Long-Term Effects of Pulsed Radiofrequency Application in Patients with Chronic Knee Osteoarthritis

Kronik Diz Osteoartritli Hastalarda Pulsed Radyofrekans Uygulamasının Uzun Dönemdeki Etkinliği

Pulsed Radiofrequency Application in Patients with Chronic Knee Osteoarthritis

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Özet

Amaç: Orta ve ileri yaşlarda diz ağrısının en önemli nedeni diz osteoartritidir (OA). OA tedavisinde pulsed radyofrekans (PRF) alternatif bir tedavi olarak kullanılmaktadır. Bu çalışmada intra-artiküler PRF uygulanmış diz OA hastalarında, PRF'nin klinik ve fonksiyonel durum üzerine etkinliğinin uzun dönem sonuçlarının değerlendirilmesi amaçlandı. Gereç ve Yöntem: Mart 2016-Ağustos 2016 tarihleri arasında, en az 1 yıldır devam eden ve çeşitli konservatif tedavi yöntemleri ile ağrı kontrolü sağlanamadığından intraartiküler PRF uygulanmış diz ağrısı olan 7 hastanın kayıtları geriye dönük olarak incelendi. Ağrı değerlendirilmesi VAS ölçeği, diz eklem fonksiyonunun değerlendirilmesi WOMAC indeksi ile yapıldı. Çalışmanın değerlendirmeleri erken dönem olarak birinci ayda, uzun dönem olarak da altıncı ayda gerçekleştirildi. Bulgular: Başvuru anında hastaların VAS skoru (VAS) ortalama 8±0,81 iken tedavi bitiminden sonraki 1.ay ve 6.ay kontrollerinde VAS skoru ortalaması sırasıyla 1,71±0,75 ve 1,86±0,69 idi. Tedavi öncesi WOMAC skoru (WOMAC) ortalama 69,5±4,92 iken tedavi sonrası 1. ve 6. aylardaki WOMAC ortalama skoru sırası ile 41,57±8,05 ve 40,86±7,08 idi. Tartışma: PRF'nin diz ağrısının tedavisinde başarılı bir şekilde kullanılabileceği ve bu yöntemle hastaların analjezik gereksinimlerinin ve analjeziklere ait yan etkilerin azaltılabileceğini düşünmekteyiz.

Anahtar Kelimeler

Pulsed Radyofrekans; Diz; Osteoartrit

Abstract

Aim: Knee osteoarthritis (OA) is the most important reason for knee pain in middle- and advanced- aged patients. In the treatment of OA, pulsed radiofrequency (PRF) has been used as an alternative treatment modality. In this study, we aimed to evaluate long-term results of PFR on the clinical and functional states of the patients with knee OA who received intra-articular PFR injections. Material and Method: We retrospectively scanned the medical files of 7 patients whose knee pain persisted for at least one year but whose pain could not be controlled with various conservative treatment methods between March 2016 and August 2016 and who required intra-articular PFR application. Pain was evaluated using a VAS scale and the function of the knee joint with the WOMAC index. The study data were evaluated as early as the first month and at the sixth month in the long-term. Results: Mean VAS scores of the patients at the time of presentation and at 1 and 6 months after termination of the treatment were 8±0.81, 1.71±0.75, and 1.86±0.69 points, respectively. Mean WOMAC scores before and at 1 and 6 months after termination of the treatment were 69.5±4.92, 41.57±8.05, and 40.86±7.08 points, respectively. Discussion: We think that PRF can be successfully used in the treatment of knee pain, while decreasing analgesic use and its side effects.

Keywords

Pulsed Radiofrequency; Knee; Osteoarthritis

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Introduction

Osteoarthritis (OA) is the most frequently encountered form of arthritis. It is pathologically characterized by fibrillation and thinning of joint cartilage, sclerosis of subchondral bone, cysts, osteophyte formation, and deformity [1]. The most important cause of knee pain seen in advanced age is knee osteoarthritis. Pain and restriction of knee movements are frequently seen and lead to serious disability [2].

Currently there are two targets in the treatment of OA: 1) to decrease the severity of pain and functional restrictions; and 2) to slow down degeneration of cartilage. To this end, prophylactic pharmacological treatment methods, experimental methods, and various physical therapy modalities, especially thermal and surgical treatments, have been used.

Thermal therapies are categorized in two classes as superficial and deep therapies. Paraffin, peloid, and warm water pads create a superficial thermal effect, while thermal effects of ultrasound and electromagnetic waves penetrate into deeper tissue layers [3]. Pulsed radiofrequency energy (PRF) is applied at high voltage (typically 45 V). During PRF, 20 msec pulses at a frequency of 500 kHz are emitted, followed by a resting silent period of 480 msec [4]. As a result, tissue temperature does not exceed 42oC because of these prolonged silent intervals. Since tissue temperature remains at 45o-50oC, the accepted threshold of irreversible tissue damage, adverse reactions such as permanent tissue damage and neuritis are not seen [5]. Although PRF is frequently applied, its mechanism of action has not been fully understood. Instead its neuromodulatory effects have been suggested. As a novel method, intra-articular PRF has been in use since the year 2008 [6].

In this study we aimed to test the effects of intra-articular PRF application on the clinical and functional states of the patients with knee OA and to evaluate long-term outcomes of PRF applications.

Material and Method

Patients selected among those who were followed up and received intra-articular PRF because of chronic knee pain were included in this study.

Patient selection

Medical files of the patients who underwent PRF applications because of chronic knee pain between March 2016 and August 2016 were retrospectively analyzed. Seven patients with the diagnosis of osteoarthritis based on criteria recommended by ACR (American College of Rheumatology) who demonstrated radiological changes suggesting stage ≥ 2 OA according to the Kellgren-Lawrence (K/L) staging system and who received intra-articular PFR treatment because of intractable pain persisting for at least one year, despite application of various conservative treatment methods, were included in the study. Exclusion criteria for PRP application were as follows: (1) Stage 4 patients according to the Kellgren-Lawrence classification (7); (2) patients with bleeding diathesis, those receiving anticoagulant treatment, and cases demonstrating contraindications to injections, including systemic or local infections; [3] other tissue diseases affecting the knees; [4] application of intra-articular steroid or hyaluronic acid injection within the previous six months; [5] presence of serious neurologic and psychiatric disorders.

PRF application

In all applications, following standard monitoring, the patient was seated on a chair. The region to be intervened was cleansed with iodine-based antiseptic solution, then the point of access at the lateral side of the knee joint was palpated. Lidocaine (1%) solution was injected into the skin and subcutaneous layers and a 10 mm-long 22 G RF introducer with an active tip (NeuroThermTM, Medipoint GmbH, Hamburg, Germany) was inserted into the joint. Then 2 Hz 20 msec PRF was applied at 42C for 900 seconds. Since the application was not painful, sedo-analgesia was not used. After completion of the procedure, the probe was removed together with the needle, and the injection site was closed with a gauze pad. The patients were kept under the surveillance of the nurse for half an hour following the procedure to monitor for early-phase complications. The patients were asked not to receive any subsequent medical treatment or physiotherapy for pain relief.

Evaluation criteria

A VAS scale was used to evaluate pain and the WOMAC index was used to evaluate the functions of the affected knee joint.

Intensity of pain at the resting state was measured using a VAS scale (0=no pain; 10=the most severe pain). For functional evaluation of the patients, the WOMAC (Western Ontario and McMaster's Universities Osteoarthritis) index was used. With the WOMAC index, disability can be analyzed from the three aspects of pain, joint stiffness, and functional state. The WOMAC index contains a total of 24 items including questions about pain (5 questions), joint stiffness (2 questions), and disability (17 questions) [8]. The total score was determined as the percentage of 24 questions which equaled 96 points (0%= no complaint, 100%=very severe complaints). These evaluation methods were utilized at baseline and at 1 and 6 months after the PFR procedure and the results were recorded in the patient files. Post-procedural complications and side effects were also recorded. The study results were evaluated in the short term at first months and in the long term at sixth months.

Statistical analysis

Because this was a retrospective study, power analysis couldn't be applied. Statistical analysis of the study was performed using IBM SPSS version 21. In the comparison of repeated measures, the Friedman test and One-Sample T-Test were employed for continuous variables. $P<0.05$ was accepted as the level of significance.

Results

The study cases were radiologically evaluated using the Kellgren-Lawrence staging system. Stage 2-3 OA patients who received the diagnosis of knee osteoarthritis based on ACR criteria and who had been complaining of chronic knee pain persisting for more than 5 years were included in the study. There was a total of 7 patients. The mean age was 54.43±4.42 years (range 48-60 years) and they had been complaining of knee pain for a mean duration of 9.29±3.68 years. Median BMI was calculated as 27.58 kg/m2. Age, gender, BMI, duration of pain, and pre- and post-treatment VAS and WOMAC scores of the patients are shown in Table 1. Mean VAS scores at first

Table 1.

	VAS			WOMAC		
	Mean±SD	95 % CI group Difference	SE	Mean±SD	95 % CI of the Difference	SE
Pretreatment	8±0,81	7,24 to 8,76	0,309	69,5±4,92	65,00 to 74,10	1,859
At 1 months	1,71±0,75	1,02 to 2,41	0,286	41,57±8,05	34,12 to 49,03	3,046
At 6 months	1,86±0,69	1,22 to 2,50	0,261	40,86±7,08	34,31 to 47,41	2,676
p(0-1months)	0,008 (p<0,05)			0,008 (p<0,05)		
p(1-6months)	0,564 (p>0,05)			1,000 (p>0,05)		

*Friedman test.
VAS: Visual Analog Scale; WOMAC: The Western Ontario and McMaster Universities Arthritis Index
Mean±SD: Mean Value and Standard Deviation; CI: Confidence Interval; SE: Standard Error

presentation and at post-treatment 1- and 6-month control visits were 8±0.81, 1.71±0.75, and 1.86±0.69 points, respectively. Mean WOMAC scores at baseline and at post-treatment 1- and 6 month control visits were 69.5±4.92, 41.57±8.05, and 40.86±7.08 points, respectively. A statistically significant decrease was detected between VAS scores calculated before PRF and at post-treatment 1 month (p=0.008). However, a significant difference was not detected when post-treatment 1- and 6-month VAS scores were compared, which indicated persistence of the treatment effect (p=0.564). WOMAC scores of the cases also paralleled the VAS scores. A statistically significant drop was seen between pre-PRF and post-PRF 1-month WOMAC scores (p=0.008). However, a significant difference was not found between post-PRF 1- and 6-month WOMAC values. These results indicate persistence of the treatment effect (p=1.000). Pre- and post-PRF VAS and WOMAC scores are shown in Table 1.

Discussion

RF has been used for years in the treatment of some painful diseases. In conventional RF, tissue damage is created, while the PRF technique is a clinically non-destructive application. PRF injection into the knee joint has reportedly achieved clinical and functional improvement [9]. However, its mechanism of action has not yet been clarified. Whereas most of the studies have indicated induction of an alteration in synaptic conduction through a neuromodulator effect [10], Karaman et al. [9] stated that PRF may exert its effect via suppression of excitatory C fibers and inhibition of synaptic conduction. Also, an impact originating from the immune system might reduce the severity of pain with radiofrequency treatment applied on major joints such as the knee joint. It has been also reported that electromagnetic fields induced by pulsed RF exert immuno-modulator effects on immune cells and pro-inflammatory cytokines as interleukine 1-β, tumor necrotizing factor α, and interleukin- 6. Injection of PRF into knee OA also can be applied on nerves of the knee joint. However, it is not known whether injury of nervous tissue causes muscle weakness in the long term. By contrast, the beneficial effects of intra-articular applications have been conceived.

Table 2.

	Age (years)	BMI (kg/m2)	Pain duration (years)	**KL grade	**Gender (f/m)
Case 1	48	30,8	6	2	F
Case 2	57	29,6	12	3	F
Case 3	60	24,4	16	3	M
Case 4	54	25,1	8	2	F
Case 5	52	32,9	7	2	F
Case 6	51	22	6	2	F
Case 7	59	28,3	10	3	M
Mean Value	54,43	27,58	9,29		f:5 m:2
±SD	±4,42	±3,88	±3,68		
SE	1,674	1,46	1,39		
95 % CI	50,33 to 58,53	23,99 to 31,18	5,88 to 12,69		

*One-Sample T-Test.
BMI: Body Mass Index; KL: Kellgren-Lawrence; SD: Standard Deviation; SE: Standard Error; CI: Confidence Interval of the difference
**no mean value nor CI calculated for KL grade and gender.

In a study where Masala et al. [11] evaluated the effectiveness of PRF on pain, they detected a dramatic decrease in the severity of pain at the first, fourth, twelfth weeks, and sixth month. They indicated that PRF did not induce tissue damage; on the contrary, PRF induced ultrastructural changes in especially nociceptive fibers (C and A delta).

In a study performed by Karaman et al. [9], the researchers demonstrated effectiveness of PRF application on chronic knee pain. Takahashi et al. applied RF 10 minutes after intra-articular hyaluronic acid injection and indicated that RF alleviated severity of pain by denervating peripheral free nerve terminals found in subchondral bone due to increase in intra-articular temperature [12].

In a series of 6 cases performed by Sluijter et al. [13], PRF was also applied intra-articularly for shoulder, cervical facet, sacroiliac, radiocarpal, and atlanto-axial joints in addition to the knee joint, resulting in significant improvements in moderate- and long-term VAS scores. In this study we retrospectively evaluated patients who received intra-articular PFR applications because of chronic knee pain associated with osteoarthritis that had not responded to conservative treatment modalities. When compared with pre- PRF application, more than fifty percent decrease in VAS pain scores at the first and sixth post-procedural months was noted. Similar outcomes were obtained in our study when compared with the literature findings.

It is known that alleviation of pain in patients with knee OA may improve patellar functions. In a study performed by Vas et al. [14], the researchers applied intra-articular injections for 10 patients and reported a significant decrease in post-procedural WOMAC scores up to 6 months [14]. Our study evaluated not only the severity of pain but also the functional state of the patients. We detected a statistically significant decrease in short- and long-term WOMAC scores following the PRF procedure.

In conclusion, we think that PRF can be used successfully in the treatment of pain associated with chronic knee osteoarthritis, while decreasing analgesic use and its side effects. Since long-term outcomes of PRF administration are not yet known, further studies with long-term follow-up periods are needed.

Competing interests

The authors declare that they have no competing interests.

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