Original Article

Effects of Dry Needling on Pain in Patients with Knee Osteoarthritis: A Preliminary Study

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Abstract

Background: Osteoarthritis is one of the most common rheumatological diseases and is also considered as one of the causes of myofascial trigger points (MtrPs). Dry needling (DN) is one of the methods used for the treatment of the MtrPs. The aim of the current study was to investigate the effects of DN on pain in participants with knee osteoarthritis (KOA). **Materials and Methods:** In this before and after preliminary clinical trial study, patients with mild to moderate KOA were enrolled. In one session, after determining the location of trigger points in quadriceps and gastrocnemius muscles, the patients underwent DN. The pain was evaluated at baseline, by passing 4 days and 1 month from the intervention using the Visual Analog Scale (VAS). **Results:** Sixteen patients with a mean age of 56.5 (4.53) years old have completed the study and follow-up period. According to the ANOVA analysis, VAS values indicated a significant decrease in pain score at the 4th and 1 month after the intervention compared to baseline ($P < 0.001$). There was no significant difference between VAS at the 4th day of intervention and also 1 month later of intervention ($P = 0.087$). **Conclusion:** The application of one session DN can lead to improvement in pain intensity in participants with mild to moderate KOA.

Keywords: *Dry needling, knee osteoarthritis, myofascial trigger points, pain*

Introduction

Knee osteoarthritis (KOA) is one of the most common musculoskeletal and rheumatological disease and more than 250 million people worldwide have KOA.[1,2] In patients with KOA, due to the biochemical variations of the disease, the joint forces during walking and daily activities can be changed.[3] Consequently, the amount of forces applied to the muscles around the joints has been also altered.[4] Evidences indicated that, over time, these muscles can be affected by myofascial pain syndrome, while myofascial trigger points (MtrPs) is the main cause of pain in this syndrome.[5-7] It requires emphasizing that trigger points (TrPs) as one of the most common sources of musculoskeletal pain, are an undeniable element in patients with KOA and may cause some symptoms such as pain, loss of range of motion, and joint stiffness.[6,8]

Given that the KOA is one of the causes of myofascial pain syndrome, the probability of trigger points formation is higher in muscles playing a role in the knee joint loading and stabilization compared to others. Therefore, the prevalence of TrPs in gastrocnemius and quadriceps muscles due to KOA are very high,[3,5,9] while the presence of TrPs in these muscles result in reduced joint range of motion and strength of associated muscle.[7,10] The findings of previous study demonstrated that all of the patients with KOA waitlisted for total knee arthroplasty had TrPs in quadriceps and gastrocnemius muscles, especially in the head of gastrocnemius muscle,[9]

The TrPs, as sensitive and painful points, can lead to more joint stiffness, increased disruption of joint biomechanics, muscle imbalance, acceleration of destruction process, and increased pain in osteoarthritic joints.[5,11,12] In spite of developing and introducing different rehabilitation treatments for KOA such as physical modalities; therapeutic exercises; manual, mechanical therapy, and lifestyle modification; local injection; spray-stretching; Friction massage; and acupuncture, it seems that the role of MtrPs treatment has not been appropriately considered in the list of therapeutic

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modalities of KOA. However, considering the role of MtrPs in the pathogenesis of KOA-related pain and symptoms, prioritizing trigger points treatment in the individuals suffering from KOA is essential.[5,11]

Dry needling (DN) is one of the invasive methods that has been recently used for the treatment of the MtrPs to inactivate them, eliminating muscle shortness, and remove the source of muscle irritation.[5,7] Previously, the positive effect of this technique on reducing pain and improving the function of some musculoskeletal disorders has been demonstrated.[5,13-17]

Considering the effects of DN technique on the treatment of MtrPs, helping to diminish the duration and cost of treatment, pain reduction, and improving the range of motions,[18-20] it seems that this method could be considered as a good choice to improve the symptoms of KOA people.

Some recent studies have investigated the efficacy of DN on pain and symptoms belonged to the patients with KOA.[6,21] However, the results are not conclusive enough. Considering the high prevalence of KOA and lack of enough evidence related to the efficacy of DN on TrPs of specific muscles that are mostly involved in KOA, we aimed at evaluating the effectiveness of DN on pain in the participants with KOA. It is anticipated that DN of gastrocnemius and quadriceps muscles would improve the pain intensity of the patients by passing 4 days and 1 month from the treatment.

Materials and Methods

Study design

A before and after preliminary clinical trial study was designed to explore the effect of DN on pain in people with mild and moderate KOA. This research was registered at Iranian registry of clinical trials (IRCT20180427039430N1).

Participants

Sixteen patients aged over 50 years old with mild to moderate KOA were referred by orthopedic surgeon or rheumatologist to "Sedigheh Tahereh Rehabilitation Center" from March 2018 to March 2019. They were enrolled based on the clinical diagnosis of KOA, in terms of the criteria from the American College of Rheumatology for medial KOA including medial knee pain lasting for 3 months or longer, crepitus on joint mobilization, and morning stiffness lasting 30 min or more.[22-24] KOA severity was classified based on a recent radiograph of the knee joint according to the Kellgren-Lawrence (K–L) grading scale using the atlas of the Osteoarthritis Research Society International.[25] The patients with mild to moderate KOA (grade 1-3) in at least one knee were recruited for this research; however, in cases with equal pain in both knees, dominant limb was treated; otherwise, the painful limb was noticed.

Pain level of KOA participants was higher than 30 mm on the Visual Analog Scale (VAS),[26] while Tegner activity scores between 1 and 3 were selected to ensure that the athlete and sedentary participants did not enter to the study. The other inclusion criteria were a history of knee pain in the last 3 months or more[22,23] and having trigger points in muscles surrounding the knee according to Simons criteria (A taut band in muscle fiber during palpation, A hypersensitive tender point in the taut band, local twitch response during compression and reproduction the referred pain during trigger points compression).[10,27,28] The participants were excluded from the study if they had a history of intra-articular corticosteroid injections or DN in last 6 months, trauma, radiculopathy, myopathy, deformity, fracture or surgery in lower limbs, fibromyalgia, hypothyroidism, meralgia paresthetica, joint instability or hemorrhage, systemic disease such as lupus erythematosus, taking anticoagulant drugs, prolonged use of corticosteroid medications, alcohol consumption and drug abuse, communication and cognitive disorders, local infection, pregnancy with the risk of abortion, menstruation, serious illness, needle phobia (fear of needles) or patellofemoral pain syndrome.[7,12,21,29,30]

Participants were completely aware of the study content, and signed a formal consent before participation. The Research Ethics Committee of Isfahan University of Medical Sciences approved the study protocol (IR. MUI. RESEARCH. REC.1397.084).

Interventions and test procedures

After enrolling to the study, a blinded physiotherapist re-evaluated the participants based on the eligibility criteria. Participants were excluded if they had only one contradiction with any criteria.

Participants were requested to fulfill the demographic form before the intervention. A blinded expert physiotherapist determined the location of trigger points in terms of the criteria described by Simons.[27,30,31] If these criteria were examined by skilled, trained, and experienced assessors, they are sufficiently reliable, as having a good inter-examiner reliability ($\kappa = 0.84–0.88$).[3,32]

After determining the location of TrPs in quadriceps and gastrocnemius muscles, all of them have been needled by experienced and skilled researcher in supine and prone positions, respectively. The area was disinfected with alcohol before the needling, then a solid filament needle of 50 mm in length and 0.3 mm in diameter was inserted to the identified TrPs. In order to create similarity in the needling procedure, the muscles have been repeatedly needled by up and down (sweeps) technique up to ten times for 10 s.[33] To avoid losing any patient during the study, a physiotherapist communicated with the participants once a week by telephone during the entire duration of the follow-up. It is necessary to explain that after completing

the study and in regard to ethical principles, participants were treated with standard physiotherapy.

Outcome measurements

The changes in pain were the outcome measures of this research study that were evaluated before the intervention and by passing 4 days and 1 months from that. The participants' pain was evaluated using VAS as a valid and reliable scale.[34,35]

Statistical analysis

Data were analyzed using the SPSS software with a global alpha of 0.05. The normal distributions of data were examined by Doornik-Hansen multivariate normality test. The sphericity of data was tested using Mauchly's test. Since three time points were examined in this research, the repeated measures analysis of variance (ANOVA) was used to compare the means of the variables across three time points. *Post hoc* analysis was conducted by pairwise compression with Bonfferoni test. In order to determine the clinical relevance of results and measure the effect size for the ANOVA, Hedges' *g* and Eta-square (η2) were calculated.

Results

In this study, from initially 20 selected KOA patients, 16 participants have completed the study and follow-up period. Diagram of the patients' enrollment and follow-up is presented in Figure 1.

Table 1 demonstrates the demographic characteristics of participants. Normal distribution of VAS was confirmed by Doornik-Hansen multivariate normality test ($P = 0.160$).

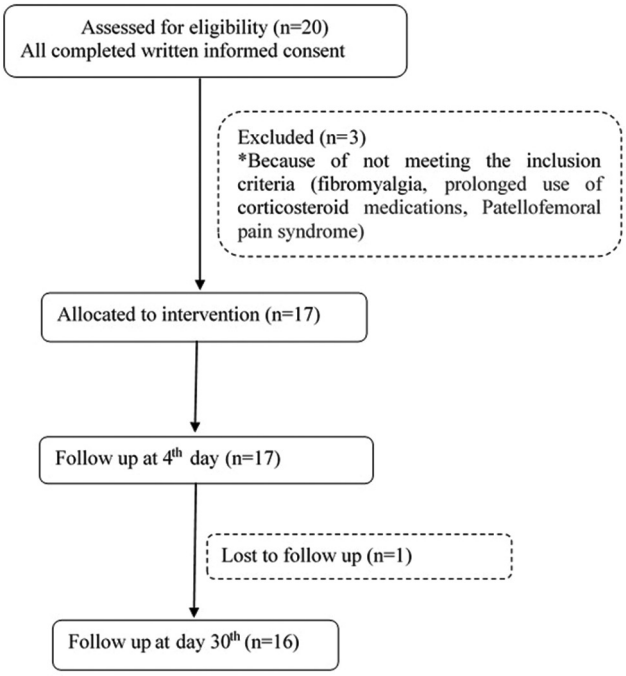

Figure 1: Diagram of the patients' enrollment and follow-up

The mean and changing pattern of VAS at baseline, at 4th day, and 1 month after the intervention are presented in Figure 2. According to repeated measure ANOVA test (within-subjects effects), VAS scores showed significant reductions during follow-ups ($F [2, 30] = 53.10$; $P < 0.001$; (effect size) partial eta squared = 0.780).

The comparison of the mean differences of VAS at baseline with the 4th day and 1 month after intervention in the study participants is presented in Table 2. The results of Bonferroni test for VAS indicated significant decrease in pain score at the 4th day and 1 month after the intervention compared to baseline ($P < 0.001$). Although the amount of pain showed a decreasing trend by passing 1 month from the intervention compared to the 4th day after the intervention, the differences were not statistically significant.($P = 0.087$). With respect to the power analysis, the sample size was sufficient to provide significant differences in outcome measure, effect size ($\eta 2 = 0.280$), $\alpha = 0.05$, power ($1-\beta$) = 0.80.

Discussion

In this preliminary study, we evaluated the effects of one session of DN on pain in people suffering from mild to moderate KOA. Our findings indicated that this easy, safe, and low-cost technique could be effective in reducing pain and improving the symptoms among the affected patients.

Considering the high prevalence of KOA and the unique role of knee joint in individual independence during daily activities and self-care, developing disabilities for the affected people was not unexpected.[1,36] One of the effective factors in the pain of these individuals can be MtrPs. Due to the changes in the biomechanics of the joint with osteoarthritis, the forces applied on the muscles have changed; and subsequently, they will create TrPs in the muscles.[5,6,21,37] Itoh *et al*. stated significant improvement in pain and WOMAC index following three sessions of

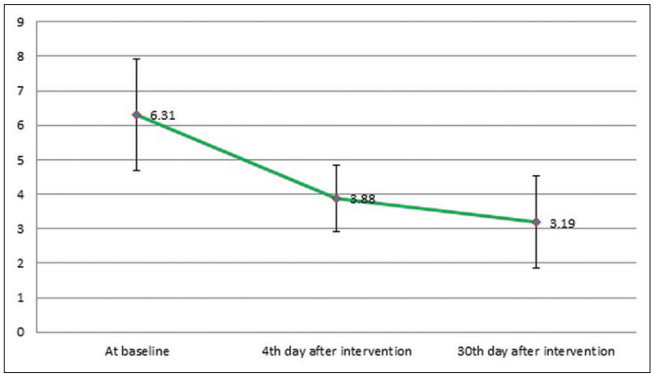

Figure 2: Mean Visual Analog Scale in patients with knee osteoarthritis at baseline, 4th day, and 1 month after intervention

treatment in patients with KOA (K–L ≥2) within 5 weeks of follow up.[38]

During movements such as knee bending or foot plantar flexion during climbing the stairs, the gastrocnemius and quadriceps muscles will be in contraction or stretching, which are considered to be the sources of pain. Since gastrocnemius and quadriceps muscles are most likely to interfere with the MTrPs.[9] Thus, these muscles play a critical role in knee join loading and stabilization.[9] Henry *et al*. found that treating TrPs by bupivacaine injection in gastrocnemius and quadriceps muscles is very effective for improving pain and activities of daily living, and its effects can last up to 1 month.[9]

Therefore, in this study, we evaluated DN effects of TrPs in these two important muscles. In literature review, we found few studies that evaluated the effectiveness of DN on pain intensity of patients with KOA, and the results were controversial.

Sánchez *et al*. in two studies have investigated the effect of DN addition to therapeutic exercise on disability and pain intensity during the treatment of older KOA patients with MTrPs. In the first pilot clinical trial, they indicated that despite the improvement of pain intensity and disability after both DN and sham-DN combined with exercise, DN sessions added to therapeutic program did not improve symptoms.[30] In the second clinical trial, they evaluated the effects of DN plus an exercise program with 1-year follow up, on the earlier mentioned symptoms. Their finding showed that long-term exercise program in conjunction with DN did not improve symptoms compared to sham-DN in the subjects suffering from KOA.[21] In both studies, pain intensity and function were assessed using numeric pain rating scale (NRS) and the Western Ontario and McMaster Universities Osteoarthritis Index questionnaire (WOMAC), respectively. In another recent study, Dunning *et al*. demonstrated that adding electrical DN to the routine manual therapy (MT) and exercise program of KOA treatment protocol could significantly improve pain intensity, disability, and functionality of patients with KOA. They indicated significant reduction in using medication for pain relief in affected patients.[24] In the mentioned studies, all of the lower limb muscles frequently involved in myofascial knee pain were examined. In our study, we used only one session of DN in gastrocnemius and quadriceps muscles, and then evaluated the short-term effect of the procedure for 1 month.

Since the positive progression was observed in the symptoms of participants and lasting effects until 1 month later, it seems that the study protocol is more affordable and has fewer side effects for patients. However, these results were in contrast to reports of the systematic review and meta-analysis.[5] Despite poor and inconsistent results on the DN effect in people suffering from KOA, previous studies have confirmed the needle as a treatment for decreasing pain intensity.[21,39] Given that the purpose of DN is to inactivate the muscle dysfunction induced by TrPs, treating musculoskeletal pain disorders and improving function, our findings were not unexpected.[5,40] Due to the correct selection of involved muscles and paying attention to their fundamental role in knee functions, improvement was observed with only one treatment session. Moreover, a skilled therapist has an important role in identifying the TrPs, safety intervention and minimizing side effects of DN.[5] Regardless of importance of evaluating the clinical effectiveness in interventional studies, in addition to statistical analysis, the effect size was also considered. In the present research work, despite significant statistical changes, the results of the effect size revealed the large clinical relevance in the improvement of participants' symptoms. Moreover, power analysis showed that the sample size was sufficient to provide significant differences in this variable.

Although this is the first before and after clinical trial study specifically designing the effect of DN on pain in people with mild and moderate KOA, the current results should be generalized within the context of its strengths and limitations. The strength of current research includes the effectiveness of only one session of DN on TrPs of specific muscles. Short duration of follow-up, subjective evaluation of the studied variable and having no control group are

Table 1: Demographic characteristics of study participants with knee osteoarthritis

Variables	Mean (SD)/*n* (%)
Age (year)	56.5 (4.53)
Sex (male/female)	3/13 (18.8/81.2)
Weight (kg)	77.0 (7.65)
Height (m)	1.62 (0.07)
BMI (kg/m^2)	29.3 (3.79)
Pain at baseline (VAS)	6.31 (1.62)

BMI: Body mass index, VAS: Visual analog scale, SD: Standard deviation

Table 2: Comparing the difference of mean of Visual Analog Scale between baseline, 4th day and 1 month after the intervention in the study participants

VAS	Mean difference (95% CI)	SE	*P*	Eta-square (95% CI)	Hedge's g (95% CI)
Baseline versus 4 days	2.438 (1.42-3.45)	0.376	<0.001*	0.736 (0.41-0.84)	1.66 (0.96-2.66)
Baseline versus. 30 days	3.125 (2.35-3.89)	0.287	<0.001*	0.888 (0.71-0.93)	1.95 (1.26-2.93)
4 days versus 30 days	0.688 (−0.07-1.45)	0.285	0.087	0.280 (0.02-0.54)	0.54 (0.06-1.11)

*Significant differences at 0.05 levels. VAS: Visual Analog Scale, SE: Standard error, CI: Confidence interval

considered to be the main limitations of the study. In addition, not comparing the method with other techniques are the weakness of our research, which should be included in future studies. We also cannot be certain that the results are generalizable to severe KOA.

Conclusion

This study showed that the one session DN can lead to improvement in pain intensity in participants with mild to moderate KOA.

Clinical relevance

- Significant decrease in pain intensity, 4 days and 1 month after using DN in patients with mild to moderate KOA
- Large clinical relevance in improvement of patients' symptoms in addition to statistical changes
- Persistence of the effects of only 1 session DN for up to 1 month.

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Conflicts of interest

There are no conflicts of interest.

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