRF prosedürü uygulanan, 18–70 yaş aralığındaki hastaların verileri analiz edildi. Demografik profil, klinik prezentasyon, ağrı şiddeti, etkililik süresi ve komplikasyonlar değerlendirildi.

Bulgular: Çalışmaya ultrasonografi eşliğinde PRF işlemi yapılan 21 hasta dahil edildi. Hastaların ortalama görsel analog skala değerinin ilk ay sonunda 9,25±0,63'ten 1,55±0,88'e düştüğü saptandı. Hastaların ağrısız döneminin 12 aya (9–21 ay) kadar sürdüğü ve herhangi bir komplikasyon oluşmadığı tespit edildi.

Sonuç: Trigeminal sinirin periferik dallarına lokal anestezik ile yapılan bloktan fayda gören hastalarda PRF işlemi etkili ve güvenli bir yöntem gibi görünmektedir.

Anahtar sözcükler: Infraorbital sinir; mental sinir; pulse radyofrekans; supraorbital sinir; trigeminal nevralji.

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Introduction

Trigeminal neuralgia is defined by the International Headache Society as a unilateral, paroxysmal and shock-like pain in the ophthalmic, maxillary, and/or mandibular nerve area that progresses with attacks.[1] The incidence of trigeminal neuralgia has been reported between 5 and 25/100,000 people. It is 1.7–2.2 times more common in women.[2] The trigeminal nerve has three main branches, and the disease may occur in any of these branches. The most affected nerve branches are mandibular and maxillary nerves. Ophthalmic nerve is rarely affected.[3]

The etiology and pathophysiology of trigeminal neuralgia are unclear because there are counterexamples for all the existing theories. The strongest hypothesis is about the factors causing demyelination of the nerve.

The main goal of any treatment is to reduce pain and relieve symptoms. Antiepileptics are the first line of medical treatment. Pharmacologic treatment is used for pain relief but does not provide a permanent cure. Various interventional and surgical methods can be used in patients who do not respond to medical treatment or cannot tolerate medication due to side effects. Percutaneous interventional procedures such as radiofrequency rhizotomy may have complications that anesthesia dolorosa, keratitis, aseptic meningitis, bacterial meningitis, nerve damage, and rarely, intracranial hematoma.[4] Local anesthetic block of the peripheral branches of the trigeminal nerve such as supraorbital, infraorbital, and mental nerves provides short-term pain relief in some cases. Pulsed radiofrequency (PRF) procedures may provide longer pain relief for the patients who have short-term pain relief with the local anesthetic block. In our clinical experience, PRF procedures have become an accepted treatment modality in patients with trigeminal neuralgia who respond to the prognostic nerve block with local anesthetics. However, literature review did not reveal any published scientific data about the effectiveness and side effects of these procedures.

This retrospective study thus aims to evaluate the analgesic effect, duration of efficacy, and side effects of PRF procedures on the peripheral branches of the trigeminal nerve.

Material and Methods

Study Design and Study Population Following the approval of the institutional ethics committee (no. 42), the data of the patients with trigeminal neuralgia who were followed up in our hospital's algology clinic from 2016 to 2018 were reviewed retrospectively. The treatment algorithm in trigeminal neuralgias was included medical treatment in the first step. Since the patients did not benefit from medical treatment, their treatment was reduced and stopped before the procedure. In cases who did not respond to medical treatment or could not tolerate side effects, a local anesthetic block was applied to the peripheral branch of the trigeminal nerve.

Localizations of pain initiation were considered in the selection of the nerve to be blocked. Among the patients with mandibular branch involvement, mental nerve block was planned for those who defined pain only in the mental nerve dermatome. Similarly, infraorbital nerve block was performed for those with maxillary nerve involvement who described pain in the infraorbital nerve dermatome, and supraorbital nerve block was performed for those with ophthalmic nerve involvement who described pain in the supraorbital nerve dermatome.

Peripheral branch block was not applied to those with pain definitions starting from the proximal part of the trigeminal nerve branches. Pulsed RF application to the same peripheral nerves was planned in patients with more than half reduction in pain after block.

Patients who had pulsed RF performed to the peripheral branches of the trigeminal nerve were included in the study.

Peripheral nerve blocks were preferred primarily because they can be easily visualized with ultrasonography (USG) and the procedure is safer and more comfortable for the patient.

Patients who had deficiencies in clinical data, intervention-related data or follow-up data in our records and patients who had previously undergone other interventional procedures for trigeminal neuralgia were excluded from the study.

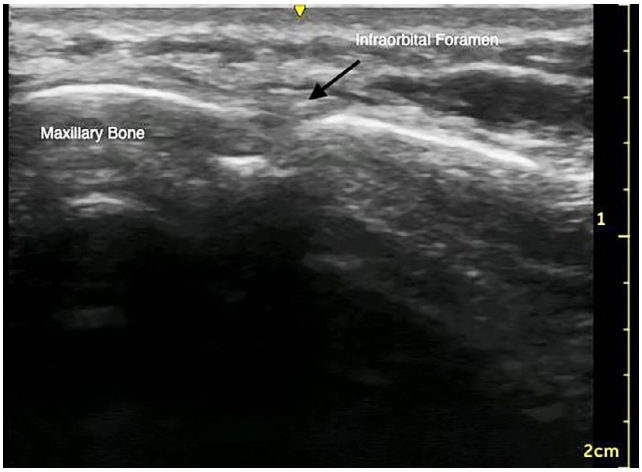

Figure 1. Scanning of the infraorbital foramen with hockey stick ultrasound probe.

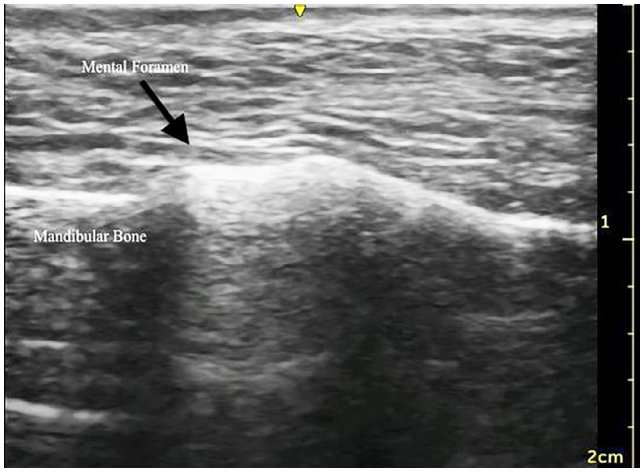

Figure 2. Scanning of the mental foramen with hockey stick ultrasound probe.

Interventions

A prognostic block was applied by 1–2 mL of 0.5% bupivacaine on the peripheral nerve branch of the site of pain. Patients with a temporary pain relief (50% or more reduction in the visual analog scale (VAS) score were planned to undergo PRF procedure in the next session after the block was resolved.

It was seen from the hospital records that the same standard protocols were applied to all patients for procedures; in supine position intravenous access was obtained and standard monitoring (electrocardiogram, blood pressure monitoring, and pulse oximetry) was applied before the procedure. The symptomatic side of face skin was cleaned with a sterile solution and sterile drapes were used. The procedure was performed under the guidance of ultrasound (Fig. 1, 2). After the location of the nerve was determined with USG, a 21-gauge 50-mm radiofrequency needle with a 5 mm active tip was inserted. After the location of the nerve was verified by creating paresthesia in the concordant trigeminal distribution of the patient's usual symptoms by a 50 Hz sensorial stimulation, 0.5 mL of 0.5% bupivacaine was injected followed by a PRF procedure at 42 °C for 240 s.

Follow-up

Patients were observed for 2 h after the procedure for the acute complications of the procedure such as hematoma formation. Patients were reevaluated for the pain relief and complications of the procedure such as anesthesia dolorosa, keratitis, and nerve damage at the 1st month after the procedure. At the post-procedural 3rd and 6th month controls, patients were asked whether their pain started again or not, and VAS values were asked if their pain started again. Paracetamol and NSAIDs were prescribed for post-procedure pain. Pain intensity was evaluated by VAS. The time between the procedure and the recurrence of pain was accepted as the duration of analgesia. Recurrent nerve blockades with local anesthetic were performed to the patients whose pain started in the post-procedure follow-up. All these data of patients were taken from the hospital records for this study.

Statistical Analysis

Statistical analyses were performed with the IBM SPSS 21 (Statistical Package for the Social Sciences) package software. For descriptive analysis; average, standard deviation, median, and 25–75 percentile values were expressed in the continuous data. The suitability of variables to normal distribution was examined by analytical methods (Shapiro–Wilk test). ANOVA test with Bonferroni correction were used for repeated VAS values. p=0.05 was considered statistically significant.

Results

Of the 21 patients who were retrospectively analyzed, 14 were female and seven were male, and their mean age was 58.6±12.1. PRF procedures were performed in the infraorbital nerve in eight patients, the mental nerve in seven patients, and the supraorbital nerve in six patients. Demographic characteristics of the patients included in the study are presented in Table 1.

None of the patients experienced complications and side effects such as vasovagal reaction, hematoma, infection, sensory processing disorder, or motor disorder during the procedure. These complications were also not observed in the early and late follow-up of the patients.

Table 1. Demographic data of the patients

	Infraorbital nerve	Supraorbital nerve	Mental nerve	Total
Age	58.25±11.29	54.1±17.2	62.85±7.3	58.6±12.1
Female	6	3	5	14
Male	2	3	2	7

Table 2. Mean VAS scores before and after the PRF procedure for infraorbital, supraorbital, mental nerves, and all peripheral nerves

	ION Mean±SD	SON Mean±SD	MN Mean±SD	APN Mean±SD	p
VAS 1	9.43±0.787	9.33± 0.516	9.00±0.577	9.25±0.639	
VAS 2	1.43±0.787	1.50±1.049	1.71±0.951	1.55±0.887	p<0.001 (VAS 1–2)
VAS 3	1.14±0.690	1.83±O.753	1.57±0.787	1.50±0.761	p<0.001 (VAS 1–3)
VAS 4	1.29±0.951	2.00±0.632	1.71±0.756	1.65±0.813	p<0.001 (VAS 1–4)

VAS: Visual analog scale; ION: Infraorbital nerve; SON: Supraorbital nerve; MN: Mental nerve; APN: All peripheral nerves; SD: Standard deviation.

The mean VAS value of the patients included in the study decreased from 9.25±0.63 to 1.5±0.88 1 month after, 1.50±0.761 3 3 months after and 1.65±0.813 6 months after procedures. Immediately after the procedure, no patients have had any pain. We think this is because of the nerve block with local anesthetic before the PRF procedure. Mean VAS scores before and after the PRF procedure for infraorbital, supraorbital, mental nerves, and all peripheral nerves are shown in Table 2. The decrease in the VAS value of the patients was statistically significant at each follow up period (p<0.001). Post-procedural VAS values was similar at 1th, 3rd, and 6th month controls. Pain started again in two of the infraorbital PRP patients 5 and 6 months after procedure. Other than these, no patients identified an increase in pain at the 3rd and 6th month controls. The painless period of the patients lasted up to 12 (9–21) months. Duration of painless period for infraorbital, supraorbital, and mental nerves, and all branches are presented in Table 3.

Discussion

Trigeminal neuralgia is a headache that affects quality of life and can disrupt socioeconomic life. Treatment options are medical treatment, interventional pain treatment, and surgery. Antiepileptics such as carbamazepine, oxcarbazepine, and lamotrigine are recommended in the first line of treatment.[5] The first-line drug carbamazepine in particular has serious side effects such as aplastic anemia, hepatotoxicity, thrombocytopenia, leucopenia, and hyponatremia.[6] In patients with systemic diseases and in the elderly population, these drugs may cause much more serious problems. Due to these side effects, many patients cannot tolerate medical treatment and treatment doses are thus insufficient. Therefore, it seems more reliable to try minor interventional methods before medical treatment in trigeminal neuralgia during pregnancy because of side effects.

Alternative methods to medical treatment of trigeminal neuralgia are peripheral neurectomies, percutaneous radiofrequency rhizotomy (PRR), percutaneous glycerol rhizotomy (PGR), percutaneous balloon compression, stereotactic radiosurgery gamma knife radiosurgery, CyberKnife, and microvascular decompression (MVD). However, these methods may cause major complications such as nerve damage, anesthesia dolorosa, keratitis, aseptic meningitis, bacterial meningitis, and decreased corneal sensation.[7,8]

Peripheral neurectomy as a minimal invasive surgical procedure is an old technique that can provide analgesia for about 2 years. Although it is usually performed under local anesthesia, general anesthesia may be needed.[9] There is no major complication but complications such as infection, sensorial loss and anesthesia dolorosa were reported.[10]

Table 3. Duration of painless period for the result of PRF for infraorbital, supraorbital, mental nerves, and all peripheral nerves

	Infraorbital nerve		Supraorbital nerve		Mental nerve		All peripheral nerves	
	Mean±SD	Median (25.p–75.p)	Mean±SD	Median (25.p–75.p)	Mean±SD	Median (25.p–75.p)	Mean±SD	Median (25.p–75.p)
Duration of painless period (months)	16.5±11.2	16.5 (7–27)	18.4±7.1	10.66 (12–24)	10.6±4.1	18.42 (7.5–13.5)	15.4±8.6	12 (9–21)

PRF: Pulsed radiofrequency; SD: Standard deviation.

MVD surgery is the first-line surgical method in patients with neurovascular compression together with magnetic resonance imaging, and it has been shown to be painless for a long time, especially in men.[11,12] However, this procedure may cause serious complications.[12,13]

PRR is performed with high temperature ablation by using radiofrequency needle, accompanied by imaging methods. Effectiveness of this procedure decreases after 1 year.[14,15] The high temperature (60–80 °C) may cause nerve damage and anesthesia dolorosa. To avoid these serious complications, PRF was tested for PRR, but found to be ineffective.[16]

PGR and balloon decompression provide almost complete relief approximately in 75% of the patients, but these procedures may also cause serious complications.[17,18] To avoid complications of the thermal lesion, PRF can be successfully applied in many neural structures such as dorsal root ganglion, sphenopalatine ganglion, and suprascapular nerve.[19–21] PRF seems to be a less destructive alternative technique which consists of regular intermittent RF waves and silent periods.[22,23] It can be performed between 90 s and 240 s, but there is no consensus on the optimal lesion time. The temperature of the PRF site remains constant at 42 °C, so it is known that there are no serious complications such as neural damage. The mechanism of action of the PRF is still not fully explained, but it may be related to the rapidly changing electric field regardless of temperature.[24]

Anugerah et al.[25] applied PRF to the pterygopalatine fossa under ultrasound guidance for the treatment of trigeminal neuralgia. They confirmed the maxillary nerve with stimulation but nerve imaging could not be performed. The patient's pain-free period continued at 6 months with no norological side effects. In another study by Nader et al.,[26] a total of 15 patients with atypical facial pain or trigeminal neuralgia were blocked by entering the pterygopalatine fossa under ultrasound guidance and the block was repeated as needed. Nerve imaging could not be performed, but maxillary block was confirmed by pin prick in all patients.

In a study in which mandibular nerve blockade with a neurostimulator was applied to three patients for perioperative pain control, a perioperative pain-free period was achieved, but ptosis due to facial nerve involvement developed in one of these patients and lasted for 24 h.[27]

Real-time imaging and visualization of vascular structures and soft tissues are advantageous in ultrasound-guided blocks, but sometimes, the imaging is insufficient because the target structures are deep.

In our study, blockade and pulse rf were applied after the peripheral nerves and their exiting foramen were visualized under ultrasound guidance. The reliability of the process is increased with sensory and motor signals. The fact that it is more reliable than the pterygopalatine fossa in terms of vascularity and that it is applied to the superficial nerves has also increased the reliability by providing an easy application of the procedure.

Interventional procedures on the peripheral branches of the trigeminal nerve usually do not cause serious neurological or vascular complications because they are not close to these important anatomical structures. The fact that PRF application is far from the neurological complications that

may occur in conventional RF application makes the treatment completely safe.[24] In our study, none of the patients had serious complications such as anesthesia dolorosa, keratitis, aseptic meningitis, bacterial meningitis, decreased corneal sensation, or nerve damage.

Luo et al.[28] found that more than 50% ofreduction in pain intensity without any important complications continued in 63% of patients who received classical pulsed RF in 1-year follow-up in patients with refractory infraorbital neuralgia of different causes. Our study included only patients with primary trigeminal neuralgia. Another difference is that our study included not only infraorbital but also mental and supraorbital nerves. However, our results of PRF applied to the infra-orbital nerve are similar in terms of duration of analgesia.

Results of this retrospective study showed that the duration of analgesia in various nerves that underwent PRF was different. For example, pain relief in mental nerve PRF procedure was longer than infraorbital and supraorbital nerve procedures. However, we concluded that the number of patients is insufficient for this assertion. In the future studies, it may be more accurate to evaluate this point of view with a larger number of patients.

This retrospective study showed that the PRF procedure in the peripheral branches of the trigeminal nerve may lead to pain relief for nearly 1 year. It has a lower risk of complications than other interventional methods. Another advantage is that it can be applied safely in many situations contraindicated for other procedures, pregnancy, coagulation defects, and old age.

There are some limitations of this study. First of all, the retrospective design of our study makes it difficult to evaluate the treatment response. In addition, increasing the number of participants and adding a control group can enable a better evaluation of the treatment effect.

We believe that USG-guided PRF procedure to peripheral branches of trigeminal nerve is an effective and safe interventional method for the patients with trigeminal neuralgia. It can be performed safely to patients who do not benefit from appropriate medical treatment or who cannot use it due to side effects, as well as patients with limited benefit from medical treatment. We think that the major advantages of the procedure are that there are no complications after the procedure, no need for general anesthesia or sedation, easy, and repeatable.

Ethics Committee Approval: The Eskişehir Osmangazi University Clinical Research Ethics Committee granted approval for this study (date: 30.04.2019, number: 42).

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