

Comparison of cooled and conventional radiofrequency applications for the treatment of osteoarthritic knee pain

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Abstract

Background and Aims: Osteoarthritis is a progressive degenerative joint disease that affects the joint cartilage and surrounding tissues. It has been determined that osteoarthritis-induced knee pain is the most common cause of physical disability in the elderly.

Material and Methods: In this study, the genicular nerve RF treatments of patients with osteoarthritic knee pain conducted at the Sakarya University Training and Research Hospital in the algology clinic of the Anaesthesiology and Reanimation Department between January 2016 and December 2016 were retrospectively examined. The preoperative and postoperative 2nd, 6th, and 12th week visual analog scale (VAS) and Turkish validated Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores were recorded. In addition, any complications after the treatment and side effects (bleeding, neurological damage, infection, etc.) were recorded in the file.

Results: When the data of the patients were evaluated statistically, the preoperative VAS and WOMAC scores were found significantly decreased compared with the postoperative 2nd week, 6th week, and 12th week scores in patients who applied both conventional radiofrequency (RF) and cooled RF. However, there was no statistically significant difference between the two techniques.

Conclusion: We found that both cooled and conventional RF techniques in genicular nerve ablation are similarly effective in reducing pain in patients with osteoarthritis-induced knee pain and improving patients' physical functions. The complication rates are very low and there was no superiority to each other.

Keywords: Conventional, cooled, genicular nerve, osteoarthritis, pain, radiofrequency

Introduction

Osteoarthritis is a progressive degenerative joint disease that affects the joint cartilage and surrounding tissues. It mostly affects the weight-bearing joints, and in this respect, the knee joint is one of the joints that is most affected. It has been determined that osteoarthritis-induced knee pain is the most common cause of physical disability in the elderly.^[1] The source of this knee pain is the neural network, which originates

from the tibial, peroneal, saphenous, and obturator nerves, known as genicular nerves. The superomedial branch of this neural network originates from the femoral and obturator nerve, the inferomedial branch originates from the saphenous nerve and the inferomedial branches originate from the common peroneal nerve.^[2]

Conservative treatments [physical therapy, non-steroidal anti-inflammatory drugs (NSAID)s etc.], non-surgical interventions (intraarticular injection and radiofrequency applications), and finally arthroplasty surgery can be used in

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| Quick Response Code: | Website: www.joacp.org |
|  | DOI: 10.4103/joacp.JOACP_126_19 |

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How to cite this article: Kocayığit H, Beyaz SG. Comparison of cooled and conventional radiofrequency applications for the treatment of osteoarthritic knee pain. *J Anaesthesiol Clin Pharmacol* 2021;37:464-8.

Submitted: 30-Apr-2019

Revised: 09-Feb-2020

Accepted: 28-Apr-2020

Published: 12-Oct-2021

the treatment of patients suffering from severe pain as a result of this innervation. Radiofrequency therapy can be used as a stepping treatment before arthroplasty, in the treatment of patients at high risk for arthroplasty or for ongoing pain after arthroplasty.^[3]

The application of RF to the genicular nerves of the knee joint is a newly introduced technique, and its efficacy has been demonstrated by several studies in the literature.^[2,4,5] Moreover, the cooled radiofrequency (RF) technique is an even newer application that allows the creation of wider lesions than the conventional RF technique; however, there are only a few studies in the literature reporting patients with knee pain-associated osteoarthritis undergoing genicular nerve cooled RF treatments.^[6-9]

Recently, several studies have been carried out regarding the importance of the heat and application time in RF treatment.^[10,11] When the heat applied during RF treatment was not too high, it was found that the area of activity increased, and the resulting lesion was much deeper and wider ($90 \pm 10^\circ\text{C}$ for conventional RF and $60 \pm 8^\circ\text{C}$ for cooled RF).^[10]

In this study, we aimed to retrospectively compare the effectiveness and safety of genicular nerve with cooled versus conventional heated RF in patients with knee pain due to osteoarthritis. The primary outcome of our study is to investigate whether cooled rf operation, which is a newer technique, is more effective than conventional rf operation. The secondary outcome is to determine whether the process is longer or not.

Material and Methods

In this study, after ethics committee approval (date: 09/02/2017), the genicular nerve RF treatments of patients with osteoarthritic knee pain conducted at the Sakarya University Training and Research Hospital in the Anaesthesiology and Reanimation Department of the Algology Clinic between January 2016 and December 2016 were retrospectively examined.

The hospital automation system Karmed (Snowdrop Software, Turkey) was used to screen the patients who had been diagnosed with the International Classification of Diseases, Tenth Revision classification of knee pain and knee osteoarthritis (knee arthrosis, M17) in the hospital archives. The missing information was obtained by telephone. Each patient's age, gender, weight, affected knee (right/left), Kellgren and Lawrence classification,^[12] RF type (conventional or cooled), preoperative and postoperative

surgical history, and complications during or after the procedure were examined. The preoperative, postoperative week 2nd, postoperative week 6th and postoperative week 12th Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)^[13] and visual analogue scale (VAS) scores were recorded in the patient files.

Those patients with osteoarthritis according to American College of Rheumatology criteria,^[14] with osteoarthritis grade 3–4 according to the Kellgren and Lawrence classification, aged 40–70 years old, with a VAS score of 4–10, conservative treatment (NSAID and physical therapy), and 50% reduction in pain with the injection of diagnostic local anesthetics were included in this study. Those patients with severe systemic disease, hemorrhagic diathesis or active knee joint infections (swelling, redness, etc.), or who had received any additional therapy (simultaneous intraarticular drug injection) with the RF treatment were excluded from the study.

After 8 h of fasting, the patient was moved to the operating room where knee was supported by a small pillow. The tibio-femoral joint was viewed via fluoroscopy. The infero-medial and infero-lateral edges of the femoral diaphyseal-metaphyseal junction and the supero-medial edge of tibial diaphyseal-metaphyseal junction were the target points for the genicular nerves [Figure 1]. These were determined using C-arm fluoroscopy under sterile conditions. The skin and subcutaneous tissues were anesthetized with 2% lidocaine (Jetmonal; Adeka Drug, Turkey). For the conventional RF treatment, a 50 Hz sensory stimulation was performed with a 10-cm, 22-gauge, 10-mm active-tip RF cannula (NeuroTherm, Medipoint GmbH, Hamburg, Germany). After receiving the appropriate sensory and motor stimuli, an RF of 90°C was applied for 90 s.

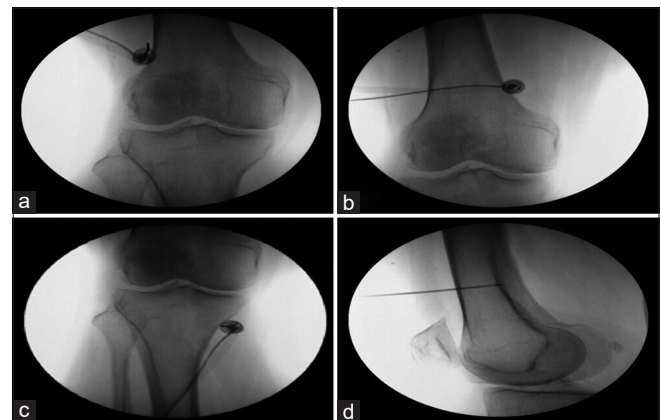


Figure 1: The RF cannula in femoral and tibial diaphyseal-metaphyseal junction of fluoroscopic image, (a) the target point of cannula for superolateral genicular nerve (b) the target point of cannula for superomedial genicular nerve (c) the target point of cannula for inferomedial genicular nerve (d) the target point of cannula for sagittal plane

A cooled RF thermocouple cannula (RF generator; RF Medical, Seoul, Korea) with a 10-cm, 22-gauge, 10-mm active tip was used for the cooled RF. The target points for the genicular nerves were the medial and lateral sides of the lower femur and the medial edge of the upper tibia. The RF cannula was applied to these points using C-arm fluoroscopy. The cooled RF was applied for 90 s at 60°C. In the postoperative period, 1000 mg paracetamol and 50 mg dexketoprofen were prescribed as analgesics.

The preoperative and postoperative 2nd, 6th and 12th week VAS and Turkish validated WOMAC scores were recorded.^[13] In addition, any complications after the treatment and side effects (bleeding, neurological damage, infection, etc.) were recorded in the file. The patients' preoperative and postoperative 2nd, 6th, and 12th week VAS and WOMAC scores showed a 50% success rate.

Statistical analysis

The statistical analysis was performed using the Statistical Package for the Social Sciences, version 13 (SPSS Inc., Chicago, IL, USA). The Kolmogorov–Smirnov test was used to determine whether the variables met the normal distribution. The measured data were presented as the mean \pm standard deviation (SD) and the differences between two groups were compared using the t test and the paired t test. A value of $P < 0.05$ was considered to be a statistically significant difference.

Results

The data of 63 patients who received RF treatments at the Algology Clinic between January 2016 and December 2016 were evaluated. Of the 63 patients who underwent radiofrequency for knee pain, 34 were treated with conventional RF (Group K, $n = 34$) and 29 with cooled RF (Group C, $n = 29$). The demographic characteristics of each patient were evaluated, including the age, gender, and body mass index (BMI). The mean age of the patients treated with conventional RF was 65.6 ± 8.66 years old, and the mean age of the patients who received cooled RF was 65.72 ± 10.84 years old. The mean BMI of the patients treated with conventional RF was 30.06 ± 7.21 kg/m², and the mean BMI of the patients who received cooled RF was 29.85 ± 5.23 kg/m². There were no significant differences between the groups in terms of the age and BMI ($P > 0.05$, Table 1).

The intra-group comparison of Group K's (patients applying conventional RF) VAS scores showed that the postoperative week 2nd, week 6th and week 12th VAS scores were significantly lower than the preoperative VAS scores ($P < 0.05$). Similarly,

the intra-group comparison of Group C's (patients applying cooled RF) VAS scores showed that the postoperative week 2nd, week 6th and week 12th VAS scores were significantly lower than the preoperative VAS scores ($P < 0.05$). However, there were no significant differences between the Group K and Group C VAS scores ($P < 0.05$, Figure 2).

As seen in Table 2, the intra-group comparison of Group K's WOMAC scores showed that the postoperative week 2nd, week 6th, and week 12th WOMAC scores were significantly decreased according to the preoperative WOMAC scores ($P < 0.01$). Similarly, the intra-group comparison of Group C's WOMAC scores showed that the postoperative week 2nd, week 6th and week 12th WOMAC scores were significantly lower than the preoperative WOMAC scores ($P < 0.01$). However, there were no significant differences between Group K and Group C WOMAC scores ($P < 0.05$, Table 3).

Discussion

Genicular RF ablation is a new treatment method that has been recently introduced to patients with knee pain due to osteoarthritis.^[2,4] It is important that these patients do not undergo general anesthesia during this procedure, and that they do not have open surgical procedures. There are numerous publications in the literature describing both conventional and cooled RF treatments being applied to other

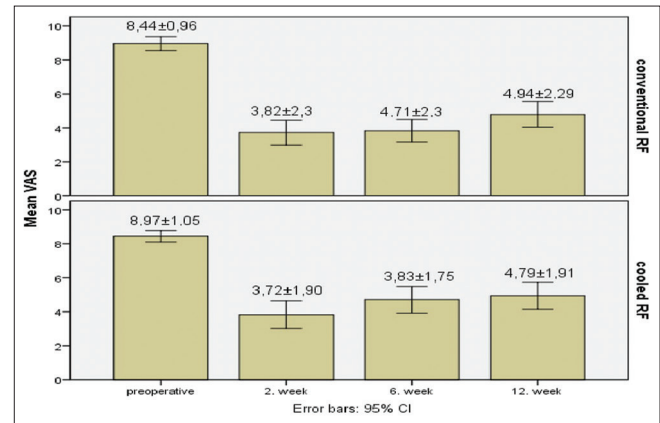


Figure 2: Comparison of VAS scores of group K and group C. There were no significant differences between group K and group C. A value of $P < 0.05$ was considered to be a statistically significant difference

Table 1: Demographic characteristics of patients applying conventional RF and cooled RF

| | Group K | Group C | P |
|--------------------------|------------------|-------------------|-------|
| Age (years) | 65.6 \pm 8.66 | 65.72 \pm 10.84 | 0.78 |
| BMI (kg/m ²) | 30.06 \pm 7.21 | 29.85 \pm 5.23 | 0.89 |
| Gender (f/m) | 32/2 | 18/11 | <0.05 |

Data were presented as the mean \pm SD. A value of $P < 0.05$ was considered to be a statistically significant difference. Group K: Conventional RF, Group C: Cooled RF

Table 2: WOMAC scores evaluation according to preoperative scores

| | Preoperative | Postoperative 2.week | Postoperative 6.week | Postoperative 12.week | P ¹ | P ² | P ³ |
|---------|--------------|----------------------|----------------------|-----------------------|----------------|----------------|----------------|
| Group K | 62.03±8.94 | 31.24±18.34 | 36.32±17.23 | 38.21±17.00 | 0.00 | 0.00 | 0.00 |
| Group C | 67.14±11.58 | 36.93±17.19 | 40.34±17.58 | 45.14±18.14 | 0.00 | 0.00 | 0.00 |

Data were presented as the mean±SD. A value of $P < 0.05$ was considered to be a statistically significant difference. Group K: Conventional RF, Group C: Cooled RF p1 comparison of preoperative WOMAC scores with postoperative 2nd week WOMAC scores. P2: p1 comparison of preoperative WOMAC scores with postoperative 6th week WOMAC scores p3: p1 comparison of preoperative WOMAC scores with postoperative 12nd week WOMAC scores

Table 3: Comparison of WOMAC scores of group K and group C

| | Group K | Group C | P |
|--------------|-------------|-------------|------|
| Preoperative | 62.03±8.94 | 67.14±11.58 | 0.69 |
| 2. Week | 31.24±18.34 | 36.93±17.19 | 0.21 |
| 6. Week | 36.32±17.23 | 40.34±17.58 | 0.36 |
| 12. Week | 38.21±17.00 | 45.14±18.14 | 0.12 |

Data were presented as the mean±SD. A value of $P < 0.05$ was considered to be a statistically significant difference. Group K: Conventional RF, Group C: Cooled RF

parts of the body, such as the sacroiliac joints and dorsal root ganglion, and they show positive effects on the pain scores and quality of life.^[15] In this study, patients who underwent conventional and cooled RF procedures were retrospectively investigated, and both procedures were found to be effective for treating osteoarthritis-induced knee pain.

Bellini *et al.* retrospectively analyzed the results of the VAS and WOMAC scores in nine cases in which they applied cooled RF for osteoarthritis-induced knee pain. They reported that the preoperative VAS and WOMAC scores of the patients were significantly decreased; and in the follow-up, this decrease continued (preoperative VAS and WOMAC, 8 ± 1.5 and 88 ± 1.9 , respectively; postoperative 12-month VAS and WOMAC, 2.2 ± 0.2 and 20 ± 1.0 , respectively).^[8] Unlike our study, the decreases in the VAS and WOMAC values in our study remained unchanged in the twelfth month. In other studies in the literature, it was observed that there was a slight increase in the twelfth week, after a significant decrease in the VAS values shortly after the procedure, although it was not statistically significant (similar to our study).^[5,6] In our study, the VAS and WOMAC values of the patients who were treated with cooled RF were significantly decreased in the second postoperative week when compared to the preoperative values, but they increased slightly in the subsequent visits. Reddy *et al.*^[7] reported that genicular nerve cooled RF treatments were performed in a series of four cases, and the satisfaction questionnaire values of the patients were significantly reduced in the postoperative sixth and twelfth months. In this study, it was reported that the researchers were very careful in the patient selection, and only the patients who had an 80% reduction in the post diagnostic pain were included in the study; thus, the success of the procedure was related to the patient selection. Similarly, McCormick *et al.* reported that 33 patients, with a total of

52 genicular nerves, were treated with cooled RF, and they were followed up for six months. The results showed marked reductions in the quality of life and pain assessment scales.^[6] In two case reports of cooled RF treatments, it was reported that the VAS and WOMAC values of the patients were significantly decreased, and that these decreases were also observed in the patients' follow-ups.^[9,16]

In a randomized controlled trial conducted by Choi *et al.*, the patients were divided into two groups; one group was treated using the conventional RF procedure and the other group was treated using only a local anesthetic as a placebo. The results showed that the VAS and Oxford Knee Scores of the conventional RF group decreased statistically significantly when compared to the control group.^[4] Similarly, in a case report by Protzman *et al.* conventional RF was applied to the genicular nerves of a 38-year-old patient, and a significant reduction in the VAS value was recorded.^[17]

A comparison of cooled and conventional RF procedures performed on the genicular nerves has not been conducted previously. Although their study did not include the genicular nerves, Cheng *et al.* retrospectively evaluated 88 patients who had cooled or conventional RF applied to the lateral branches of the sacroiliac joints. As a result, both of the procedures were found to be effective in the palliation of the patients' pain, but no statistically significant difference was found between the groups.^[15] Similarly, in our study, when compared with the preoperative values of the cooled and conventional RF procedures, the postoperative VAS and WOMAC scores were found to be statistically significantly decreased, but no statistically significant difference was found when the effectiveness of the procedures was compared. However, one previous study showed that the diameter of the cooled RF lesion was larger and bigger.^[11] There was no clinically significant difference in the 12-week follow-ups, but a long-term follow-up could be useful for elucidating this issue.

It has been reported in the literature that cooled rf procedure was applied to genicular nerves and there was a decrease in VAS score by 67%.^[18] In studies about about knee joint, generally one technique was applied, the effect of the technique applied was shown but no studies have been conducted comparing the RF techniques or showing the advantage of one over the other. Our study is important because it compared the two techniques.

When the complications with previous studies are concerned, it was observed that 67% of the patients developed subcutaneous bleeding and 78% developed prolonged hypoesthesia in the study by Ikeuchi *et al.*^[2] In our study, only one patient developed a subcutaneous hematoma, and this hematoma was healed in three weeks.

An important limitation of our work was that it was a retrospective study without a control group. The short follow-up time of the patients was an additional limitation. The other limitations of our study is that it was applied with fluoroscopy. Recently, genicular rf procedure is also applied with USG, and there are studies in the literature reporting that there is no superiority of the application with scopy or USG to each other.^[19]

Conclusion

Both techniques improve the pain symptoms and physical functions, and the complication rates of both techniques were low. Overall, we found that neither conventional RF nor cooled RF was superior to the other.

Acknowledgements

Disclosure of Benefit is a declaration that the authors have no conflicting interests, not supported or funded by any Drug Company

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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