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ORIGINAL ARTICLE

Fluoroscopy-guided genicular nerves pulsed radiofrequency for chronic knee pain treatment

Kronik diz ağrısı tedavisinde fluoroskopi-destekli genikular sinir pulsed radyofrekans uygulaması

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Summary

Objectives: The primary objective of this study was to investigate the effects of Pulsed RF application in the genicular nerve on pain and function in patients with osteoarthritis (OA) and its side effects.

Methods: This study was conducted between February 2018 and June 2018. Patients who were previously administered diagnostic blocks were evaluated a day later; a drop of at least 50% in numeric pain scores was considered a positive response, and these patients were included in the Pulsed RF neurotomy procedures. Radiofrequency (RF) cannula was advanced towards targeted nerves under the guidance of fluoroscopy. RF lesions were created by applying Pulsed RF treatment to the three genicular nerves three times with five minutes intervals at 42 °C using NT1000 RF Generator. Following the Pulsed RF application, 2 mL 0.5% bupivacaine was injected into each genicular nerve as an anesthetic agent. VAS, pain DETECT scores, WOMAC scores were evaluated preoperative baseline and postprocedure weeks 1, 4, and 12. Patient Global Impression of Change (PGIC) score was evaluated postprocedure weeks 12.

Results: This study included 20 patients who were administered genicular nerve Pulsed RF. The mean age was 55.2±3.24 years, and F/M ratio was 12/8. Compared to the pre-procedure period, patients' pain and function evaluation, WOMAC and VAS values decreased by approximately 50% at the end of the 12th week. No side effect was observed in any patients.

Conclusion: Our findings suggest that Pulsed RF neurotomy of the genicular nerves is an efficient and safe treatment method for patients with chronic knee osteoarthritis.

Keywords: Genicular block; osteoarthritis; pulsed RF.

Özet

Amaç: Bu çalışmamızda, primer olarak genikular sinire Pulsed RF uygulamasının diz osteoartrit (OA) hastalarında ağrı ve fonksiyon üzerine etkisini ve yan etkilerini araştırmayı amaçladık.

Gereç ve Yöntem: Bu çalışma, Şubat 2018-Haziran 2018 tarihleri arasında gerçekleştirildi. Daha önceden tanı bloğu yapılan hastalar bir gün sonra değerlendirildi, sayısal ağrı skorlarında en az %50 oranında bir düşüş pozitif yanıt olarak kabul edilerek bu hastalar Pulsed RF nörotomi işlemine dahil edildi. Hastaların genikular sinir (GN) dalları USG ile tanımlandı ve floroskopi klavuzluğunda hedef sinirlere radyofrekans (RF) kanülü ilerletildi. Ön-arka ve yan görüntü ile RF kanülü ucunun yeri görüntülendi. Ardından RF bir NT1000 RF Jeneratörü kullanılarak 42 °C'de üç kez beş dakika ara ile 3 genikular sinirlere Pulsed RF tedavisi uygulayarak RF lezyonları oluşturdu. Pulsed RF uygulaması sonrası, herbir genikular sinire 2ml lokal anestezik olarak bupivakain %0,5 enjekte edildi. İşlem öncesi bazal ve işlem sonrası 1, 4 ve 12. haftalardaki sonuç ölçümleri (VAS, pain DETECT skorları, WOMAC skorları) ve Patient Global Impression of Change (PGIC) skoru değerlendirildi.

Bulgular: Genikular sinir Pulsed RF uygulanan 20 hasta dahil edildi. Hastaların yaşı (ort±SS) 55.2±3.24, K/E oranı ise 12/8 olarak değerlendirildi. Hastaların ağrı ve fonksiyon değerlendirme WOMAC skorları ve VAS değerleri işlem öncesi dönemle karşılaştırıldığında 12. haftanın sonunda yaklaşık %50 oranında azalma gözlenmiştir. Hiçbir hastada da yan etki gözlenmemiştir.

Sonuç: Sonuç olarak, genikular sinirlerin pulsed RF nörotomisinin kronik diz OA hastaları için etkili ve güvenli bir tedavi yöntemi olduğunu düşünmekteyiz.

Anahtar sözcükler: Genikular blok; osteoartrit; pulsed RF.

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Introduction

Chronic knee osteoarthritis (OA) is a condition characterized by severe pain and joint stiffness, showing a tendency to affect the geriatric age group.[1] Conventional ad surgical treatment methods can be applied in addition to oral analgesics in patients with chronic knee OA. Intraarticular corticosteroids injection, acupuncture, physical therapy and rehabilitation and prolotherapy are among the various conservative treatment methods.[2, 3] The disease can be treated with knee arthroplasty if conservative and injection-based treatments do not provide relief.[4] Although total knee joint arthroplasty is a successful treatment option in these patients, the surgical applications associated with increased rates of morbidity and mortality in patients are at high risk.[5]

Recently, radiofrequency thermocoagulation (RFT) of the genicular nerves, which is offered to the patients in whom conventional methods are insufficient and who rejected operation due to comorbidity, is applied as an alternative method in the treatment of refractory knee OA pain.[6–9]

The knee joint is usually innervated by the femoral, peroneal, saphena, tibial, and obturator nerves that are known as the genicular nerves. Superomedial, inferomedial, and superolateral genicular nerve branches are the target nerves for RF because they are the articular branches providing the main innervation of the knee joint, and they can be easily localized as bone landmarks under fluoroscopy since they are adjacent to the bone periosteum.[10]

In general, a diagnostic genicular nerve block (GNB) with local anesthetics is performed before RFT, and GNB is considered to show the need for genicular RFT.[11]

In this study, we primarily aimed to investigate the effects of the Pulsed RF application in the genicular nerve on pain relief, functions and probable side effects in patients with osteoarthritis (OA).

Material and Method

This study was conducted between February 2018 and June 2018 after receiving approval from the Institutional Ethics Committee. Each patient gave written informed consent to involve in this study. Patients were informed in detail about the scientific basis and possible risks and benefits of the treatment they would be administered.

Patients who presented to the algology outpatient clinic with osteoarthritis-character chronic knee pain, grade ≥2 knee osteoarthritis according to the Kellgren-Lawrence grading confirmed with imaging, and who failed conservative treatment, rejected operation or were not eligible due to comorbidity, and patients with a drop of at least 50% in genicular nerve block were included in this study.

Patients with acute knee pain, previous knee surgery, other connective tissue disorders affecting the knee, serious neurologic or psychiatric disorders, those had previously received radiofrequency ablation therapy for similar symptoms, and patients with accompanying radicular pain, contraindications for genicular nerve block or genicular nerve RF (active infection, bleeding disorders, current use of anticoagulants or antiplatelets, allergy against the drugs used during the protocol, pregnancy, cardiac pacemaker) were excluded from this study. Patients who previously administered diagnostic blocks were evaluated a day later; a drop of at least 50% in numeric pain scores was considered a positive response, and these patients were included in the Pulsed RF neurotomy procedures.

Patients' demographics (age, gender, height, and weight) were recorded. VAS, pain DETECT scores, WOMAC scores were evaluated and recorded preprocedurely and 1, 4, and 12 weeks after intervention. Patients were evaluated by a blinded independent physician. Resting pain intense of the patients was measured with 10 cm visual analogue scale (VAS) pain score (0= no pain, 10= the most severe pain). Pain DETECT score is a simple, verified, patients based, and easy to use screening questionnaire used to determine the prevalence of neuropathic pain component. A score between 0-12 points suggests the presence of a neuropathic pain component. A score between 12-19 points indicates a possible neuropathic component, while a score between 19-38 points suggests >90% possibility of neuropathic pain. Kellgren-Lawrence (KL) grading is a radiography based method evaluating joint disorder as mild, moderate and severe. The scale assesses joint space

narrowing, presence of osteophyte, subchondral sclerosis, and bone deformity. The functional evaluation of the patients was made using the Western Ontario and McMaster Universities Osteoarthritis (WOMAC) index. The index has three subscales to evaluate pain (5 items), stiffness (2 items), and physical function (17 items). In addition, Patient Global Impression of Change (PGIC) score (1-7 points as 1=No change, 2=Almost the same, 3=A little better, 4=Somewhat better, 5=Moderately better, 6=Better, 7=A great deal better).

Patients were oxygenated with a nasal cannula before Pulsed RF. Pulsed RF was performed with appropriate monitoring and taking aseptic measures. Inferomedial, superomedial, and superolateral GN branches of the patients were identified with ultrasonography, and a 22 Gauge, 10 cm radiofrequency (RF) cannula with a 10 mm active tip was advanced to the targeted nerves under fluoroscopy guidance. The location of the RF cannula was visualized by anterior-posterior and lateral images. Sensory stimulation was applied at 50 Hz to determine the nerve position. Since the sensory stimulation threshold must be <0.6 V, nerve position was tested with the absence of fasciculation in the relevant area of the lower extremity upon 2.0 V stimulation at 2 Hz.

RF lesions were created by applying Pulsed RT treatment to the three genicular nerves for five minutes three times at 42 °C using NT1000 RF generator. The procedure was completed in 15 minutes for one knee.

Following the Pulsed RF application, 2 mL 5% bupivacaine was injected into each genicular nerve as an anesthetic agent.

After the procedure, patients were advised to continue their previously prescribed drugs for the other degenerative disease, as well as for knee OA. Patients were not allowed to make any change in their drugs and to perform physiotherapy over 12 weeks following the procedure.

Primary outcomes were the rate of the patients with mean changes in the baseline knee pain measured with VAS at 1st, 4rd, and 12th weeks, and at least 50% knee pain relief achieved after 12 weeks. Secondary outcomes included functional changes (Western Ontario and McMaster Universities (WOMAC) Index) and side effects. All side effects (e.g. abnormal proprioception, numbness, paresthesia, neuralgia, and motor weakness) were recorded.

Statistical Analysis

Data analysis was performed using SPSS v 22.0 package software (SPSS Inc, Chicago, IL, USA). The normality of the quantitative variables was tested using the Kolmogorov Smirnov test. One way ANOVA test was used in the comparison of normally distributed dependent groups and descriptive statistics were expressed as mean±standard deviation. Friedman test was used for the comparison of skewed dependent groups, and descriptive statistics were expressed as median (25.–75. percentile). $p<0.05$ values were considered statistically significant.

Results

This study included 20 patients with 50% relief after diagnostic block, who were then administered genicular nerve Pulsed RF. The mean age was 55.2±3.24 years, and F/M ratio was 12/8. The demographic data of the patients are shown in Table 1.

When pain and functional evaluation WOMAC scores of the patients were compared with the values before the procedure, approximately 50% decrease was observed at the end of the 12th week. In addition, VAS values also decreased by 50% compared to preprocedure values. According to the pain DETECT questionnaire evaluating neuropathic pain of the patients, we found that the pain showed neuropathic character, and there was a decrease following Pulsed RF compared to pretreatment values (Table 2) (Figs. 1a, b).

Based on PGIC evaluation scale, the mean global change efficiency was found as 2.5±0.75 (25% Percentile: 2, 75% Percentile: 3). Of all patients, 10%

Table 1. Demographic features of the patients

	Mean.±SD / %
Age (years)	55.2±3.24
Gender F/M	12 (60) /8 (40)
BMI (kg/m^2)	28.4±1.03

SD: Standard deviation; BMI: Body mass index.

Table 2. Pain/function evaluation of the patients

	WOMAC pain	WOMAC sniffness	WOMAC function	WOMAC total	Pain detect	VAS
Before procedure						
Medyan/25–75 percentile	20/18–24	7/2–8	44.5/35–65	74.5/59–98	10.5/9–21	8/8–9
1st weeks						
Medyan/25–75 percentile	7.5/5–14	2.5/2–4	22.5/20–38	33/29–52	4.5/2–7	2/1–4
4rd weeks						
Medyan/25–75 percentile	8.5/5–15	2.5/2–4	27/22–40	35/30–54	5/2–7	3.5/1–5
12th weeks						
Medyan/25–75 percentile	9.5/6–16	3.5/2–4	28.5/23–40	39.5/29–60	5.5/3–7	4/2–5
p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

WOMAC: Western Ontario and McMaster Universities Osteoarthritis; VAS: Visual analogue scale.

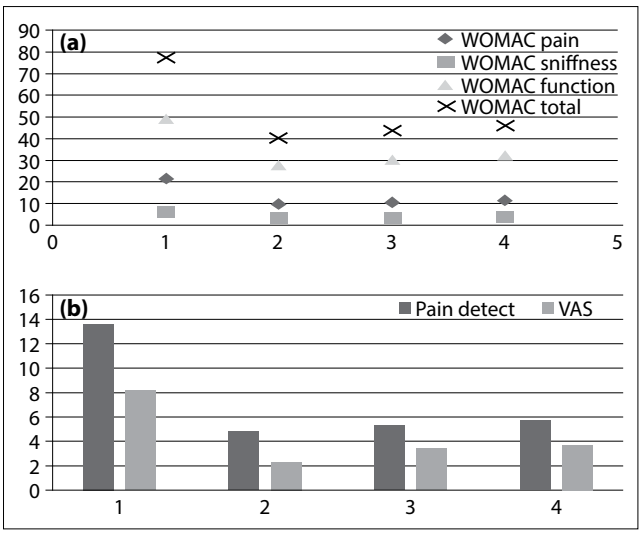

Figure 1. (a) Comparison of pre- and postprocedure functional status of the patients. **(b)** Comparison of pre- and postprocedure pain DETECT and VAS values of the patients.

(n=2) were assessed as 'a great deal better', 40% (n=8) as 'better', 45% (n=9) as 'somewhat better', and 5% (n=1) as 'no change'.

Discussion

This findings obtained in this study suggest that genicular nerve Pulsed RFT provided clinically significant improvements at a 12-week follow-up of the knee pain and function scores in patients with chronic pain due to knee osteoarthritis.

Two articular arms were determined in the knee as anterior and posterior groups. The nerves in the anterior arm include branches of the femoral, common peroneal, and saphena nerves. The posterior group consists of articular branches of the tibial, obturator, and sciatic nerves.[12, 13] Tibial nerve forms articular branches in the popliteal fossa and is responsible for the innervation of the medial and posterior side of the knee joint. Articular arms of the common peroneal nerve innervate inferolateral and anterolateral sides of the articular capsule.[13, 14] The literature supports the ablation of the superior medial, superior lateral, and inferior medial genicular nerves.[15–18] However, the inferior lateral branch is avoided because of its proximity to the common peroneal nerve and the risk for motor neural damage and foot drop.[19]

Kesikburun et al.[20] underlined that Pulsed RF treatment to the superomedial and inferomedial genicular branches is sufficient for pain relief in medial compartment osteoarthritis.

In our study, we used the genicular arteries as landmarks when defining inferomedial, superomedial, and superolateral branches with ultrasonography. The genicular arteries could be easily identified with color Doppler in the junction of tibia and femur shaft and epiphysis. Then RF cannula was directed toward the targeted nerve under fluoroscopy.

RF is an alternative current type that brings about the heat in the targeted tissues by providing friction between the molecules. Therefore, a thermal lesion is formed with the heat generated from this current.[21] In general, a local-anesthetic diagnostic genicular nerve block (GNB) is performed before the RF genicular ablation. A successful response to GNB determines the need for RF to the genicular nerve. However, one study has shown that GNB is as effec-

tive as RF genicular ablation when administered with corticosteroids.[11] Adjuvant corticosteroid therapy may contribute to and prolong the analgesic effect of local anesthesia, but despite the other reports analgesic effect of corticosteroids on peripheral nerve block is still controversial.[22]

In has been stated in a study that the addition of a corticosteroid during GNB for chronic knee pain can prolong analgesic effect and increase functional capacity in the short term; however, the clinical benefit of the additional corticosteroid is not significant when compared to the benefit of a local anesthetic alone.[23]

In our study, local anesthesia injection was made for the diagnostic block, and a drop of by at least 50% in the numeric pain scores within a period longer than 24 hours was considered as a positive response and included in Pulsed RF ablation procedures. No adjuvant was added to the local anesthetic.

Rajiv et al.[24] administered unilateral or bilateral cRFA in four patients with pain relief of 80% from the diagnostic genicular nerve block before the ablation, and reported improvements by 80-100% in knee pain, function and using analgesic drugs at six to 12-month follow up in all patients. Mc Cormick et al.[25] showed clinically significant improvement concerning pain, physical function, and psychologic function up to approximately six months in about half of the patients who underwent genicular nerve cRFA for chronic pain associated with knee osteoarthritis. The authors underlined that a prognostic genicular nerve block used as a threshold of 50% pain relief for conformity of 1 mL local anesthetic volume and subsequent cRFA in each injection region did not improve the rate of treatment success.

In general, conventional RF, which is preferred for patients who are candidates for knee replacement and have knee osteoarthritis, and leads to permanent damage, is applied in the genicular nerve branches.
In this study, Pulsed RF, which does not cause thermal lesions in the genicular nerve and prevents any nerve destruction that may lead to Charcot joints and neuropathic pain, was administered under fluoroscopy in patients with osteoarthritis related knee pain.

In their study investigating the effectiveness of RF genicular neurotomy in chronic knee pain due to osteoarthritis concluded that there was a significant improvement in pain and satisfaction in the RF treatment group, RF neurotomy of the genicular nerves is a safe, efficient, and minimal invasive treatment method.[7]

In our study, we noted a decrease by 50% pain and functional status scores in the 4th and 12th weeks compared to the preprocedural values as a result of the Pulsed RF application to the genicular nerves in patients with knee pain unresponsive to conservative treatments and who underwent GNB.

The neuropathic processes involving both sensory and motor nerves make OA knee pain a product of neuromyopathy rather than just neuropathy. The motor neuropathy presumably has the potential to directly produce structural changes in the joint by altering the tension in the muscles, acting across the patellofemoral and tibiofemoral joints.[26]

Pain DETECT questionnaire is a reliable and simple screening tool to estimate the presence of neuropathic pain component in chronic pain disorders. The questionnaire can be easily applied to the patients by medical personnel before the physical examination.[27]

In the present study, a pain DETECT questionnaire was applied in all patients to determine the neuropathic component of the pain before prognostic GNB application, and the pain was evaluated again with this questionnaire before the physical examination at follow-ups of the patients.

While we were evaluating for the complication, we did not observe any complications, which is consistent with the literature. Therefore, we think that the Pulsed RF method is safe in the treatment of osteoarthritis-related knee pain.

Our study has some limitations. First, the lack of a control group was a disadvantage. Second, we could have preferred a longer duration of follow-up. Third, we did not assess the emotional status of the patients, which might affect the perception of knee pain.

In conclusion, we believe that Pulsed RF neurotomy of the genicular nerves is an efficient and safe treatment

method for patients with chronic knee osteoarthritis who give a positive response to the diagnostic block. Further controlled, randomized studies with larger series and longer follow up durations are needed.

Ethical Approval: University of Necmettin Erbakan, Medical Faculty (2018/1356).

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