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The genicular nerve: radiofrequency lesion application for chronic knee pain*

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Background/aim: We investigated the short- and medium-term effectiveness of genicular nerve radiofrequency (RF) applied in patients with chronic knee pain due to osteoarthritis.

Materials and methods: Radiofrequency was performed in 49 patients with a diagnosis of knee osteoarthritis. VAS and WOMAC were measured at baseline and at 1, 4, and 12 weeks postprocedure. Under fluoroscopic guidance, the cannula was advanced percutaneously towards the area connecting the shaft to the epicondyle. The RF electrode was inserted through the cannula and the electrode tip temperature was raised to 80 °C for 90 s. One RF lesion was made for each genicular nerve.

Results: Mean patient age was 64 ± 10.6. VAS score before the procedures was 8.9 ± 0.8, while 1, 4, and 12 weeks after the procedure it was 4.73 ± 3.23, 3.89 ± 2.9, and 3.93 ± 2.95, respectively. WOMAC score before the procedures was 64.26 ± 7.29, while 1, 4, and 12 weeks after the procedures it was 44.93 ± 13.18, 42.81 ± 13.15, and 43.04 ± 13.36, respectively.

Conclusion: RF neurotomy of genicular nerves led to significant pain reduction and functional improvement in a subset of elderly patients with chronic knee osteoarthritis pain, and thus may be an effective treatment in such cases.

Key words: Chronic pain, osteoarthritis, knee, genicular nerve, catheter ablation, radiofrequency

1. Introduction

Osteoarthritis is a widespread health problem throughout the world, with 20%– 30% of patients aged over 65 years reported as symptomatic (1). The primary symptoms of osteoarthritis patients are knee pain, joint stiffness and instability, functional restriction, and muscle weakness (2).

In the conservative treatment of osteoarthritis-related chronic knee pain, analgesics, physical therapy, intra-articular steroids, opioid, nonsteroidal anti-inflammatory drugs (NSAIDs), local anesthetic, and visco-supplementation are applied (3–6). The use of NSAIDs as pharmacological treatment is limited because of serious side effects such as gastro-intestinal ulcers and bleeding. Intra-articular steroids, hyaluronic acid, acupuncture, or periosteal stimulation are interventional procedures that are often applied as complementary treatments but are not sufficient for pain control in severe osteoarthritis (2). As these treatments are sometimes unsuccessful, surgical interventions such as arthroscopy or total knee replacement are required. However, surgical interventions may not be possible because of comorbidities in the patient (7). Therefore, radiofrequency neurotomy (RFN) applied to the genicular nerve may be an alternative treatment method that can be applied successfully with few complications.

The RFN procedure reduces pain and improves patient functions by blocking transmission of the sensory nerves (8). Innervation of the knee joint is supplied by the articular branches of the femoral, common peroneal, saphene, tibial, and obturator nerves (9–14). These articular branches around the knee are known as genicular nerves and they can be easily reached percutaneously under fluoroscopy guidance (8).

The aim of the present study was to examine the efficacy on pain and functional recovery in the short and medium term of the application of radiofrequency applied to the genicular nerve of osteoarthritis patients with chronic knee pain.

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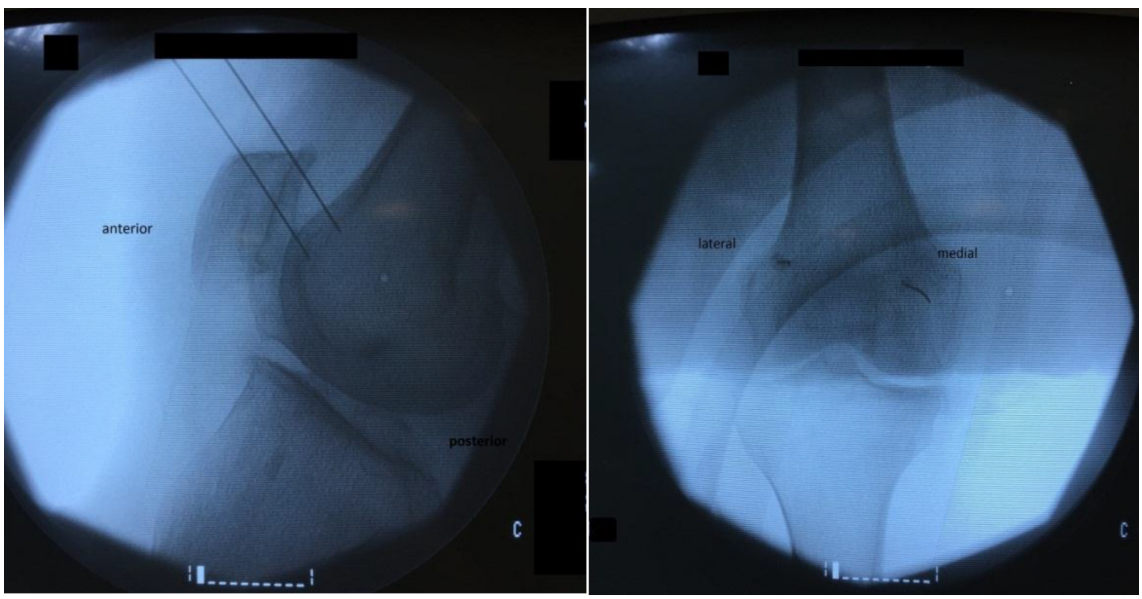
2. Materials and methods

Approval for the study was granted by the Local Ethics Committee. A total of 49 patients aged 55–75 years were included in the study between June 2014 and 2015 at Süleyman Demirel University Medical Faculty, Anesthesiology and Reanimation Department, Pain Clinic. Patients included were at Stage 2–4 according to the Kellgren–Lawrence classification of diagnostic criteria of the American Rheumatology Association DOA (11), and had not responded to a 6-month period of conservative treatment such as physiotherapy, analgesics, or intra-articular steroid or hyaluronic acid injection. Patients were excluded from the study if they had acute knee pain, a history of knee surgery, connective tissue disease affecting the knee, intra-articular injection within the last 6 months, severe neurological or psychiatric disease, sciatic pain, use of anticoagulants, systemic infection or localized infection in the procedure area, or if they had a cardiac pacemaker.

The technique and benefits and potential complications of the procedure were explained to the patients, written informed consent was obtained, and then the patients were taken to the procedure room. An intravenous vascular route was opened and standard monitorization (ECG, arterial tension, pulse oximetry) was applied. The patient was placed on a fluoroscopy table in a supine position with a cushion placed under the popliteal fossa and then 2 mg of iv midazolam was administered. The intervention area was cleaned with an iodine-based antiseptic solution and sterile draped. Under AP fluoroscopy, the tibiofemoral joint point was identified at an equal distance from both sides of the joint space. Local anesthetic of 1% lidocaine was applied to the application point. A 22-gauge RF cannula 10 cm in length with a 10-mm active tip was used for this procedure. The cannula was advanced percutaneously with the tunneling method under fluoroscopy to the area where the shafts of the femoral and tibial bones joined the epicondyles until contact was made with the bone. After placement of an RF electrode within the RF cannula, RF generator sensory stimulation was applied at 50 Hz and 0.6 V to determine whether or not it was on the target nerve. When the patient felt pain, whether fasciculation occurred or not was checked in the extremity by applying RFN at 2 Hz and 2 V motor stimulation so as not to affect the motor nerves. When there was no fasciculation, the RF procedure was applied separately to each genicular nerve in lesion mode for 90 s at 80 °C (Figure). After the procedure, the patient rested in the recovery room for 30 min and then was discharged with the recommendation to rest that day. Medications being used by the patient before the procedure were continued.

All the patients were evaluated pretreatment and at 1, 4, and 12 weeks after the procedure with respect to pain level and functional improvement in quality of life using a visual analogue scale (VAS) and the Western Ontario McMaster University Osteoarthritis Index (WOMAC).

VAS is a 10-cm scale measuring the severity of pain where 0 = no pain and 10 = the worst pain imaginable. WOMAC consists of a total of 24 questions under 3 main headings as 5 questions on joint pain, 2 questions on



Lateral fluoroscopic image | Anterior posterior fluoroscopic image

Figure. Lateral and anterior posterior fluoroscopic image of the left knee joint.

stiffness, and 17 questions on physical function in daily life (0 = the best score, 96 = the worst score).

Continuous variables were stated as descriptive statistics as mean ± standard deviation (SD) and categorical variables as frequency (n) and percentage (%). The patients were evaluated statistically with respect to age, sex, previous treatments, and American Society of Anesthesiologists (ASA) and Kellgren–Lawrence gradings. In the comparisons of the VAS and WOMAC values, the K-paired samples t-test was applied. A value of $P < 0.05$ was accepted as statistically significant.

3. Results

The total 49 patients comprised 83.7% females and the mean age of the whole group was 64 ± 10.6 years. The demographic characteristics of study patients are shown in Table 1.

The VAS and WOMAC values were measured and recorded pretreatment and at 1, 4, and 12 weeks after the procedure. A statistically significant improvement was seen in pain and physical functions. The VAS values are shown in Table 2. The WOMAC values are shown in Table 2 as total values comprising the pain, stiffness, and physical function

Table 1. Demographic characteristics of study patients.

Age (years) Mean ± SD	64 ± 10.6
Sex	Female n (%) 41 (83.7) Male n (%) 8 (16.3)
ASA n (%)	ASA I 12 (24.5) ASA II 26 (53.1) ASA III 11 (22.4)
Comorbidities n (%)	Morbidity 36 (73.5) No morbidity 13 (26.5)
Medication n (%)	Medication 43 (87.8) No medication 6 (12.2)
KL grade n (%) Mean ± SD: 2.85 ± 0.73	2: 17 (34.7) 3: 22 (44.9) 4: 10 (20.4)
Treatment forms applied before n (%)	No medications: 6 (12.2) Analgesic drugs (NSAIDs and/or opioid): 22(44.9) Intra-articular injection: 8 (16.3) External NSAIDs application: 13 (26.5)

KL grade: Kellgren–Lawrence grade

Table 2. VAS and WOMAC values.

	Basal value Mean ± SD	Week 1 Mean ± SD	Week 4 Mean ± SD	Week 12 Mean ± SD
VAS P value	8.9 ± 0.8	4.73 ± 3.23 <0.01	3.89 ± 2.9 <0.01	3.93 ± 2.95 <0.01
WOMAC pain P value	15.8 ± 1.64	10.55 ± 3.71 <0.01	9,63 ± 3,60 <0.01	9.71 ± 3.66 <0.01
WOMAC stiffness P value	6.48 ± 0.64	4.36 ± 1.46 <0.01	4.22 ± 1.48 <0.01	4.26 ± 1.51 <0.01
WOMAC physical functioning P value	42.46 ± 5.09	30.73 ± 8.32 <0.01	29.20 ± 8.02 <0.01	29.30 ± 8.13 <0.01
WOMAC total P value	64.26 ± 7.29	44.93 ± 13.18 <0.01	42.81 ± 13.15 <0.01	43.04 ± 13.36 <0.01

Basal values versus: VAS: Visual analogue scale WOMAC: Western Ontario and McMaster Universities OA index P value < 0.05

measured values. A statistically significant improvement was determined in all the WOMAC values and the VAS values at 1, 4, and 12 weeks posttreatment compared to the pretreatment values (Table 2). No complications such as infection, hemorrhagia, thermal injury, or sensory or motor loss in the procedure area developed in any patient.

4. Discussion

The results of this study showed that an improvement can be obtained in pain levels and daily functions with the application of RFN to patients with osteoarthritis-related chronic knee pain. There is no side effect to the RFN procedure applied to the genicular nerve. In addition to the improvement obtained in knee pain and physical functions, another significant advantage is the ease of application to elderly patients.

RFN first started to be used in the 1970s for the treatment of chronic pain that was unresponsive to conservative treatment methods (15). In the RFN procedure, after placement of the active tip RF needle close to the target nerve, an RF electrode is passed within the needle and alternating electric currents (radiowave frequency) are transferred to the nerve from the RF generator (15). Thus lysis is provided in the target nerve by raising the tissue temperature to 60–80° C (6,15,16). Following the first successful application of RFN in trigeminal neuralgia (17), it was then applied to the sacroiliac joint causing chronic back pain and the facet joints (18,19). It then started to be applied to cases of cervical facet and discogenic pain (20,21) and has also been used in cancer pain treatment (7).

According to Kennedy (14), the knee joint is innervated by the articular branches of several nerves, including the femoral, obturator, saphene, common peroneal, and posterior tibial nerves. Therefore, some knee pain may not be relieved by the RFN procedure. Genicular nerve RFN is also more invasive than other conservative methods and, as such, is preferred for application to patients who have not responded to other conservative methods. Analgesics, physical therapy procedures, intra-articular steroids, opioids, NSAIDs, local anesthetic, and visco-supplementation are all used in the conservative treatment of osteoarthritis-related chronic knee pain (3–6). NSAIDs are used extremely frequently as pharmacological treatment worldwide, but their use is limited due to the high cost and serious side effects such as gastro-intestinal ulcers and bleeding (22). The costs of the RF procedure can be considered to be lower as there is no need for long-term chronic treatment and the results are extremely good.

In a randomized controlled study by Choi et al. (8), it was shown that the application of RF reduced osteoarthritis pain compared to a control group and improved functions. In the current study, significant improvements were seen in the VAS and WOMAC scores of the patients compared to the pretreatment values. The RF procedure may be an alternative method for elderly patients who would not be able to undergo surgery. Previous studies have also shown that RF application to the genicular nerve has been successful in patients with pain following total knee prosthesis (2,23).

There were some limitations to this study. It is a disadvantage that there was no control group. There is a need for prospective, randomized, placebo-controlled studies with larger patient groups and longer-term follow-up to be able to better differentiate the efficacy of the procedure from a placebo. These future studies would be able to demonstrate the efficacy of the RF procedure more objectively.

In conclusion, the RF procedure is an effective, safe, and minimally invasive method that can be applied to the genicular nerve of patients with osteoarthritis-related chronic knee pain when there has been insufficient response to conservative treatment.

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