

## The Analgesic Effect And Functional Improvement Produced by Radio-Frequency Ablation of Genicular Nerves in Patients with Advanced Knee Osteoarthritis

Uzma Akhlaque, Saeed Bin Ayaz, Khalil Ahmad, Muhammad Shoaib, Umer Younas, Naureen Tassadaq\*

Armed Forces Institute of Rehabilitation Medicine/National University of Medical Sciences (NUMS) Rawalpindi Pakistan,

\*Fauji Foundation Hospital, Rawalpindi Pakistan

### ABSTRACT

**Objective:** To study the efficacy of radiofrequency ablation for treating pain in patients with advanced knee osteoarthritis.

**Study Design:** Quasi-experimental study.

**Place and Duration of Study:** Pain Clinic of Armed Forces Institute of Rehabilitation Medicine Rawalpindi, from Sep 2019 to Feb 2020.

**Methodology:** Patients of more than 50 years of age, with grade III and IV Kellgren-Lawrence grades of knee osteoarthritis and at least a score of 4 for three months on the numerical rating scale were included in the study. Measurements were taken on the numerical rating scale and Western Ontario and McMaster universities osteoarthritis index before and four weeks after fluoroscopy-guided radiofrequency ablation of three genicular nerves around the knee joint.

**Results:** Fifty patients (mean age:  $62 \pm 6.5$  years) were included in the study. The median numerical rating scale scores before and after intervention were 9 (Interquartile range: 7-10) and 5 (Interquartile range: 2-8), respectively ( $p < 0.001$ ). The mean Western Ontario and McMaster universities osteoarthritis index scores before and after intervention were  $76.7 \pm 13.4$  and  $50.3 \pm 18$ , respectively ( $p < 0.001$ ). No complications were reported. The reduction in numerical rating scale, Western Ontario and McMaster universities osteoarthritis index scores after the intervention were significantly better in females than in males ( $p = 0.023$  and  $p = 0.012$  respectively); however, no significant change was observed for the right and left knee or grades of knee osteoarthritis ( $p > 0.05$ ).

**Conclusion:** Radiofrequency ablation of genicular nerves around the knee joint significantly improves pain, stiffness and body function in patients with advanced knee osteoarthritis and results are better in women.

**Keywords:** Chronic pain, Fluoroscopy, Knee joint, Methods, Osteoarthritis, Radiofrequency ablation.

**How to Cite This Article:** Akhlaque U, Ayaz SB, Ahmad K, Shoaib M, Younas U, Tassadaq N. The Analgesic Effect and Functional Improvement Produced by Radiofrequency Ablation of Genicular Nerves in Patients with Advanced Knee Osteoarthritis. *Pak Armed Forces Med J* 2022; 72(1): 80-85. Doi: <https://doi.org/10.51253/pafmj.v72i1.5297>

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

### INTRODUCTION

Osteoarthritis (OA) knee is among the most common diseases, primarily affecting the elderly population.<sup>1</sup> Its prevalence has increased significantly over the last decades and it continues to rise, to some extent, because of increasing life expectancy and the rising incidence of obesity and other risk factors.<sup>2</sup> Knee OA is a significant contributor to pain in advanced age. Across the globe, knee pain affects 250 million people.<sup>3</sup> Chronic knee pain leads to disability, psychological distress and impaired quality of life.

Various conservative treatments are offered to the patients with chronic knee OA, including oral analgesics, visco-supplementation, intra-articular Corticosteroid and platelet-rich plasma injections, herbal medicines, nutritional supplements, massage, acupuncture, homoeopathic medicines, manipulation, faith healing

and prolotherapy.<sup>3-5</sup> Even after these measures, many patients continue to experience refractory pain in their knees. Total knee arthroplasty may be an effective surgical choice in cases where conservative treatments fail to respond. However, surgery can result in augmented morbidity and mortality among patients with chronic knee OA and its indications are limited in high-risk patients with comorbidities.<sup>6</sup> Moreover, not all the patients are suitable for total knee arthroplasty because of their young age, high body mass index, or medical comorbidities.<sup>7</sup>

Due to the lack of appropriate treatment options, alternative methods for treating knee pain resulting from OA are required. A relatively new alternative is radiofrequency ablation (RFA) of the genicular nerves. Genicular nerves are the branches of the tibial, common peroneal and obturator nerves. These nerves provide innervation to the knee joint capsule, along with intra-articular and extra-articular ligaments. This technique nurtures considerable interest as an effective intervention to alleviate knee pain, particularly in

**Correspondence:** Dr Uzma Akhlaque, Consultant Rehab Medicine, AFIRM, Rawalpindi Pakistan

Received: 10 Nov 2020; revision received: 26 Mar 2021; accepted: 30 Mar 2021

patients with knee OA. RFA of the genicular nerves appears to be safe and effective for treating intractable knee OA pain, according to several studies.<sup>8-10</sup> A diagnostic genicular nerve block (GNB) with local anaesthetic is performed before RFA of genicular nerve and successful response to GNB is considered a supporting indication for RFA of the genicular nerves.

In Pakistan, RFA of the genicular nerves for knee OA is practised in approximately 8-9 centres in Islamabad, Rawalpindi, Lahore, and Karachi. The data regarding different procedures in these centres is still not available in the literature. In this study, we wanted to share our experience regarding the efficacy of RFA in reducing morbidity associated with advanced knee OA. The comparison of the effect among gender, grades of knee OA based on Kellgren-Lawrence (KL) radiological classification of knee OA and right versus left knee were secondary objectives of the study.

## METHODOLOGY

A quasi-experimental study was conducted at the Pain Clinic of Armed Forces Institute of Rehabilitation Medicine Rawalpindi Pakistan, from September 2019 to February 2020. After obtaining approval from the Institutional Ethics Committee (IERB Approval Certificate Number: AFIRM-Trg/18), we consecutively included the patients.

**Inclusion Criteria:** Patients with age more than 50 years, of both genders with painful knees who fulfilled the diagnostic criteria for knee OA of the medial tibio-femoral joint as defined by the American college of rheumatology<sup>11</sup> and had radiographic knee OA with KL grade III-IV evaluated using weight-bearing anteroposterior (AP) X-rays of the tibio-femoral joint were included in the study.

**Exclusion Criteria:** Patients with acute knee pain, sciatica, previous knee surgery, other connective tissue diseases affecting the knee joint, extreme neurological or psychiatric conditions, steroid or hyaluronic acid injection treatment in the past three months and use of anticoagulant medications and pacemakers were excluded from the study.

A sample size of 30 was calculated using the web-based sample size calculator (Available at <https://www.enterprise-development.org/measuring-results-the-dced-standard/sample-size-calculator/>) while keeping 95% confidence level, a minimal detectable difference of "1" and a range of "0-5" for the parameter endpoint taken as reference from the previous study.<sup>12</sup>

The study parameters were the numerical rating scale (NRS),<sup>13</sup> score and the Western Ontario and McMaster universities osteoarthritis index (WOMAC) score.<sup>14</sup> NRS was used to evaluate pain in a score range from 0-10. For inclusion criteria, we enrolled individuals with NRS scores of more than 4/10 that persisted most of the days for more than three months.

The WOMAC is a validated and widely used set of questionnaires to evaluate the condition of patients with OA of the knee and includes questions regarding pain, stiffness and physical functioning of the joints. It measures five items for pain (score range 0-20), two for stiffness (score range 0-8), and 17 for physical function in daily life (score range 0-68).<sup>15</sup> Physical functioning issues include daily tasks such as using a staircase, standing up from a sitting or lying position, standing, leaning, walking, getting in and out of a vehicle, shopping, taking on or off socks, lying in bed, entering or leaving a bath, sitting and heavy and light domestic chores. The assessments were conducted before the procedure and six weeks after the procedure. The WOMAC was administered in the form of a written proforma. For the assessment, the individuals who could read, understand and reply to the questions were encouraged to fill out the proforma themselves. However, for those who could not read, understand or answer the questions, the questions were translated into the language they understood by the primary investigator and the proforma was filled by the investigator.

All the patients consented formally for inclusion in the study. Under aseptic conditions, to relieve pain, patients were put in a supine position on a fluoroscopy table with a pillow underneath the popliteal fossa. The accurate AP fluoroscopic view of the tibiofemoral joint was taken. Skin and soft tissues were anaesthetised with 1 mL of 1% preservative-free Lignocaine. A diagnostic block was performed in three genicular nerves during the first visit, namely superior medial, superior lateral and inferior medial with 0.25% Bupivacaine Hydrochloride injection. Patients who reported 50% relief in pain for at least two hours were considered suitable candidates for RFA. On the next day, RFA was conducted. A 10-cm, 22-gauge RFA cannula was used for the procedure with an active tip of 10mm. Sensory stimulation at 50 Hz was undertaken under proper fluoroscopic guidance to determine the location of the nerves. The threshold needed for sensory stimulation was <0.6 V. Motor stimulation was tested on stimulation of up to 2.0 V at 2 Hz for lack of fasciculation in

the corresponding region of the lower extremity. Before triggering the RFA generator, Lignocaine (2mL of 1%) was injected. Lesions were performed at 80°C for the 90s for each genicular nerve. After six weeks at the same clinic, the patients were asked for a follow-up. Complications after the procedure and adverse effects such as pain, swelling, hematoma and motor or sensory deficits were notifiable.

The findings were recorded and analysed using Statistical Package for Social Sciences version 20.0. Quantitative data was presented as mean and standard deviation for normally distributed variables and as median and interquartile ranges for variables with non-normal distribution. The qualitative data was presented as numbers and percentages. The NRS and WOMAC scores were evaluated for normality using the Shapiro Wilk test. WOMAC scores were distributed normally while NRS scores, the difference between

males. The mean age of the patients was  $62 \pm 6.5$  years (range: 50-74 years). Twenty patients were in grade-III, while 30 were in grade-IV of knee OA based on KL classification. In 23 (46%) patients, the right knee was intervened, while in 27 (54%) patients left knee was intervened. The median NRS score before RFA was 9 (Interquartile range: 7-10) and the median NRS score after RFA was 5 (Interquartile range: 2-8) ( $p < 0.001$ ). The mean WOMAC score before RFA was  $76.7 \pm 13.4$  and the mean WOMAC score after RFA was  $50.3 \pm 18$  ( $p < 0.001$ ). No complications in the area of the procedure was encountered in any patient, such as persistent pain, infection, swelling, excessive bleeding, thermal injury or sensory or motor failure.

On comparing parameter scores in different subgroups, there were a significant reduction in NRS scores in males and females, right and left knees, and grade III and IV of knee OA ( $p < 0.001$ ) (Table-I).

**Table-I: Comparison of numerical rating scale score in gender, knee joints and categories of knee osteoarthritis based on kellgren-lawrence classification.**

Variables	Numerical Rating Scale score Before intervention		Numerical Rating Scale scores After intervention		p-value
	Median	Interquartile Range	Median	Interquartile Range	
<b>Gender</b>					
Male	9	7-10	5	3-8	<0.001
Female	9	7-10	5	2-8	
<b>Side of Knee Involved</b>					
Right	9	7-10	4	3-7	<0.001
Left	10	7-10	6	2-8	
<b>Grade of Knee Osteoarthritis</b>					
Grade III	8	7-10	4	2-6	<0.001
Grade IV	9.5	7-10	5	3-8	

pre-and post-intervention NRS scores and the difference between pre-and post-intervention WOMAC scores did not follow a normal distribution. The paired sample t-test was used at baseline and six weeks after injection to determine variations between the WOMAC scores. Wilcoxon signed-rank test was used at baseline and six weeks after injection to determine variations between the NRS scores. The same tests were used to compare results within subgroups based on gender, the right or left knee involvement and grade of knee OA based on KL classification. The Mann-Whitney U test was applied for subgroups of males and females, right and left knees and grade III and IV KL knee OA categories. The  $p$ -value of  $\leq 0.05$  was considered statistically significant.

## RESULTS

There were 50 patients enrolled in the study. Twenty-five (50%) were males and 25 (50%) were fe-

Similarly, there was a significant reduction in WOMAC scores in males and females, right and left knees, and grade III and IV of knee OA (All  $p < 0.001$ ) as shown in the Table-II.

The mean reduction in NRS and WOMAC scores after the intervention was significantly better in females than in males ( $p = 0.023$  and  $p = 0.012$ , respectively). However, the reduction in NRS and WOMAC scores did not vary significantly among different sides ( $p = 0.362$  and  $p = 0.055$ , respectively) or grades of knee OA based on KL classification ( $p = 0.521$  and  $p = 0.165$  respectively) as shown in the Table-III.

## DISCUSSION

In this study, we observed a significant reduction in pain, stiffness and human functional ability measured on WOMAC even in patients with grade III or IV knee OA according to KL classification. We did not observe any side effects related to the procedure.

**Table-II: Comparison of western ontario and mcmaster universities osteoarthritis index score in gender, knee joints and categories of knee osteoarthritis based on kellgren-lawrence classification.**

Variables	Western Ontario and McMaster Universities Osteoarthritis Index Score Before intervention	Western Ontario and McMaster Universities Osteoarthritis Index Score After intervention	p-value
	Mean ± SD	Mean ± SD	
<b>Gender</b>			
Male	75.5 ± 14.9	54.8 ± 16.7	<0.001
Female	78 ± 12	45.7 ± 18.6	
<b>Side of Knee Involved</b>			
Right	74.9 ± 12.1	43.7 ± 17	<0.001
Left	78.3 ± 14.6	55.9 ± 17.3	
<b>Grade of Knee Osteoarthritis</b>			
Grade III	68.8 ± 13.7	38.5 ± 14.9	<0.001
Grade IV	82 ± 10.6	58.2 ± 15.6	

**Table-III: Comparison of change in numerical rating scale and western ontario and mcmaster universities osteoarthritis index scores in gender, knee joints and categories of knee osteoarthritis based on kellgren-lawrence classification.**

Variables	Difference in Numerical Rating Scale score		p-value	Difference in Western Ontario and Mc Master Universities Osteoarthritis Index Scores		p-value
	Median	Interquartile Range		Median	Interquartile Range	
<b>Gender</b>						
Male	3	1-6	0.023	22	5-44	0.012
Female	4	2-6		35	6-78	
<b>Side of Knee Involved</b>						
Right	4	2-6	0.362	26	8-78	0.055
Left	4	1-6		22	5-48	
<b>Grade of Knee Osteoarthritis</b>						
Grade III	4	3-6	0.521	25.5	9-78	0.165
Grade IV	4	1-6		22	5-48	

In 2011, Choi *et al.*<sup>8</sup> originally identified the application of RFA to the genicular nerves under fluoroscopic guidance. In their study, there was more than 50% relief in pain and improved physical function at 12 weeks without reporting any side effects. They used an active tip 100 mm RFA needle and every 90s, a nerve lesion was created at 70°C. Since then, many investigators have reciprocated their studies and tried different temperatures for different periods.<sup>9,10,11</sup> We used a 100 mm needle at 80°C for the 90s. Kirdemir *et al.*<sup>10</sup> documented significant improvements in the visual analogue scale (VAS) and WOMAC scores among 49 patients at 1, 4, and 12 weeks post-treatment in a Turkish quasi-experimental study compared with pre-treatment values. No side effect was reported by any patient. Another Turkish quasi-experimental study by Konya *et al.*<sup>12</sup> found significant improvement in 48 patients regarding their VAS and WOMAC scores at 1, 3, and 6 months after RFA of genicular nerves of the knee joint. All the patients had knee OA of stage III or IV. However, in three cases, they reported non-serious side effects. Hematoma and ecchymosis occurred in two patients at the needle sites and transient paresthesia around the knee joint was observed in one patient,

which settled without any treatment. It was also interesting to note that the treated patients reported a decline in their use of opioids and non-steroidal anti-inflammatory drugs (NSAIDs) such that 66.7% discontinued opioid use and 56.3% discontinued NSAIDs use with statistically significant changes in the values before the procedure and after the procedure ( $p < 0.001$ ). Another Turkish randomised study compared RFA and intra-articular injection of Morphine and steroid combination while being scaled on VAS and WOMAC scores.<sup>9</sup> A substantial decrease was observed in the VAS score ( $p < 0.001$ ) in the RFA group after one and 3 months of the procedure compared to the intra-articular group. A significant improvement in WOMAC scores ( $p < 0.001$ ) was observed only after one month. In an American multicenter randomised controlled trial with 63 subjects having grade II to IV KL knee OA and chronic ( $\geq 6$  months) knee pain, effects of RFA were compared with intra-articular injection using NRS, Oxford knee score, global perceived effect, analgesic drug use and adverse events.<sup>15</sup> At six months, the RFA group had more favourable outcomes in NRS score ( $4.9 \pm 2.4$  versus  $1.3 \pm 2.2$ ,  $p < 0.001$ ), Oxford knee score ( $35.7 \pm 8.8$  vs  $22.4 \pm 8.5$ ,  $p < 0.001$ ), global perceived

effect (91.4% vs 23.9%,  $p < 0.001$ ) and the mean change in non-opioid medication use ( $p = 0.02$ ). There were no significant adverse effects connected to the treatment. Two other studies have also supported RFA as a possible treatment for pain with knee OA or knee pain persistent after arthroplasty.<sup>16,17</sup>

The effects of RFA have rarely been studied for longer terms, yet the available data suggest that the effects generally start reducing after 3 or 6 months. Qudsi-Sinclair *et al.*,<sup>18</sup> noted that functional outcomes in the intervened patients were most prominent between the first and six months and declined towards the baseline by 12 months. The decrease in knee pain peaked at three months with no further improvement until 12 months. Santana Pineda *et al.*,<sup>19</sup> observed the effects of ultrasound-guided RFA of the superior medial, superior lateral and inferior medial genicular nerves. The proportion of participants with an improvement of 50% or greater in pre-treatment VAS and WOMAC scores were observed at 1, 6, and 12 months after the intervention. It was noticed that there was a gradual decline in the outcomes at 6 and 12 months. The apparent reason for this phenomenon appears to be nerve regeneration and growth.<sup>20</sup>

RFA is a target-specific and safe mode of treatment that can be provided as an outdoor procedure in a short time without the requirement of excessive sedation.<sup>15</sup> Though the effects are not permanent, the procedure can be readily repeated. Even if it may involve some discomfort, it is still reasonable as a significant reduction in pain and pain-related disability is observed and the requirement for oral analgesics decreases.

### LIMITATIONS OF STUDY

The study did not involve a control group. Thus, randomised, placebo-controlled trials with broader patient groups from the Pakistani population and longer-term follow-ups are required to register better the effective duration of RFA and its long-term safety profile.

### CONCLUSION

Radiofrequency ablation of genicular nerves around the knee joint significantly improves pain, stiffness and body function in patients with advanced knee osteoarthritis and results are better in women.

**Conflict of Interest:** None.

### Authors' Contribution

UA: Conception data collection, manuscript writing review, SBA: Manuscript writing review analysis, KA: Manuscript writing and review, MS: Data collection, UY: Data entry and compilation, NT: Review.

### REFERENCES

- Palazzo C, Nguyen C, Lefevre-Colau MM, Rannou F, Poiraudou S. Risk factors and burden of osteoarthritis. *Ann Phys Rehabil Med* 2016; 59(3): 134-138.
- Nguyen US, Zhang Y, Zhu Y, Niu J, Zhang B, Felson DT. Increasing prevalence of knee pain and symptomatic knee osteoarthritis: survey and cohort data. *Ann Intern Med* 2011; 155(11): 725-732.
- Mora JC, Przkora R, Cruz-Almeida Y. Knee osteoarthritis: pathophysiology and current treatment modalities. *J Pain Res* 2018; 11(1): 2189-2196.
- Ayaz SB, Rathore FA, Ahmad K, Matee S. The use of complementary health approaches among patients with knee osteoarthritis in Pakistan: a hospital-based survey. *Egypt Rheumatol* 2016; 38(2): 111-116.
- Akhlaque U, Ayaz SB, Akhtar N. Efficacy of intra-articular autologous platelet rich plasma injection in primary knee osteoarthritis; a quasi-experimental study. *J Pak Med Assoc* 2020; 70(12): 2143-2146.
- Castano-Betancourt MC, Fruschein Annichino R, de Azevedo E Souza Munhoz M, Gomes Machado E, Lipay MV, Marchi E. Identification of high-risk groups for complication after arthroplasty: predictive value of patient's related risk factors. *J Orthop Surg Res* 2018; 13(1): 328.
- Santaguida PL, Hawker GA, Hudak PL, Glazier R, Mahomed NN, Kreder HJ, et al. Patient characteristics affecting the prognosis of total hip and knee joint arthroplasty: A systematic review. *Can J Surg* 2008; 51(6): 428-436.
- Choi WJ, Hwang SJ, Song JG, Leem JG, Kang YU, Park PH, et al. Radiofrequency treatment relieves chronic knee osteoarthritis pain: A double-blind randomized controlled trial. *Pain* 2011; 152(3): 481-487.
- Sari S, Aydin ON, Turan Y, Özlülerden P, Efe U, Kurt Ömürlü I. Which one is more effective for the clinical treatment of chronic pain in knee osteoarthritis: radiofrequency neurotomy of the genicular nerves or intra-articular injection? *Int J Rheum Dis* 2016; 21(10): 1772-1778.
- Kirdemir P, Çatav S, Alkaya Solmaz F. The genicular nerve: Radiofrequency lesion application for chronic knee pain. *Turk J Med Sci* 2017; 47(1): 268-272.
- Altman R, Asch E, Bloch D, Bole G, Borenstein D, Brandt K, et al. Development of criteria for the classification and reporting of osteoarthritis: classification of osteoarthritis of the knee. *Arthritis Rheum* 1986; 29(8): 1039-1049.
- Konya ZY, Akin Takmaz S, Başar H, Baltacı B, Babaoğlu G. Results of genicular nerve ablation by radiofrequency in osteoarthritis-related chronic refractory knee pain. *Turk J Med Sci* 2020; 50(1): 86-95.
- Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale for Pain (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale (CPGS), Short Form-36 Bodily Pain Scale (SF-36 BPS), and Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP). *Arthritis Care Res (Hoboken)* 2011; 63 (Suppl-11): S240-S252.
- Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. *J Rheumatol* 1988; 15(12): 1833-1840.

## Radio-Frequency Ablation

15. Davis T, Loudermilk E, DePalma M, Hunter C, Lindley D, Patel N, et al. Prospective, multicenter, randomized, crossover clinical trial comparing the safety and effectiveness of cooled radiofrequency ablation with corticosteroid injection in the management of knee pain from osteoarthritis. *Reg Anesth Pain Med* 2018; 43(1): 84-91.
  16. Bhatia A, Peng P, Cohen SP. Radiofrequency procedures to relieve chronic knee pain: an evidence-based narrative review. *Reg Anesth Pain Med* 2016; 41(4): 501-510.
  17. Jamison DE, Cohen SP. Radiofrequency techniques to treat chronic knee pain: a comprehensive review of anatomy, effectiveness, treatment parameters, and patient selection. *J Pain Res* 2018; 11(1): 1879-1888.
  18. Qudsi-Sinclair S, Borrás-Rubio E, Abellan-Guillén JF, Padilla Del Rey ML, Ruiz-Merino G. A comparison of genicular nerve treatment using either radiofrequency or analgesic block with corticosteroid for pain after a total knee arthroplasty: a double-blind, randomized clinical study. *Pain Pract* 2017; 17(5): 578-588.
  19. Santana Pineda MM, Vanlinthout LE, Moreno Martín A, van Zundert J, Rodríguez Huertas F, Novalbos Ruiz JP. Analgesic effect and functional improvement caused by radiofrequency treatment of genicular nerves in patients with advanced osteoarthritis of the knee until 1 year following treatment. *Reg Anesth Pain Med* 2017; 42(1): 62-68.
  20. Choi EJ, Choi YM, Jang EJ, Kim JY. Neural ablation and regeneration in pain practice. *Korean J Pain* 2016; 29(1): 3-11.
- .....