

## Research Article


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# Effectiveness of radiofrequency rhizotomies of genicular nerves for treating chronic pain in knee osteoarthritis

## Abstract

**Background:** Osteoarthritis (OA) is the most common cause of lower extremity disability in the elderly, primarily affecting lower extremity joints, such as the knee and hip. Elder patients with comorbidities may not be suitable candidates for surgery. For these difficult to treat cases, radiofrequency (RF) rhizotomies may be an effective alternative treatment. Likewise, it has been found that RF therapy can improve joint function and reduce pain by preventing the transmission of pain signals thus easing the patient.

**Objective:** To evaluate the effectiveness of radiofrequency rhizotomies of genicular nerves in treating knee pain caused by knee osteoarthritis.

**Results:** A total of 100 patients were enrolled in the current study. The mean age of patients was  $62.7 \pm 9.7$ . Majority of the patients were female (69%), married (79%), and overweight (58.0%). Regarding affected knee sites, 39% had left, 34% right and 29% had both knees affected, respectively. There was a significant difference in mean scores among patients before and after treatment follow-up. The mean pain score before starting the treatment was  $7.63 \pm 1.11$ , in the 1<sup>st</sup> week. The follow up mean pain score was  $3.94 \pm 0.874$ , which further reduced in the 12<sup>th</sup> week to  $1.51 \pm 1.12$ . The pain score, OKS and HADs significantly improved from baseline to 12<sup>th</sup> week follow up which shows that RFA was an effective treatment for OA knee pain ( $P$ -value  $<0.05$ ) which shows that Radiofrequency rhizotomies of genicular nerves was an effective treatment for OA knee pain ( $P$ -value  $<0.05$ ).

**Conclusion:** Radiofrequency rhizotomies of genicular nerves is a safe and effective treatment option for patients suffering from chronic pain caused by knee OA.

**Keywords:** Radiofrequency, Radiofrequency rhizotomies, Osteoarthritis, Knee pain, Genicular nerves

## Introduction

Osteoarthritis (OA) is a frequent type of arthritis, affecting 15% of the world population. It is the most common reason for lower extremity disability in the elderly thereby primarily affecting lower extremity joints, such as the knee and hip. The lifetime risk of developing knee OA estimates around 40% in men and 47% in women. The risk is even higher in obese people.<sup>1</sup> Currently, OA is among the most frequently diagnosed diseases. In general practice, its prevalence was expected to increase by 2020, as a result of the ageing population and increasing obesity.<sup>2,3</sup> Women are more likely than men to have hand, foot, and knee OA, and they also tend to have it more severely. Gender inequalities may be influenced by differences in neuromuscular strength, pregnancy, ligamentous elasticity, alignment, and bone strength.<sup>4</sup> The most common cause of chronic knee pain is osteoarthritis (OA), which is characterized by progressive loss of articular cartilage. Other common causes of chronic knee pain include rheumatoid arthritis, trauma, crystal arthropathies, and persistent pain after surgery.<sup>5</sup> Total knee arthroplasty (TKA) or arthroscopic surgery is a suitable therapeutic option for end-stage knee OA and provides better functional recovery.<sup>6</sup>

However, 20-53% of patients receiving arthroscopic surgery or TKA do not experience effective relief from chronic pain. Additionally, due to advanced age or significant comorbidities, some patients have contraindications or are poor surgical candidates.<sup>7</sup> Depending on the etiology and diagnosis, many therapies are available for knee pain, but in general, they include physical therapy, oral medicines, injections, and surgery.<sup>8</sup>

There are diverse types of injections for knee pain that can be administered into the soft tissues around the knee joint or into the interior of the joint. Medications that can be administered intraarticularly include anti-inflammatory corticosteroids, proinflammatory prolotherapy, platelet-rich plasma solutions (PRP), viscous preparations, and stem cell preparations.<sup>9,10</sup> The application of radiofrequency energy (RF) to the nerve supply of the knee is a newly adaptive safe procedure that can be performed without surgery or surgical revision even when an artificial joint is present. By selectively delivering thermal energy generated by an alternating current to nerve tissue, radiofrequency ablation (RFA) reduces the ability of nerve tissue to transmit pain signals.<sup>11</sup> Elder patients with comorbidities may not be suitable candidates for surgery. In such cases, radiofrequency rhizotomies (RF) may be an effective alternative treatment with few side effects. The idea behind this treatment is that by cutting the nerve supply to a painful tissue, pain can be relieved and function restored.<sup>12</sup>

However, the targeted thermal damage to the nerves which primarily affects the painful tissue through RF rhizotomies therapy can improve joint function and reduce pain by preventing the transmission of pain signals. It is well known that TKA is an expensive treatment procedure for Knee OA. TKA decreases the life quality of patients and increases their financial burden. Since there is no efficacious health insurance system in Pakistan, patients must pay all the costs out of their own pockets. So comparatively, the magnitude of the health problems in Pakistan is much higher than the developed countries. The extent of disease guides the selection and application of efficient therapies and management techniques for people identified with knee

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OA. This study, therefore, was conducted to probe the effectiveness of radiofrequency therapy in treating knee osteoarthritis to reduce pain.

## Methods

A quasi-experimental pre-post study was conducted from January 2019 to September 2019 at Iffat Anwar Medical Complex after taking the ethical approval from Ethics Review Committee of Azra Naheed Medical College/Superior University Lahore. After getting the written informed consent of patients, a total of 100 participants were enrolled by using convenient sampling techniques. All the patients, ranging 46-80 years, were diagnosed with Knee OA pain clinically and radiologically, and having history of pain for the last five years or more. The patients had failed to respond to other treatment modalities like oral medications, physiotherapy, and steroidal injections. The exclusion criteria were localized or general infections, tumor, previous history of comorbidities (uncontrolled diabetes mellitus, hypertension), connective tissue diseases, psychiatric and neurological disorders, pacemaker, or steroidal injections over the last three months.

## Procedure

Genicular nerve radiofrequency rhizotomies (GNRFR) procedure consists of two steps. A diagnostic block was given to patients under fluoroscopic or ultrasound guidance. A 20-gauge, 3.5-in (90-mm) spinal needle was used to administer 1 mL of 1% lidocaine specifically to the superior lateral, superior medial, and inferior medial genicular nerve branches. The patients were included for genicular ablation if they reported a baseline pain reduction of 50% or more for at least 24 hours after receiving the diagnostic injection. After successful diagnostic blocks, patients were to undergo RF Rhizotomies. The patient was positioned supine on a fluoroscopy table in sterile settings, with a pillow under the popliteal fossa to ease discomfort. The tibiofemoral joint was seen in its actual AP fluoroscopic perspective, which revealed an open joint area with equal-width interspaces on both sides. 1 mL of 1% lidocaine was used to anaesthetize the skin and soft tissues. A 20-gauge, 100-mm cannula with a 10-mm active tip was advanced percutaneously down to the junction of the femoral shaft and lateral epicondyle, contacting bone, to target the superior lateral genicular nerve. The superior medial genicular nerve was the focus of the fluoroscopic anteroposterior picture. The location of the nerve was determined using sensory stimulation at 50 Hz. It was necessary for the sensory stimulation threshold to be lower than 0.6 V. The nerve was evaluated for the presence of fasciculation in the corresponding area of the lower extremities following stimulation of 2.0 V at 2 Hz to prevent inactivating motor nerves. Before turning on the RF generator, 2 mL of 1% lidocaine was administered. The temperature of the electrode tip was then increased to 80°C for 90 s after the RF electrode had been introduced through the canula. For each genicular nerve, a single RF lesion was created. All the patients were advised to take their regular medication for Knee OA.

Baseline characteristics of patients were reported on a predesigned proforma. Patients were followed on the 1<sup>st</sup> and 12<sup>th</sup> weeks. Visual analog scale (VAS) was used to determine the intensity of pain. At every appointment, patients were asked to inform the doctor of any adverse effects. They could also call out at any other time for further management and assistance.

SPSS 25.0 was used to enter and analyze all data. Qualitative variables were presented as frequencies and percentages, whereas all quantitative data were presented as means  $\pm$  SD. ANOVA was used to determine the mean difference in VAS, OKS and HADS at baseline, 1st and 12th week of treatment. A P-value of less than 0.05 was considered significant.

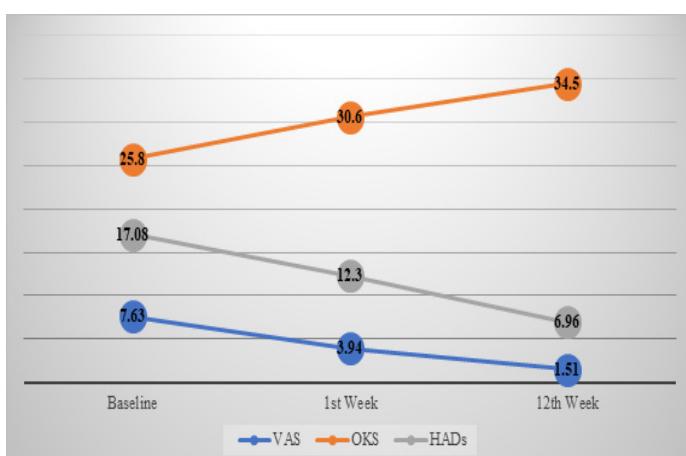
## Results

A total of 100 patients were enrolled in the current study. The mean age of patients was 62.7 $\pm$ 9.7. Majority of the patients were females (69%), married (79%), overweight (58.0%). Regarding effected knee site, 39% had left, 34% right, and 27% had both knees affected (Table 1).

**Table 1** Baseline characteristics of patients

Variables	Frequency (n=100)	Percentages
<b>Age</b>		
<b>40-60 Years</b>	43	43.0
<b>61-80 Years</b>	57	57.0
<b>Gender</b>		
<b>Male</b>	31	31.0
<b>Female</b>	69	69.0
<b>Marital status</b>		
<b>Married</b>	79	79.0
<b>Unmarried</b>	21	21.0
<b>BMI</b>		
<b>Underweight</b>	6	6.0
<b>Normal</b>	29	29.0
<b>Overweight</b>	58	58.0
<b>Obese</b>	7	7.0
<b>Knee Site</b>		
<b>Left</b>	39	39.0
<b>Right</b>	34	34.0
<b>Both</b>	27	27.0
<b>Mean duration of Disease (Mean <math>\pm</math> SD)</b>	5.63 $\pm$ 2.09	

The comparison of pain score at follow up is described in Table 2 and Figure 1. Patients pain score, OKS and HADs were assessed at baseline, and after treatment 1<sup>st</sup> and 12<sup>th</sup> week, respectively. There was a significant difference in mean score among patients before and after treatment follow up. At 1<sup>st</sup> week follow up, the mean pain score (VAS) was 3.94 $\pm$ 0.874, which is reduced at 12<sup>th</sup> week that is 1.51 $\pm$ 1.12. At 1<sup>st</sup> week follow up, the mean OKS was 30.6 $\pm$ 6.97, which is improved at 12<sup>th</sup> week that is 34.5 $\pm$ 10.37. At 1<sup>st</sup> week follow up the mean HADs was 17.08 $\pm$ 2.82, which is reduced at 12<sup>th</sup> week, that is 6.96 $\pm$ 3.77. The pain score, OKS and HADs significantly improved from baseline to 12<sup>th</sup> week follow up which shows that RFA was an effective treatment for OA knee pain (P-value <0.05) (Figure 1).



**Figure 1** Mean Change in VAS, OKS, HADS.



RF Rhizotomies of Genicular Nerves procedure.



RF Needles position in Lateral view.



RF Needles position in AP view.

## Discussion

This quasi-experimental study was conducted to find out the effectiveness of RFA rhizotomies in terms of pain relief in Knee OA. The current study revealed that majority of the study population with Knee OA were elders and females. Females encounter Knee OA more

frequently as compared to males. It is significant to note in the current study that the RFA rhizotomies was effective in treating patients with severe Knee OA pain, whereas the patients were followed for a specific time. At 1<sup>st</sup> week follow up the mean pain score was 3.94+0.874, which is reduced at 12<sup>th</sup> week that is 1.51+1.12. The pain score, OKS, and HADs significantly improved from baseline to 12<sup>th</sup> week follow up which shows that RFA was an effective treatment for OA knee pain (P-value <0.05) (Figure 1).

**Table 2** Comparison of mean change in different time points

Time	Pain score (VAS)		95% Confidence Interval for Mean		P-value
	Mean	SD	Lower Bound	Upper Bound	
Base line	7.63	1.11	7.40	7.85	
1 <sup>st</sup> week	3.94	.874	3.76	4.11	0.000***
12 <sup>th</sup> week	1.51	1.12	1.28	1.73	
<b>OKS score</b>					
Base line	25.8	8.16	24.2	27.4	
1 <sup>st</sup> week	30.6	6.97	29.2	32.0	0.000***
12 <sup>th</sup> week	34.5	10.37	32.4	36.5	
<b>HADs</b>					
Base line	17.08	2.82	16.5	17.6	
1 <sup>st</sup> week	12.3	2.98	11.7	12.8	0.000***
12 <sup>th</sup> week	6.96	3.77	6.21	7.70	

### One-way ANOVA

P-value < 0.05\*\*\*

VAS, Visual analog scale; OKS, Osteoarthritis Knee score; HADs, Hospital Anxiety and Depression Scale

Noticeably, RF rhizotomies for knee OA reduced the knee pain without any side effects and was accessible and well-tolerated by elder patients. It is suggested that the use of RF rhizotomies should be preferred for knee OA patients who have not responded to conservative treatments but have had a positive response to diagnostic block because it is more invasive than other treatments.<sup>13</sup> However, proper technique is essential for the success of RF. With denervation techniques including several lesions, there is strong evidence for both short- and long-term pain relief.<sup>14</sup> Since then, this method has become the accepted standard of treatment. The accuracy of diagnostic blocks performed and the application of appropriate technique during diagnostic and rhizotomies operations are closely related to RFN's effectiveness.<sup>15</sup>

We have found that there is a significant decrease in VAS after receiving treatment. The findings of current study were supported by various studies which showed that the RF is an effective treatment method in reducing pain in patients.<sup>16-18</sup> Another study conducted by Karaman et al. for the management of Knee OA pain concluded that PRF interventional treatment of chronic knee OA was an efficient and secure method after performing an intra-articular Pulsed RF in 31 patients and found 32.8% reduction rate in pain after one month follow up. They concluded that the PRF was an effective and safe method to treat Knee pain.<sup>19</sup> Our findings are also supported by Sar et al. The objective of the study was to determine the effectiveness

of RF rhizotomies and Intra articular injection of genicular nerves of patients with Knee OA pain. To study the effects of RF genicular nerve rhizotomies, patients were followed for three months. The baseline scores of VAS were same in both groups but after the 3-month follow up, it was observed that RF rhizotomies group showed significant reduction in VAS score. The study concludes that the RFA rhizotomies is a safe and effective treatment method and also provides better functional outcomes.<sup>20</sup> Another randomized control trial conducted by Choi et al., with 38 participants to treat acute knee pain also supports the findings of this study. With the medial retinacular nerve and RF rhizotomies of knee OA, rather than nerve, significant improvements in function, discomfort, and patient satisfaction were seen. They stated that the WOMAC stiffness and physical function subscales are not significantly affected by the RF therapy. In fact, the RF therapy changed the WOMAC pain domain in a way that makes it likely that the patients' complaints were only related to knee pain rather than stiffness and physical dysfunction.<sup>21</sup> After total knee replacement, the patients received cooled RF for the genicular nerve in a study conducted by Bellini et al. It was determined that after the surgery, the patients' VAS scores improved in the first, third, sixth, and twelfth months of follow-ups.<sup>22</sup> The results of current study revealed that patients having severe anxiety and depression at the start of study significantly reduced after 12<sup>th</sup> week. In a study, it was discovered that patients with osteoarthritis experienced higher levels of anxiety, depression, and psychological distress.<sup>8</sup> Psychological issues may accompany OA, which is a chronic condition that requires long-term therapy, increase the severity of the disease. According to another study, depression is closely associated to OA patients. Additionally, it was noted that the pain caused by osteoarthritis and associated depression have a strong relationship.<sup>23</sup> Another study concluded that anxiety is a problem for OA patients because their limbs hurt when they move. Due to the wear and tear of carrying most of their body weight and supporting them while walking, bending, sitting and standing up, patients' knees become weaker as they age.<sup>24</sup> The two main symptoms of OA, pain and physical disability, are associated with anxiety and depression. By impairing pain perception and functioning, anxiety and depression can severely affect patients' quality of life. Since OA is a progressive disease, many OA patients eventually require surgery. Patients who undergo surgery may experience anxiety, but their behavior can be modified with regard to their health by informing them about the treatment and encouraging them to develop a self-care plan.<sup>25</sup>

## Conclusion

This study has demonstrated that genicular nerve rhizotomies using thermal RF is a safe and effective treatment option that helps improve symptoms of patients with chronic knee OA while significantly reducing pain, HADs and improving OKS. It also relieves joint stiffness and impairment caused by persistent pain due to knee osteoarthritis. It is suggested that the use of RF rhizotomies should be preferred for knee OA patients who have not responded to conservative treatments but have had a positive response to diagnostic blocks.

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## Conflicts of interest

None

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