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Effects of trigger point dry needling on pain, strength, and functional status among patients with anterior knee pain: a randomised controlled trial

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Abstract

Introduction. The objective of this study was to assess the effects of trigger point dry needling on pain, strength, and functional status among patients with anterior knee pain.

Methods. This randomised controlled trial was conducted in the physical therapy department, Memon Medical Institute Hospital. Thirty patients, both male and female, between the ages of 20–45 years, participated. They were randomly divided into two groups through the sealed envelope method. Stretching and strengthening exercises were given to both groups; moreover, the experimental group underwent dry needling. The primary outcomes were pain intensity, knee range of motion, and muscle strength measured by the Numeric Pain Rating Scale (NPRS), goniometry, and manual muscle testing. The secondary outcomes were disability measured by the Kujala score and the Lower Extremity Functional Scale (LEFS). The assessment was done at baseline and after the second and fourth weeks. The Shapiro–Wilk test determined the normality, and the Mann–Whitney and an independent sample *t*-test were used to compare the variables.

Results. The average age of participants was 33.8 years, and the study includes 46.7% males and 53.3% females. The Mann–Whitney and an independent sample *t*-test showed that every participant in the experimental group experienced a significant improvement in their functional status, muscle strength, pain, and knee ranges ($p < 0.05$). No significant differences were reported for the range of motion of left knee flexion, or strength of the left quadriceps muscles ($p > 0.05$).

Conclusions. This randomised controlled trial shows that both techniques are effective for the treatment of anterior knee pain; however, the dry needling technique is a clinically more effective treatment approach to decreasing pain and improving muscle strength, knee ranges and functional status in patients.

Key words: dry needling, exercise, functional status, range of motion, pain

Introduction

Anterior knee pain (AKP) is the most common reason for consulting physicians in the context of knee problems in the young and adult population, with sports-participating individuals experience up to 74% of knee pain. Meanwhile, AKP is a common occurrence in working adults, where it has critical social influence due to work absences and reduced efficiency as well as the financial expenditure included in the treatment of these individuals [1]. Anterior knee pain occurs at the anterior and middle point of the knee, and can be caused many disorders, including chondromalacia patella, runner's knee, quadriceps tendinitis, and patella maltracking. Tightness or weakness of the muscles on the anterior and back of the thigh and performing excessive work that places extra stress on the patella (such as running, jumping or twisting, skiing, or playing soccer) can contribute to patellar problems. Individuals having flat feet, overweight, a history of patellar dislocation, any fracture, runners, jumpers, skiers, bicyclists, and soccer players have a high risk of developing anterior knee pain [2]. AKP is a common disorder, with an incidence of around 22.7% of the general population and 28.9% of adolescents and can result from many factors, including weak knee and hip muscles, tight leg muscles, an unexpected increase in physical activity that has not been previously performed, e.g., prolonged running or frequent stair climbing, increased physical training, previous knee injury/surgery, or foot/ankle disorders, including flat feet [3]. The most common symptom reported by an individual with anterior knee pain is retropatellar or peripatellar pain. Further symptoms beyond the pain are a sensation of giving way, walking on uneven surfaces, particularly during stairs or ramps, and crepitus. The unanticipated reflex inhibition and/or quadriceps muscle atrophy cause the episodes of giving-way. Under the best of circumstances, crepitus is asymptomatic, but in 62% of first-year medical students, it is common [4]. The beginning of anterior knee pain is usually insidious and without trauma; it imitates an overuse disorder or a basic malalignment. Misuse of muscles may results from performing a novel action or an increase in the occurrence or strength of normal activities [5].

Myofascial trigger points (MTrPs) are hyper-irritable points inside a taut band of skeletal muscle or muscle fascia that initiates pain on pressure at a target spot and across all the adjacent parts, which is referred pain. Overexerting muscles leads to the development of trigger points, fatigue or damage to the muscle [6, 7]. MTrPs cause pain and pressure in the muscle or muscle fibre, which leading to reflex inhibition of the muscle and the advancement of fatigue, which makes the muscle more susceptible to supplementary trigger points. MTrP pain has been treated with a variety of techniques, such

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as physical activity, MTrP injections, posture adjustment, range of motion exercises, cardiovascular fitness, strengthening and stretching exercises, addressing perpetuating factors, tricyclic antidepressants, muscle relaxants, and other drugs [8]. There is evidence that the vicious cycle of pain, dysfunction and instability, lead to insufficiency and weakness of the quadriceps muscle, leading to the muscle having to work harder to attain similar contraction to perform movement, ultimately resulting in overuse and fatigue. This clarifies the etiology of MTrPs in quadriceps muscles [9]. Previous research showed that 95% of individuals revealed latent or active trigger points in their quadriceps, and a significant amount of overlap among the occurrence of myo-fascial pain syndrome and patella-femoral pain syndrome. Research has verified that myofascial pain syndrome is an analytical feature connected to patella-femoral pain [6]. Another study recommended that active trigger points in knee muscles, mainly the vastus medialis and lateralis muscles should be addressed in the management [10].

Myofascial trigger point (MTrP) therapy had made extensive use of dry needling. Following the cessation of muscular twitching, there is a significant reduction in discomfort and dysfunction as well as impulsive electrical activity. Using a relatively recent method, dry needling is utilised by medical professionals and physical therapists worldwide. It has been discovered that the profound dry-needling approach is more successful than the superficial one in treating pain associated with MTrPs. Therefore, it is recommended that this be the method of choice [11]. MTrPs are highly irritable points within a taut band of skeletal muscle, causing pressure pain. When palpated, MTrPs in the quadriceps muscle could generate peripatellar and anterior knee pain, which is a characteristic of patellofemoral pain syndrome (PFPS). It is advised to apply this approach only to the superficial sections of the body, which have also been shown to be somewhat beneficial, while the upper parts of the body carry a danger of significant adverse effects, such as in the lungs and massive blood arteries. In order to validate the findings that paraspinal needling supplementing MTrP needling is more successful than MTrP needling alone, additional study is needed to evaluate the effectiveness of superficial dry needling [12]. The therapeutic effects of dry needling (DN) are attributed to its mechanical, neurophysiological, and pharmacological effects. The primary treatment technique involves the needle mechanically disrupting the trigger point. In this way, the trigger point's shortened sarcomeres stretch and return to their resting length [13]. Furthermore, the DN can excite A-delta nerve fibres, which results in opioid-mediated pain alleviation. Certain substances, including substance P, calcitonin gene-related peptide, and bradykinin, are linked to the local twitch response and are associated with pain in MPS. DN may also have an impact on muscle blood circulation [14]. The majority of research done has examined trigger point dry needling's effects on individuals with osteoarthritis (OA) in the knee as well as its effects on the muscles of the upper limbs. The relationship between MTrPs and dry needling in the lower limb has not been extensively studied, and even less research has examined the relationship between MTrPs and dry needling in patients with anterior knee pain [15]. This study intends to assess how well quadriceps trigger point dry needling reduces anterior knee pain, improves the range of motion in the knee joint, and improves functional performance in people with anterior knee discomfort. The author hypothesises that trigger point dry needling may benefit people with anterior knee pain.

Subjects and methods

Study type

This randomised controlled trial (RCT) was conducted at the Dr Ali therapy clinic, Islamabad, Pakistan. The research was conducted over a period of 6 months, from June to December 2022.

Sample

30 participants having anterior knee pain diagnosed with patellofemoral pain syndrome and quadriceps muscle weakness.

Sample size calculation

The sample size was 30 and calculated using a calculator on the open Epitool website using the Kujala functional scale. The confidence level was set at 95%, the effect size was 0.5, the power was 80% and the type I error rate was set at 5% (alpha level, 0.05) [16].

Selection criteria

Both genders, within the age limit of 20–45 years, with knee pain for more than 3 months, unilateral or bilateral knee pain, and MTrPs in the quadriceps muscle were included. In contrast, participants with knee osteoarthritis, diabetic mellitus, chondromalacia patella, plica syndrome, any history of trauma or prior lower limb surgery, taking any anticoagulant medications, meniscal tears, patellar tendinopathy and ligamentous injury, lumbo-sacral nerve root or peripheral nerve engrossment, belonephobia, those who had received acupuncture, dry needling or an injection for knee pain during the past 6 months, and any peripheral neurological pathology were excluded in this study.

Groups

The sealed envelope method was used to divide the thirty participants into two equal groups of 15 each. The experimental group received the dry needling technique with exercises, and the control group received exercises alone.

Outcome measures

The parameters used to measure the pain intensity were the Numeric Pain Rating Scale (NPRS), quadriceps muscle strength by manual muscle testing, and functional status through a Kujala scoring questionnaire and the Lower Extremity Functional Scale (LEFS), and knee Range of Motion measured (ROM) through a universal goniometer.

Intervention procedures

Experimental group

Utilising 0.35 × 35 mm and 0.35 × 40 mm disposable stainless-steel needles, the trigger points dry needling technique was applied to the quadriceps femoris muscles (vastus medialis, rectus femoris, and vastus lateralis), the halfway between the medial knee area and the pubic symphysis is the measurement of the medial vastus muscle belly. Following the identification of the active TrP, the approach was carried out using the clean method, which included cleaning hands,

donning latex-free gloves, and preparing the skin's surface with alcohol. The fast-in and fast-out methodology was applied in the current study. The trigger point zone was punctured with a needle until the first local twitch reaction was obtained. The vastus medialis muscle required a needle depth of 15 to 20 mm, while the vastus lateralis and rectus femoris required a depth of 30 to 35 mm. After achieving the initial local twitch response, the needle was raised and lowered (35 mm vertical motions without rotations) [17].

Every patient underwent 30-min treatment sessions (15 repetitions), 2 sessions/week for 4 weeks. Patients received conventional physical therapy in the form of a hot pack for 15 min, and static muscle stretching of the quadriceps and hamstrings (3 repetitions with a 10-sec hold). Strengthening of the quadriceps and hamstring muscles was performed as well. The exercises for the quadriceps muscles included straight leg raises, short arc quads, and terminal knee extensions. Similarly, exercises to strengthen the hamstring muscles include seated leg extensions, hamstring curls, and prone leg raises.

Control group

The 15 participants received only conventional physical therapy, including a hot pack for 15 min, static muscle stretching of the quadriceps and hamstring muscles (3 times with a 10-sec hold). Strengthening of the quadriceps and hamstring muscles was performed as well. All exercises featured 2 repetitions per week, with 15 reps of each, which worked out as 30 min/session, 2 sessions/week for 4 weeks [12].

Every measured characteristic, including pain, muscular strength, range of motion, and functional status, was measured on both the left and right knees. The patients in this study experienced bilateral, unilateral, or right knee pain. The physical therapist diagnosed the patient, and there was no negative feedback from the patients.

Statistical analysis

Data was analysed using the Statistical Package for the Social Sciences (SPSS) version 23.0 (SPSS Inc., Chicago, IL, USA). The Shapiro–Wilk test determined the normality distribution at a 95% confidence interval and a 0.05 significance level. Normality tests revealed that the baseline readings of the research participants were not identical; therefore, non-parametric testing was used for the variables of pain, strength, and range of motion, and parametric tests were used for the Kujala and lower extremity functional scales. Mean, median, standard deviation and interquartile range were used in the descriptive statistics for the quantitative variables, whereas mean and standard deviation were provided for the demographic data. The Mann–Whitney test and independent samples *t*-test were used to observe the difference from baseline, at the second week, and at the post-testing follow-up at four weeks for pain, strength, ROM and functional status.

Blinding

The study used a single-blind design. The study's participants were blinded to their group assignment, that is, the interventions. The interventional protocol and group assignment were not disclosed to the participants to maintain blinding.

Instrument validation

Numeric Pain Rating Scale (*NPRS*)

A numerical pain rating scale was used to gauge the degree of pain. This pain scale often uses an outcome instrument. The spectrum of pain experienced by a patient extends from minimal discomfort to excruciating anguish. The NPRS has good test-retest reliability, ranging from 0.79 to 0.96 [18].

Goniometer

A universal goniometer was used to determine the knee joint's range of motion (ROM). A precise angle can be calculated by aligning the instrument with the test area and then moving its arms to match the joint's position. The goniometer's inter-tester reliability (r = 0.98; ICC = 0.99) and validity (r = 0.97–0.98; ICC = 0.98–0.99) were high [19].

Lower Extremity Functional Scale (*LEFS*)

The Lower Extremity Functional Scale (LEFS) was used to assess the degree of functional status limitations and intensity of knee pain. The 20 questions in the LEFS are related to a person's capacity to carry out daily tasks. It can also be used to test a patient over time, evaluate the effectiveness of a therapy, and determine the functional limitations of a patient with a disorder affecting one or both lower limbs. The LEFS has excellent test-retest reliability, with intraclass correlation coefficients ranging from 0.85 to 0.99 [20].

Kujala questionnaire

The Kujala questionnaire is a sophisticated tool designed to assess knee discomfort in the anterior region. More specifically, it is a 13-item screening test with a variable ordinal response style intended to assess patellofemoral pain in adolescents and young adults. The range of total scores is 0 to 100. The Kujala scale was found to have high internal consistency (r = 0.83 to 0.91) [21].

Results

Descriptive analysis

A total of 30 patients were included in this study, divided into two groups of 15 each, i.e. the experimental group (dry needling) and the control group. The mean age of the patients was 33.83 ± 5.5 years, height was 167.9 ± 5.7 cm, weight was 63.9 ± 5.07 kg, BMI was 22.8 ± 1.96 kg/m^2, and the mean of the history of knee pain was 8.73 ± 2.70 months (Table 1). Among the 30 patients, 14 (46.7%) were male and 16 (53.3%) were female. Only 4 (13.3%) of the 30 patients had a history of hypertension, while 4 (13.3%), 3 (10%), 4 (13.3%), 8 (26.7%), and 11 (36.7%) patients had had pain for 5 months, 6 months, 7 months, 8 months and 12 months, respectively. Out of the 30 patients, 14 (46.7%) had a diagnosis of anterior knee pain and 16 (53.3%) had patellofemoral pain syndrome. Five (16.7%) had knee pain on the right side, 2 (6.7%) on the left side, and 23 (76.7%) had bilateral knee pain. Before treatment, all parameters were compared (see Table 2), and no discernible differences were seen.

Between-groups analysis

Through the Kujala and LEFS, all groups were compared to observe differences in pain, strength, knee flexion range

Table 1. Demographic data of the participants

Variable	Experimental group (mean ± *SD*)	Control group (mean ± *SD*)	*p*-value
Age (years)	34.7 ± 5.6	33.0 ± 5.4	0.414
Weight (kg)	64.7 ± 4.8	63.1 ± 5.4	0.397
Height (cm)	167.9 ± 5.6	167.9 ± 6.0	1.000
BMI (kg/m^2)	23.1 ± 2.2	22.5 ± 1.8	0.438
History of knee pain (months)	9.5 ± 2.50	7.9 ± 2.7	0.106
Total (n = 30)	15	15	

BMI – body mass index

Table 2. Comparison of study parameters before treatment

Parameters	*p*-value
NPRS	0.159
ROM right knee flexion	0.173
ROM left knee flexion	0.155
MMT right quadriceps	0.140
MMT left quadriceps	0.095
Kujala scale	0.621

NPRS – numeric pain rating scale, ROM – range of motion, MMT – manual muscle testing, LEFS – lower extremity functional scale

of motion, and functional status of the patients from baseline to the post-fourth week follow-up. The analysis showed statistically significant improvement in the experimental group for the variables of NPRS, strength of the right quadriceps, and ROM of right knee flexion ($p < 0.05$), whereas significant improvement was seen in the Kujala and lower extremity functional scale ($p < 0.001$). However, no significant differences were reported for the ROM of left knee flexion or strength of the left quadriceps. The median interquartile NPRS score at baseline = 7.0 (1.25), at the second week = 4.0 (1.25), and at the fourth week = 1.0 (2), while the median interquartile of the ROM of right knee flexion at baseline = 135 (0), at the second week = 135 (5), and at the fourth week = 140 (2). The median interquartile of the ROM left knee flexion at baseline = 135 (0), at the second week = 135 (5), and at the fourth week = 135 (4). Therefore, the median interquartile of the MMT of the right quadriceps muscle at baseline = 3 (0), at the second week = 4 (1), and at the fourth week = 5 (1), while the median interquartile of the MMT of the left quadriceps muscle at baseline = 3 (0), at the second week = 4 (1), and at the fourth week = 4 (1). Compared to the left knee, the right knee's discomfort and muscular strength improved more noticeably (Table 3).

The mean standard deviation of the Kujala scale for the experimental group at baseline is 51.6 ± 7.9, at the second week = 79.3 ± 6.9 and at the fourth week = 94.8 ± 2.2. While the mean standard deviation of the LEFS at baseline is 27.2 ± 6.3, at the second week = 53.1 ± 4.0 and at the fourth week = 75.1 ± 2.9. However, in the control group, the mean standard deviation of the Kujala scale at baseline is 50.1 ± 8.1, at the second week = 57.0 ± 9.5 and at the fourth

Table 3. Inter-group analysis (Mann–Whitney test)

Variable	Assessment	Control group		Experimental group		*p*-value
		mean rank	median (IQR)	mean rank	median (IQR)	
NPRS	at baseline	17.80	7.0 (1.3)	13.20	6.0 (1)	0.14
	at 2nd week	12.40	4.0 (1.3)	18.60	4.0 (1)	0.04*
	at 4th week	10.60	1.0 (2)	20.40	2.0 (1)	0.001*
ROM right knee flexion (°)	at baseline	16.0	135 (0)	15.0	135 (0)	0.55
	at 2nd week	19.47	135 (5)	11.53	135 (5)	0.004*
	at 4th week	19.0	140 (2)	12.0	140 (5)	0.003*
ROM left knee flexion (°)	at baseline	14.0	135 (0)	17.0	135 (0)	0.15
	at 2nd week	15.87	135 (0)	15.13	135 (0)	0.78
	at 4th week	18.03	135 (5)	12.97	135 (0)	0.090
MMT right quadriceps (RM)	at baseline	16.87	3 (0)	14.13	3 (0)	0.190
	at 2nd week	20.83	4 (1)	10.17	3 (1)	0.000**
	at 4th week	19.70	5 (1)	11.30	4 (1)	0.003*
MMT left quadriceps (RM)	at baseline	13.27	3 (0)	17.73	3 (0)	0.060
	at 2nd week	16.20	4 (1)	14.80	4 (1)	0.611
	at 4th week	17.47	4 (1)	13.53	4 (0)	0.183

NPRS – numeric pain rating scale, ROM – range of motion, MMT – manual muscle testing, RM – repetition maximum
* statistically significant differences ($p < 0.05$), ** statistically significant differences ($p < 0.001$)
The non-parametric Mann–Whitney test was used in the inter-group analysis.

Table 4. Inter-group analysis (independent samples *t*-test)

Variable	Assessment	Experimental group (mean ± *SD*)	Control group (mean ± *SD*)	Mean diff.	*p*-value
Kujala scale	at baseline	51.6 ± 7.9	50.1 ± 8.1	1.47	0.62
	at 2nd week	79.3 ± 6.9	57.0 ± 9.5	22.3	0.000**
	at 4th week	94.8 ± 2.2	74.13 ± 8.4	20.7	0.000**
LEFS	at baseline	27.2 ± 6.3	22.53 ± 6.2	4.7	0.000**
	at 2nd week	53.1 ± 4.0	40.9 ± 7.1	12.1	0.000**
	at 4th week	75.1 ± 2.9	64.8 ± 6.6	10.3	0.000**

LEFS – lower extremity functional scale
** statistically significant differences ($p < 0.001$)
The parametric independent samples *t*-test was used in the inter-group analysis.

week = 74.13 ± 8.4, and the mean standard deviation of the LEFS at baseline is 22.5 ± 6.2, at the second week = 40.9 ± 7.1 and at the fourth week = 64.8 ± 6.6 (Table 4).

Discussion

Myofascial trigger points (MTrPs) in the quadriceps muscle are a major contributing factor for anterior knee pain found in different conditions such as runner's knee and patellofemoral pain [1]. MTrP pain has been treated with a variety of techniques, such as physical activity, MTrP injections, posture adjustment, range of motion exercises, cardiovascular fitness, strengthening and stretching exercises, addressing perpetuating factors, tricyclic antidepressants, and muscle relaxants [8]. DN is one novel intervention technique under investigation. A solid needle is placed into the skin and myofascial trigger site to reduce neuromuscular pain and restore ROM. Although the exact mechanism behind this method is still unknown, it is safe, affordable, and less intrusive. According to the literature, the nervous system responds to DN in a localised and centralised manner. It enhances oxygenation, boosts blood flow, and reduces the sensitivity of the central and peripheral nerve systems to pain. DN has been demonstrated in earlier clinical research to provide a localised effect at the uncomfortable region that increases the ROM and reduces discomfort [22]. The usefulness of dry needling for patients with osteoarthritis in the knee or hip was examined in a comprehensive review and meta-analysis. In individuals with hip and knee OA, the study discovered very weak evidence that DN therapy had a short-term beneficial impact on pain and physical function when compared to sham, exercise, or control interventions [23]. The main aim of the current research is to assess the effects of trigger point DN of quadriceps muscles in reducing anterior knee pain, improving knee joint ranges and functional performance of patients with anterior knee pain. The subjects in the current study who had anterior knee discomfort had this improve significantly.

Previous research proposed that DN improved pain using an algometer after three sessions of treatment on vastus lateralis trigger points in patients with patellofemoral pain syndrome. The results showed significant differences in pain throughout the activity and in Knee Injury and Osteoarthritis Outcome Score (KOOS) scores after 3 sessions of the technique in both groups ($p < 0.05$). Pain intensity that measured by using an algometer was reduced only in the DN group. There were no differences in any variable immediate pretreatments. The study documented no significant changes among the DN and kinesiotaping groups after treatment via the VAS throughout activity, VAS utilising an algometer, pressure pain threshold, or KOOS scores. DN and KT produced an improvement in pain, strength and knee disorders and might be given for PFPS individuals along with MTrP in vastus lateralis muscle, especially when pain relief is the main goal of the rehabilitation [11]. Romero et al. [24] conducted a study on the efficacy of DN and exercise in treating osteoarthritis of the knee. The findings demonstrated that in patients with knee OA, DN in combination with a long-term exercise program did not result in a greater reduction in pain and disability than sham DN combined with a long-term exercise program [24]. In another study, the effects of one DN session versus one sham needling session on knee osteoarthritis patients' pain, central pain processing, muscular co-contraction, and spatiotemporal characteristics during walking are evaluated both immediately after the intervention and three days later. The findings showed that when compared to sham needling, DN had no greater impact on pain, central pain processing, muscular co-contraction, or gait pattern 15 minutes or three days after the intervention. Unlike DN, mean conditioned pain modulation scores declined during sham needling [25]. In the current study, DN was also an effective technique to decrease pain, improving the knee range, muscle strength and functional status of individuals with anterior knee pain, with the results showing significant changes in all the variables in the experimental group ($p < 0.05$).

Another comparative study on the effects of dry needling (DN) and ischemic compression techniques on the pain and functional status of individuals with patellofemoral pain syndrome showed that not all statistically significant variations were detected in both groups ($p > 0.05$). All groups had significant enhancements in pain, functional performance and pressure pain threshold. The study concluded that temporal enhancements in both groups proposed that the two methods might be equally effective for the management of PFPS [1]. The literature also discussed DN trigger sites in the knee and hip regions to enhance activities in patients with mild to moderate knee osteoarthritis (OA).

40 female participants were treated with DN and sham therapy. They received 3 sessions of treatment and were reassessed after 3 weeks. The results showed that the treatment group significantly improved in all variables; however, pain and peak pain pressure were reduced, and timed up and go was increased in the sham group. This study concluded that 3 DN sessions could improve functional performance, sensitivity and balance and reduce pain in individuals with knee osteoarthritis [26]. To assess the impact of trigger point dry needling, either by alone or in conjunction with other therapies, on pain and associated impairment in individuals with knee pain, a systematic review and meta-analysis

were carried out. According to the findings, TrP dry needling was successful in reducing pain in PFP, but not in knee OA or post-operative knee pain [27]. The qualitative synthesis for myofascial trigger points dry needling revealed conflicting findings, according to Ughreja and Prem's systematic review. In terms of discomfort and function immediately after treatment, the mean difference for periosteal stimulation was significant ($p < 0.00001$). Significant variability was seen among the trials; however, the mean difference for intramuscular electrical stimulation on pain was significant ($p = 0.03$). The evidence included in that review is of moderate quality regarding the short-term impact of the periosteal stimulation method on knee osteoarthritis pain and function [28]. In the current study, both male and female participants were assigned to one of 2 groups, i.e. the experimental group and the control group. The current study used a four-week treatment procedure, and the evaluation was done by Numeric Pain Rating Scale (NPRS), strength, range of movement (ROM), Kujala scale and lower extremity functional scale. As compared to the control group, the experimental group experienced greater clinical improvement. A between-groups analysis showed that the right quadriceps and ROM of right knee flexion improved ($p < 0.05$). Significant improvement was seen in the Kujala and lower extremity functional scale ($p < 0.001$), but no significant changes were reported for the ROM of left knee flexion or the strength of the left quadriceps muscle.

Strengthening exercises are also an integral part of a rehabilitation protocol. Previous research has presented prolonged effects of strengthening exercises on the hip region, quadriceps muscle exercise training and physical status of patients with patellofemoral pain syndrome. The study helps to explain the function of hip and quadriceps strength training in the rehabilitation of patellofemoral pain syndrome. Evidence regarding anxiety and depression, kinesiophobia, and self-efficacy will be compiled, particularly in relation to prognosis and response to exercise therapy.

[29]. Another study was conducted to evaluate differences in hip strengthening, core endurance, and lower limb biomechanics for individuals with patellofemoral pain syndrome. It comprised an 8-week protocol of strengthening exercises of hip and core muscles and improvement of advanced dynamic malalignment. Significant enhancements in pain, functional status, strengthening of the hip musculature and improved core endurance. Additionally, there was a notable reduction in knee abduction when running.

An 8-week treatment protocol designed around strength training and enhancing neuromuscular control of the hip and core muscles developed positive results, improved hip and core muscular strength, and decreased knee abduction, which are linked to the development of patellofemoral pain syndrome [30]. Research by Amani et al. examined how dry needling affected knee osteoarthritis patients' discomfort. This study demonstrated that DN can reduce the severity of pain after just one session. Patients with mild-to-moderate knee osteoarthritis experienced a significant reduction in pain intensity both four days and one month after using DN [31]. In this current study, strengthening exercises for the quadriceps muscles were provided to both the experimental and control groups, both of which showed an improvement in pain, muscle strength and functional status of the patients. The 4-week protocol of strengthening and stretching exercises of the quadriceps and hamstring muscles was provided and produced clinically significant differences.

Limitations

This controlled trial's primary drawback was the failure to report the number of treated and active TrPs, which may have led to only minor changes in the number of TrPs treated in each group. The participants' fear of needling is another drawback.

Conclusions

The current study concluded that both techniques are effective for the treatment of anterior knee pain, however the dry needling technique is a clinically more effective treatment approach to decreasing pain, and improving the muscle strength, knee ranges of motion and functional status of patients suffering from anterior knee pain.

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Ethical approval

The research related to human use complied with all the relevant national regulations and institutional policies, followed the tenets of the Declaration of Helsinki, and was approved by the Advance Studies and Research Committee (ASRC) of Isra University, Islamabad, Pakistan (approval No.: F-1/IUIC-IIRS/ASRC/2021). The study was registered with the Iranian Registry of Clinical Trials under the identification number IRCT20220804055615N3.

Informed consent

Written informed consent was obtained from patients/participants before their involvement in the study. The data was coded alphanumerically to maintain participant anonymity and was kept secure under lock and key. The head of the study's setting was granted permission to collect the data, which was then stored in a locked case to protect the participants' privacy.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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