

Radiofrequency ablation of genicular nerve in a patient with knee pain associated with osteoarthritis



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ABSTRACT

Osteoarthritis is a leading cause of pain and disability in the elderly. In addition to the economic burden, the pain caused by knee osteoarthritis may also reduce the quality of life and affect the patient's psychological condition. Surgery is the best option for patients with severe osteoarthritis. However, a patient with severe osteoarthritis generally tend to be elderly and have multiple

co-morbidities, and thus, may not be a suitable candidate for surgery. In regards to several interventional methods that have been investigated, radiofrequency ablation (RFA) neurotomy showed promising results. We report a case of 65-year-old woman with chronic knee osteoarthritis pain that underwent a conventional RFA procedure for right genicular nerve.

Keywords: Osteoarthritis, genicular nerve, radiofrequency ablation

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INTRODUCTION

Osteoarthritis (OA) is a degenerative joint disease which involves cartilage destruction as well as the surrounding tissue. Muscle weakness and synovial inflammation can also occur. Cartilage destruction in osteoarthritis is a leading cause of pain and disability in the elderly. Whilst its exact mechanism is unknown, it is speculated that degenerative changes with inflammatory reaction play a role in osteoarthritis' pathogenesis. Osteoarthritis can be defined based on pathology, radiography, and clinical findings. The most common method to define osteoarthritis radiographically is by using Kellgren-Lawrence (K/L) classification. In this classification, there are gradings (0-4) based on findings of osteophyte, joint space narrowing, sclerosis, cyst formation, and deformity.

Knee osteoarthritis showed the radiographic prevalence of 19.2% in individuals older than 45 years, and up to 43.7% in 80 years. The most common risk factor was obesity. Nationally, knee osteoarthritis' prevalence in Indonesia was 30.3%, with the highest prevalence found in West Papua province (28.8%). The prevalence increased along with age, with 5% at the age of <40 years, 30% at the age of 40-60 years, and 65% at the age of >60 years. In addition to the economic burden, knee osteoarthritis may also reduce the quality of life and affect the patient's psychological condition, especially due to the chronic pain produced.

Osteoarthritis may be managed by several treatment strategies, such as non-pharmacological (i.e. education, exercise, physiotherapy), pharmacological (i.e. analgesic), and surgery. In general, the first two

therapies are carried out simultaneously. Surgery is indicated only if the patient has refractory pain even after both non-pharmacological and pharmacological therapy. Surgery is the best option for patients with severe osteoarthritis. However, a patient with severe osteoarthritis generally tend to be elderly and have multiple co-morbidities, and thus, may not be a suitable candidate for surgery. To reduce the gap between pharmacological treatment and surgery, several interventional methods have been investigated. One of the most promising interventional methods is Radiofrequency Ablation (RFA). RFA in knee osteoarthritis patients aims to reduce pain by targeting the genicular nerves, which are the afferent nerves of knee joints. RFA has been shown to be effective in reducing pain in patients with chronic knee pain associated with osteoarthritis. In this case report, we present a 65-year-old female with chronic knee osteoarthritis pain that underwent a conventional RFA procedure for right genicular nerve.

CASE REPORT

A 65-year-old female presented with the complaint of right knee pain for the last 5 years. She felt constant sharp, "pulsating" pain, worsened with activity, particularly when walking up the stairs. The pain was relieved with rest. The pain was 8/10 on activity using Visual Analogue Score (VAS). She experienced pain on left knee as well, although not as significant. She felt cracking on her knees whenever moved. Patient's mobility was reduced as the pain kept worsened progressively. The patient's pain was refractory to various treatments. Previous medication history included acetaminophen 500 mg orally

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3 times daily and sodium diclofenac 50 mg orally 2 times daily, which did not provide a significant effect for the pain. The patient also underwent 3 knee intra-articular injection therapies for the last 2 years. However, the relieving effect only lasted a few days. Her medical history included controlled hypertension and dyslipidemia.

On examination, the patient had a BMI of 29.1 kg/m². On inspection, there was genu varum deformity on both legs, along with antalgic gait. There was crepitation on palpation and positive effusion test on both knees. The knees also had a limited range of movement. Several maneuvers were used to assess ligament and meniscal abnormality, including anterior drawer test, posterior drawer test, Lachman test, pivot shift test, and McMurray test. Neither of the maneuvers reproduced her pain. Knee plain film revealed bilateral osteoarthritis, which was grade IV on the right knee and grade III on left knee (Figure 1).

The patient agreed to a conventional genicular nerve RFA procedure of her right knee. The procedure was performed using fluoroscopic guidance. The patient was in a supine position. The aseptic and antiseptic technique was done on the right femoral and upper tibial region. The target nerves were superior lateral, superior medial, and inferior medial genicular nerves. The anatomic locations of these targets are junction between medial femoral shaft and medial femoral condyle for the superior medial genicular nerve (Figure 2), junction between lateral femoral shaft and lateral femoral condyle for superior lateral genicular nerve (Figure 3), and junction between medial tibial shaft and medial tibial condyle for inferior medial genicular nerve (Figure 4). Needles were placed using a 'tunneling' technique until the needle touched the bone and confirmed using the anteroposterior (AP) view of fluoroscopy guidance. Three 10-cm COSMAN RF 20G needles were placed at the said locations. Lateral view of fluoroscopy guidance was used to make sure the needle was placed at 1/2 – 2/3 of the femoral shaft for superior medial and superior lateral genicular nerve, and 1/2 – 2/3 of the tibial shaft for inferior medial genicular nerve.

Sensory stimulation was done and reproduction of pain was obtained at 50 Hz and less than 0.6 V. There was no muscle fasciculation in motoric stimulation of 2 Hz and 2 V. Two milliliter of 2% lidocaine was injected before ablation. The ablation was done using COSMAN RF machine at 80°C for 90 seconds for 2 cycles by turning the needle tip 180°. There was no noted adverse effect. The patient was followed up after 3 months. She reported that the pain was reduced significantly, with VAS of 1-2 on rest and 2-3 on activity. The patient could do her daily activities as usual.



Figure 1 Knee plain film (AP view) showed grade IV right knee OA (right) and grade III left knee OA (left)



Figure 2 Needle position at superior medial genicular nerve. (A) AP view; (B) Lateral view

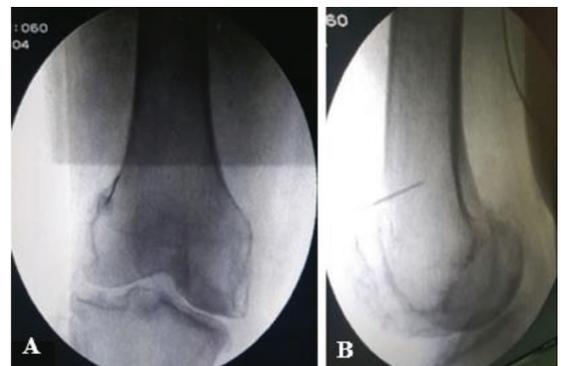


Figure 3 Needle position at superior lateral genicular nerve. (A) AP view; (B) Lateral view



Figure 4 Needle position at inferior medial genicular nerve. (A) AP view; (B) Lateral view

DISCUSSION

The current guideline on OA's management plan consists of non-pharmacological therapy, pharmacological therapy, as well as surgery.¹ Despite the effectiveness of conservative therapy (physiotherapy, an analgesic such as non-steroidal anti-inflammatory drugs, intraarticular steroid injection, or visco-supplementation), it only offers temporary effect, with relatively high-cost and possible significant side effects, especially to elders.² Knee arthroplasty, is the best option for a patient with severe osteoarthritis. However, most of the patients is not a suitable candidate to undergo surgery due to having multiple co-morbidities or the patient simply not prefer to undergo surgery.³ Such a proposition has led to investigations for new therapeutic modality for patients who are not suitable for surgery.

Studies have shown that genicular nerve radiofrequency ablation (RFA) neurotomy has been promising, with satisfying results. RFA was generally used to alleviating pain from the degenerative process at sacroiliac and facet joints. Genicular nerve RFA is indicated in 1) patients with chronic knee pain associated with osteoarthritis, 2) patient with failed knee replacement, 3) patient who is not a suitable candidate for knee replacement, 4) patient who is not willing to undergo surgery, and 5) patient with neuropathic pain associated with inflamed genicular nerve.⁴ This technique involves ablation of superior

lateral, superior medial, and inferior medial genicular nerves. These nerves function as afferent pain signal from the anterior joint capsule. Lesion made by RFA is known to cut off nociceptive pain input (A- δ and C-fiber) from peripheral to central nervous system without damaging sensory or motoric fiber (A- β). Heat from ablation cause thermocoagulation and local neuronal destruction, leading to scarring, acute inflammatory response, cell necrosis, and fibrosis with collagen fiber deposition.⁵

RFA procedure requires the anatomical site as a lesion target. Articular branches, also known as genicular nerves, innervates the knee. These nerves are the sensory branches of the femoral, tibial, common peroneal (fibular), saphenous, and obturator nerves. The target of knee RFA are branches of the common peroneal and tibial nerves. The superior lateral genicular nerve originates from the common peroneal nerve. The superior lateral genicular nerve descends towards the popliteal fossa and supplies the superolateral part of the joint, passing through the biceps, along with the lateral intermuscular septum above the femoral condyle. The location of the superior lateral genicular nerve is at the junction between the lateral femoral shaft and the lateral femoral condyle. Meanwhile, the superior medial and inferior medial genicular nerve originates from the tibial nerve. The superior

Table 1 Studies on RFA procedure in knee pain associated with osteoarthritis.

Study	Sample	RFA model	Imaging	Follow-up	Result
Choi <i>et al.</i> (2011) ¹¹	38	Conventional	Fluoroscopy	1 and 3 month(s)	Significant improvement in knee pain
Zachary <i>et al.</i> (2017) ¹²	33	Cooled RFA	Fluoroscopy	6 months	Significant improvement in knee pain (20% of patients with VAS 0/10)
Ahmed <i>et al.</i> (2017) ³	3	Conventional	USG	6 months	Significant improvement in knee pain
Wong <i>et al.</i> (2016) ⁷	1	Conventional	USG	1 month	Significant improvement in knee pain (VAS on rest 0/10, activity 2/10)
Kirdemir <i>et al.</i> (2017) ⁸	49	Conventional	Fluoroscopy	1, 4, 12 weeks	Significant improvement in knee pain
Davis <i>et al.</i> (2018) ⁹	151	Cooled RFA	Fluoroscopy	6 months	Significant improvement in knee pain, more effective than intraarticular steroid injection
Sari <i>et al.</i> (2016) ¹⁰	73	Conventional	Fluoroscopy	1 and 3 months	Significant improvement in knee pain, more effective than intraarticular steroid injection
Sylvester <i>et al.</i> (2017) ¹³	1	Conventional	Fluoroscopy	3 months	Significant improvement in knee pain (in post-TKA patients)
Protzman <i>et al.</i> (2014) ¹⁴	1	Conventional	Fluoroscopy and USG	3 months	Significant improvement in knee pain (in post-TKA patients)
Ray <i>et al.</i> (2018) ¹⁵	24	Conventional	Fluoroscopy	1, 4, 12 weeks	Significant improvement in knee pain, more effective than hyaluronic acid injection

RFA = Radiofrequency Ablation; TENS = Transcutaneous Electrical Nerve Stimulation; TKA = Total Knee Arthroplasty; VAS = Visual Analogue Score.

medial genicular nerve passes along the medial part of the femur above the medial condyle, enters the magnus adductor muscle, and through the medial vastus to the superomedial part of the joint. The superior medial genicular nerve is located at the junction between the lateral femoral shaft and the lateral femoral condyle. The inferior medial genicular nerve is the largest of the tibialis nerve, passes along the upper border of popliteus, through the anterior part between the tibial shaft and the medial collateral ligament (MCL), curving superiorly to the inferomedial part of the capsule. The inferior medial genicular nerve can be found at the junction between the medial tibial shaft and the medial tibial condyle.⁶ Genicular nerve RFA does not target other nerves as there may be motor involvement.

Genicular nerve RFA has been shown to be effective, safe, and minimally invasive. Despite limited literature regarding efficacy, there was strong evidence that supported RFA in managing knee pain. Several studies on RFA procedure in knee pain associated with osteoarthritis have been published (Table 1).^{3,7-15} The first study that determined whether genicular nerve RFA could relieve chronic knee OA pain was done by Choi et al (2011). The author concluded that genicular nerve RFA lead to significant pain reduction and functional improvement in elderly chronic knee OA pain. Since then, several studies have been conducted regarding the procedure's efficacy. In addition to the effect given, genicular nerve RFA can be repeated if necessary to provide further relief, with no cumulative effect.¹¹

In this case, the patient was diagnosed with severe OA that led her to undergo conservative management after. Both non-pharmacological and pharmacological did not provide a satisfactory result. The patient has also tried intraarticular injection, which only offered a temporary effect before the reproduction of pain. The patient was not willing to undergo surgery, thus offered the choice to undergo conventional genicular nerve RFA. There was no reported significant adverse effect, and the patient was satisfied with the result on her 1-month follow up an appointment, with significant VAS difference in before and after the procedure.

CONCLUSION

In conclusion, the genicular nerve RFA can be an effective treatment option for patients with knee pain associated with osteoarthritis who cannot or not willing to undergo surgery.

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