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Long term effect of ultrasound guided radiofrequency ablation of genicular nerves in chronic knee osteoarthritis

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Abstract
Background: Genicular nerve radiofrequency ablation (RFA) was offered as a therapeutic alternative for individuals who have not had success with conservative pain management of knee osteoarthritis (OA) and are either unsuitable candidates for surgery or prefer to avoid total knee replacement. The purpose of this work was to assess long term efficiency of ultrasonography (US) guided RFA of genicular nerves for individuals with chronic knee OA using Arabic translation of Oxford Knee Scale (OKS).
Methods: This prospective randomised clinical work had been performed on 40 participants, both sexes, with symptomatic knee OA, failed knee replacement. All patients were subjected to US -guided Cooled RFA technique overview.
Results: There was significant change of OKS after one week, three months and six to twelve months. Changes in modified Mac-Nab criteria were significantly different at different periods of measurements. No patients were referred to surgery during our follow up time.
Conclusions: US guided RFA of genicular nerves is efficient and safe technique in management of chronic knee OA.

Keywords: Ultrasound guided radiofrequency ablation, genicular nerves, chronic knee osteoarthritis, oxford knee score

Introduction
Chronic knee osteoarthritis (OA) is well recognized as the prevailing condition associated with the progression of age [1, 2] Population-based studies indicate that symptomatic knee OA affects around 20%-30% of those aged 65 years and older. This incidence is rising, partly due to the aging demographic. [3].

While there are several pharmacological and surgical therapy options available for knee OA, it is important to consider the associated issues and potential drawbacks. Non-steroidal anti-inflammatory drugs (NSAIDs) may be utilized initially to OA [4], but their long-term usage is restricted owing to significant adverse effects including dyspepsia, gastrointestinal bleeding, elevated blood pressure, exacerbation of congestive cardiac failure, and toxicity to the kidneys [5, 6].

An alternative option proposed in the recommendations for treating knee OA is the use of intra-articular corticosteroid injections [4, 7]. Repeated administrations of injections are often required to provide sustained pain relief over an extended period [8].

Genicular nerve radiofrequency ablation (RFA) has just been presented as a therapy for individuals with knee OA who have not responded to conservative pain management. This technique is suitable for those who are not good candidates for surgery or decide not to undergo total knee replacement. This approach includes the use of thermal lesioning to disrupt the sensory afferent pathways of the superior lateral, superior medial, inferior medial genicular, and Suprapatellar genicular nerves, which are also known as the retinacular nerves [9-12].

One often asked issue is if this treatment causes a Charcot-type joint to develop. It manifests as long-term impaired blood flow and changed properties of the soft tissues, along with peripheral neuropathy [13].

Fluoroscopy is the conventional method used for observing the positioning of probes. A novel visualization approach has been created, making use of ultrasonic (US) probes [14].

There are other benefits to using ultrasound, such as no radiation exposure, improved precision in needle insertion, and enhanced visibility of soft tissues. Moreover, the availability of US equipment surpasses that of fluoroscopy, hence enhancing accessibility for patients seeking this therapy [15].

The purpose of this work was to assess long term efficiency of US-guided RFA of genicular nerves for individuals with chronic knee OA using Arabic translation of Oxford Knee Scale (OKS).

Patients and Methods

This prospective randomized clinical work had been conducted on 40 participants, both genders, with symptomatic knee OA, failed knee replacement, who have medical comorbidities and/or have an elevated BMI and aren't suitable candidates for surgery, and who have previously had a successful genicular nerve RFA (GNRFA), might choose for a repeat procedure to treat recurring symptomatic knee OA. The research was conducted with clearance from the Ethics Committee of Tanta University Hospitals in Tanta, Egypt. The patients provided their informed written permission.

Criteria for exclusion had been pregnancies, acute knee injuries, psychological overlay, unstable knee joints, uncontrolled diabetes mellitus, chronic pain syndrome, bleeding disorders, existence of a pacemaker and current active, or history of chronic knee infections.

Ultrasound-guided Cooled radiofrequency ablation technique overview

Prior to the application, the patient was positioned lying in supine posture, and the skin was prepared and covered in the typical sterile manner. 1 cc of 1% lidocaine had been utilized for anaesthesia of the subcutaneous tissue and skin at each spot. The genicular nerves were detected utilizing ultrasound method. The 17-gauge RF cannula (NeuroTherm) was inserted and moved forward to the designated target sites until the needle made contact with the bone. The RF probe was positioned at a right angle to the estimated direction of the nerve. A sensory stimulus with a frequency of 50 Hz was administered, using a threshold of less than 0.6 V. Throughout the sensory stimulation, the participants were queried about sensations of pain, tingling, or discomfort inside the knee. The RF probe was kept in position until one of those sensations was triggered. Furthermore, a 2.0 V motor stimulation was administered at a frequency of 2 Hz in order to ascertain the lack of fasciculation. Prior to activating the RF generator, a 2 mL injection of lidocaine solution with a concentration of 1% was administered. Afterwards, RF lesions were created.

Superior medial geniculate nerve block

Position the transducer of US in a coronal configuration above the middle joint line and then shift it towards the junction between the metaphysis and diaphysis. Locate the genicular nerve and artery (long axis), often found in close proximity to the periosteum. If the neurovascular bundle is not clearly visible, utilize the metaphyseal/diaphyseal junction as a reference point for the insertion of the introducer. Place a mark on the skin at the halfway point of the transducer of US that aligns with the genicular artery. Rotate the transducer of US to a position that allows for an axial view of the genicular nerve and artery. Anaesthize the soft tissues and skin utilizing a 1% lidocaine solution. Insert the introducer from the front to the back utilizing a technique that aligns with the genicular artery and nerve or reaches halfway into the femur. Rotate the transducer of US coronally and confirm that the tip of the introducer is close to the genicular nerve and artery or the junction between the metaphysis and diaphysis. Sensory capture confirmed at 0.15 V and absence of motor simulation, the electrode target temperature was set to 60 °C for 120 seconds.

Inferior medial geniculate nerve block

Position the transducer of the US in a coronal configuration above the medial joint line and pass caudally towards the junction between the metaphysis and diaphysis. The genicular nerve and artery (long axis) are often situated in close proximity to the periosteum. If the neurovascular bundle is not clearly visible, utilize the metaphyseal/diaphyseal junction as a skeletal reference point for the insertion of the introducer. Indicate the location on the skin where the genicular artery aligns with the midway of the transducer of the US. Rotate the US transducer to align it axially in order to see the genicular artery/nerve in a short-axis view. Anaesthize the soft tissues and skin with a 1% lidocaine solution. Move the introducer from the front to the back utilizing a method that is aligned with the genicular nerve/artery or halfway into the tibia. Rotate the transducer of US to align with a coronally and confirm that the tip of the introducer is in close proximity to either the genicular artery/nerve or the metaphyseal/diaphyseal junction. Sensory capture confirmed at 0.15 V and absence of motor simulation, the electrode target temperature was set to 60 °C for 120 seconds.

Superior lateral genicular nerve block: Position the transducer of US coronally along the lateral joint line and advance upwards towards the junction between the metaphysis and diaphysis. The genicular nerve and artery (long axis) may be identified in close proximity to the periosteum. If the neurovascular bundle is not clearly visible, utilize the metaphyseal/diaphyseal junction as a reference point for the insertion of the introducer. Indicate the location on the skin where the genicular artery aligns with the midway of the US transducer. Rotate the transducer of the US to align it axially in order to see the genicular artery/nerve in a short-axis view. Administer 1% lidocaine for anesthesia of the soft tissues and skin. Move the introducer from the front to the back utilizing a method that follows the same plane as the genicular nerve/artery or reaches halfway into the femur. Rotate the transducer of US to position it coronally and confirm that the tip of the introducer is in close proximity to either the genicular artery/nerve or the metaphyseal/diaphyseal junction. Sensory capture confirmed at 0.15 V and absence of motor simulation, the electrode target temperature was set to 60 °C for 120 seconds.

Supra patellar genicular nerve: Position the midpoint of the transducer of the US sagittally about 5 cm closer to the superior pole of the patella. This will allow for visualization of the tendon of the quadriceps, pre-femoral fat pad, and femur. When there is a fluid accumulation, reposition the transducer to the nearest border of the accumulation. Rotate the transducer of the US by 90 degrees to provide a short-axis view of the femur and tendon of quadriceps. Take measurements to determine the depth of the fat pad located just above the femur. Administer 1% lidocaine for anesthesia of the soft tissues and skin. Place the introducer into the femur/quadricep tendon, aligning it with the midline and positioning it slightly above the periosteum**. S**ensory capture confirmed at 0.15 V and absence of motor simulation, the electrode target temperature was set to 60 °C for 120 seconds.

Follow up by Arabic version of OKS either through telephone or attendance to outpatient clinic. Patient satisfaction: The participant was requested to evaluate the level of pain reduction using a numerical scale. The scale used to assess pain levels is as follows: 0 indicates an unsuccessful outcome, 1 indicates a poor outcome, 2 indicates a moderate outcome where extra analgesics is needed, 3 indicates a good outcome with little discomfort and no need for additional analgesics, and 4 indicates an excellent outcome with no pain and any complications of the procedure was identified.

Sample Size Calculation

Utilizing the Epi Info software, a computer application developed by the Center for Disease Control and Prevention, version 2002. The number of patients was determined to be 40 according to the following criteria: The research has a 95% confidence limit and 80% power.

Statistical analysis

Statistical analysis had been conducted utilizing SPSS v26 (IBM Inc., Chicago, IL, USA). Quantitative parameters had been displayed as mean and standard deviation (SD) and contrasted between all groups utilising ANOVA (F) test with post hoc test (Tukey). Qualitative parameters had been displayed as frequencies and percentages (%) and had been analysed employing the Chi-square test. A two tailed P value < 0.05 was considered statistically significant.

Results

Demographic data had been enumerated in this table. Table 1

Table 1: Distribution of the studied cases according to demographic data

		N=40
Age (years)		54.28±10.47
Sex	Male	21(52.5%)
	Female	19(47.5%)
Weight (Kg)		90.25±12.08
ASA physical status	I	16(40.0%)
	II	19(47.5%)
	III	5(12.5%)

Data are presented as mean ± SD or frequency (%). ASA: American Society of Anesthesiologists.

There was significant change of OKS after one week, three months and six to twelve months. Change in modified Mac-Nab criteria were significant different at different periods of measurements. Table 2.

Table 2: Comparison between the different periods according to oxford knee score and change in modified Mac-Nab criteria

		Base	1 week	3 months	6 – 12 months	P
OKS		38.86±5.38	24.4±4.40	21.63±4.16	19.46±3.56	<0.001*
P_{Base}		-	<0.001*	<0.001*	<0.001*	
Change in modified Mac-Nab criteria	Excellent	0 (0%)	29 (72.5%)	22 (55%)	23 (57.5%)	<0.001*
	Good	0 (0%)	9 (22.5%)	14 (35%)	13 (32.5%)	
	Fair	21 (52.5%)	0 (0%)	0 (0%)	0 (0%)	
	Poor	19 (47.5%)	2 (4%)	4 (10%)	4 (10%)	

Data are presented as mean ± SD or frequency (%). *: Statistically significant at p ≤ 0.05, p: p value for comparing between the studied periods, P_{Base}: p value for comparing between Base with each other period, OKS: oxford knee score.

No patients were referred to surgery during our follow up time. Table 3.

Table 3: Distribution of the studied cases according to complications

		N=40
Complications	No	39(97.5%)
	Yes (numbness)	1(2.5%)

Data are presented as frequency (%).

Discussion

The use of radiofrequency neurotomy was initially implemented to address persistent pain in individuals who did not show improvement with conservative therapy methods. After achieving positive outcomes with radiofrequency neurotomy in treating trigeminal neuralgia, the same technique was used to address chronic pain in the sacroiliac and facet joints. [16].

Supporting our results in using the classical approach, Kesikburun *et al*. [17] a work was made on individuals with medial knee OA. US -guided GNRFA had been conducted only to the SMGN and IMGN to 15 knees of 9 patients using the classical approach (metaphyseal / diaphyseal junction). The assessment of pain and knee function was conducted using a 100-mm VAS. A substantial decrease in the VAS score was seen over time following pulsed RF therapy. This proves using classical approach is effective in GNRFA. Interesting, Franco *et al.* [18] conducted a dissection of 8 human knees to determine the main nerve supply of the anterior knee joint. They took images and measures of each relevant nerve branch and placed stainless-steel wires along the path of each primary nerve supply. Radiographs were then taken.

Supporting our findings for efficacy of US guided radiofrequency for knee osteoarthritic pain, Kim *et al.* [14] showed no significant variation regarding of efficiency between both the two groups, however US guidance is advantageous in preventing both physicians and patients from being exposed to radiation. Going hand in hand to our study, according to Yaşar *et al.* [19], it was determined that the injection of the inferior and superior medial genicular nerve branches may be properly accomplished in a cadaveric model utilizing anatomic landmarks and ultrasound guidance.

Supporting our results for Oxford scale follow up, work by Choi *et al.* [9] was performed to contrast fluoroscopy guided GNRFA to sham RFA. The nerves that were the focus of this study were the IM, SM, and SL genicular branches. The secondary results revealed a noteworthy correlation between the group and time for the average alterations in the oxford knee scores. Within the RF group, the oxford knee scores shown improvement at all evaluation points in comparison to the initial baseline. In addition, Ahmed A *et al.* [20] conducted genicular nerve neurolysis using ultrasound for four individuals. Following the surgery, there was a notable enhancement in the Oxford Knee Score that lasted for a period of six months.

Supporting our results of role of genicular nerve RFA of long-term pain relief and function enhancement in chronic knee OA, El-Hakeim *et al.* [21] shown that GNRFA provided significantly better pain alleviation compared to other treatments at all follow-up intervals. The function, as evaluated by the WOMAC (Western Ontario and McMaster Universities) measure, revealed enhancement in both groups after 6 months. However, the improvement was greater with GNRFA. Hong *et al.* [22] reported that GNRFA ablation of genicular nerves has a relatively long-lasting analgesic effect.

At the end of our study we can stress in the strong points of our study, using new updated anatomical study for articular nerve supply to knee which is different from old studies illustrating the nerve supply of the knee which affected the positivity of our intervention for those articular nerves [23], using US for guidance of our intervention with it known advantages, using valid Arabic translation of the OKS which is used to evaluate patients after total knee arthoplasty (TKA) and then extended to evaluate outpatients in chronic knee OA [24]. Lastly, we put the long-term efficacy as primary outcome which improved strength of the procedure in the view of our patients.

Limitations of the work involved the relatively small sample size. Nature of knee osteoaethritis disease with complicated pathophysiology and variability between patient and patient and even on both legs of same patient may lead to bias in the results and difficulty in choosing the inclusion and exclusion criteria.

Conclusion

US guided RFA of genicular nerves is efficient and secure technique in treatment of chronic knee OA.

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Conflict of Interest: Nil

References

1. Felson DT. An update on the pathogenesis and epidemiology of osteoarthritis. Radiologic Clinics of North America. 2004;42:1-9.
2. Di J, Bai J, Zhang J, Chen J, Hao Y, Bai J, *et al.* Regional disparities, age-related changes and sex-related differences in knee osteoarthritis. BMC Musculoskeletal Disorders. 2024;25:66-70.
3. Ikeuchi M, Ushida T, Izumi M, Tani T. Percutaneous radiofrequency treatment for refractory anteromedial pain of osteoarthritic knees. Pain Medicine. 2011;12:546-551.
4. Hochberg MC, Altman RD, April KT, Benkhalti M, Guyatt G, McGowan J, *et al.* American College of Rheumatology 2012 recommendations for the use of nonpharmacologic and pharmacologic therapies in osteoarthritis of the hand, hip, and knee. Arthritis Care & Research (Hoboken). 2012;64:465-474.
5. Scott D, Berry H, Capell H, Coppock J, Daymond T, Doyle D, *et al.* The long-term effects of non-steroidal anti-inflammatory drugs in osteoarthritis of the knee: A randomized placebo-controlled trial. Rheumatology. 2000;39:1095-1101.
6. Sostres C, Gargallo CJ, Lanas A. Nonsteroidal anti-inflammatory drugs and upper and lower gastrointestinal mucosal damage. Arthritis Research & Therapy. 2013;15:213-220.
7. McAlindon TE, Bannuru RR, Sullivan MC, Arden NK, Berenbaum F, Bierma-Zeinstra SM, *et al.* OARSI guidelines for the non-surgical management of knee osteoarthritis. Osteoarthritis and Cartilage. 2014;22:363-388.
8. Gossec L, Dougados M. Intra-articular treatments in osteoarthritis: From the symptomatic to the structure modifying. Annals of the Rheumatic Diseases. 2004;63:478-482.
9. 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;152:481-487.
10. Bellini M, Barbieri M. Cooled radiofrequency system relieves chronic knee osteoarthritis pain: The first case-series. Anaesthesiology and Intensive Therapy. 2015;47:30-33.
11. Rojhani S, Qureshi Z, Chhatre A. Water-cooled radiofrequency provides pain relief, decreases disability, and improves quality of life in chronic knee osteoarthritis. American Journal of Physical Medicine & Rehabilitation; C2017;96
12. Shen WS, Xu XQ, Zhai NN, Zhou ZS, Shao J, Yu YH. Radiofrequency thermocoagulation in relieving refractory pain of knee osteoarthritis. American Journal of Therapeutics. 2017;24:693-700.
13. Dellon AL. Partial knee joint denervation for knee pain: A review. Orthopedic Muscular System. 2014;33:2161-2166.
14. Kim DH, Lee MS, Lee S, Yoon SH, Shin JW, Choi SS. A prospective randomized comparison of the efficacy of ultrasound- vs fluoroscopy-guided genicular nerve block for chronic knee osteoarthritis. Pain Physician. 2019;22:139-146.
15. Garratt AM, Brealey S, Gillespie WJ. Patient-assessed health instruments for the knee: A structured review. Rheumatology. 2004;43:1414-23.
16. Chase G, Jani S, Manchikanti L, Simopoulos TT. Sacroiliac Joint Injections and Radiofrequency Neurotomy. Essentials of Interventional Techniques in Managing Chronic Pain. 2nd ed: Springer; C2024. p. 409-435.
17. Kesikburun S, Yaşar E, Uran A, Adigüzel E, Yilmaz B. Ultrasound-guided genicular nerve pulsed radiofrequency treatment for painful knee osteoarthritis: A preliminary report. Pain Physician. 2016;19:751-759.
18. Franco CD, Buvanendran A, Petersohn JD, Menzies RD, Menzies LP. Innervation of the anterior capsule of the human knee: Implications for radiofrequency ablation. Regional Anesthesia & Pain Medicine.

2015;40:363-368.
19. Yasar E, Kesikburun S, Kılıç C, Güzelküçük Ü, Yazar F, Tan AK. Accuracy of ultrasound-guided genicular nerve block: A cadaveric study. Pain Physician. 2015;18:899-904.
20. Ahmed A, Arora D. Ultrasound-guided neurolysis of six genicular nerves for intractable pain from knee osteoarthritis: A case series. Pain Practice. 2019;19:16-26.
21. El-Hakeim EH, Elawamy A, Kamel EZ, Goma SH, Gamal RM, Ghandour AM, *et al*. Fluoroscopic guided radiofrequency of genicular nerves for pain alleviation in chronic knee osteoarthritis: A single-blind randomized controlled trial. Pain Physician. 2018;21:169-177.
22. Hong T, Wang H, Li G, Yao P, Ding Y. Systematic review and meta-analysis of 12 randomized controlled trials evaluating the efficacy of invasive radiofrequency treatment for knee pain and function. Biomedical Research International. 2019;2019:90-99.
23. Fonkoué L, Behets C, Kouassi J-ÉK, Coyette M, Detrembleur C, Thienpont E, *et al*. Distribution of sensory nerves supplying the knee joint capsule and implications for genicular blockade and radiofrequency ablation: An anatomical study. Surgical and Radiologic Anatomy. 2019;41:1461-1471.
24. Ahmed KM, Said HG, Ramadan EKA, Abd El-Radi M, El-Assal MA. Arabic translation and validation of three knee scores, Lysholm Knee Score (LKS), Oxford Knee Score (OKS), and International Knee Documentation Committee Subjective Knee Form (IKDC). SICOT-J. 2019;50:23-26.

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