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Effect of ischaemic compression versus kinesiotape on patellar tendinitis

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Abstract

Introduction. The goal of this study was to compare the impact of ischaemic compression and kinesiotape on pain, physical function, and resting myoelectric activity of vastus medialis and vastus lateralis muscles in patients with unilateral acute patellar tendinitis.

Methods. Overall, 33 patients were randomly assigned to 3 equal groups. Group A received ischaemic compression and conventional treatment of patellar tendinitis. Group B received kinesiotape and conventional treatment of patellar tendinitis. Group C received only conventional treatment. Each patient received 3 sessions per week for 1 month. Pain intensity, physical function, and resting myoelectric activity were measured before, after, and after another 2 weeks of completion of the study.

Results. The results showed a statistically significant improvement in all the variables between the pre-intervention, post-intervention, and follow-up evaluations in the 3 groups ($p < 0.05$).

Conclusions. Kinesiotape is more effective than ischaemic compression in decreasing pain intensity level, improving physical function, and enhancing the activity of vastus lateralis and vastus medialis muscles in patients with unilateral acute patellar tendinitis.

Key words: kinesiotape, ischaemic compression, patellar tendinitis, resting myoelectric activity

Introduction

Patellar tendinitis is considered one of the most common conditions of overuse causing pain to the anterior knee area [1]. Its prevalence ranges from 31.9% to 44.6% [2]. It is commonly caused by repetitive jumping, cutting, or sprinting without rest between exercises, which severely loads the patellar tendon, as in basketball and volleyball players [1]. Ultimately, the tendon overload leads to tendon degeneration and, furthermore, reactive tendinopathy that weakens its structure and affects the career of subjects [3]. Witvrouw et al. [4] found that the patellar malalignment, patella alta, excessive laxity of the patellar tendon, muscle tightness, muscle imbalance, decreased flexibility of the quadriceps and hamstring muscles, and defects in knee extensor mechanisms, heavy training, and tougher training surfaces were suggested as potential risk factors for jumper's knee.

The knee extensor mechanism (the quadriceps muscles) linkage into the quadriceps tendon connects apex of the patella bone to the tibial tuberosity and functions to extend the tibiofemoral joint. The patella bone functions as a pulley, which shifts the quadriceps force direction, increases the quadriceps moment arm, and increases the quadriceps efficiency [5]. Also, the oblique fibres of the vastus medialis help balance the lateral pull exerted on the patella by the vastus lateralis muscle. So, impaired quadriceps muscle flexibility exacerbate tendon strain during joint movement, leading to tendon overload and the development of patellar tendinitis. Atrophy or inhibition of the vastus medialis oblique muscle lead to the development of patella alta or patellar tracking and patellar tendinitis [6].

Anomalous fascial tension in the form of myofascial trigger points (MTPs) in the thigh muscles leads to uncoordinated quadriceps contraction, which, in turn, causes patellar tendon pain. Therefore, in cases of patellar tendinitis, therapists should not focus their treatment only on the tendon itself but also on releasing MTPs and removing motor incoordination, which is in the muscular fascia of the thigh region [7]. MTPs release techniques include invasive and non-invasive therapies. The non-invasive therapies involve ice application, heat therapy, spray and stretch technique, electric stimulation, ultrasound therapy, and ischaemic compression [8].

Patellar tendinitis affects young to adult athletes with a peak age of 15–40 years [9]. The condition can be categorized into acute, sub-acute, and chronic, depending on the onset stage. The acute stage ends within 2 weeks; the sub-acute stage starts 2 weeks and ends 6 weeks after onset; and the chronic stage continues for more than 6 weeks [10].

Many physical therapy approaches have been used to improve symptoms of patellar tendinitis, such as application of manual therapy in the form of myofascial release of the knee extensor muscles, shockwave therapy, rest, anti-inflammatory medications, weight reduction, and kinesiotaping [2].

Ischaemic compression is performed by compressing the trigger points with tolerable pain of progressive and strong intensity. The compression causes blocking of blood flow in the area to be treated followed by its resurgence after releasing the pressure. The local blood flow supplies the affected area with energy and nourishment and enhances lymphatic drainage and removing the accumulated waste products, so relieving pain and fascial restrictions caused

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by MTPs [11]. The ischaemic compression technique normalizes the neuromuscular dysfunction present in muscles with MTPs, induced by an excessive release of acetylcholine from an autonomic modulation triggered by the release of chemical substances that results in increased myoelectric activity in the resting state [12].

Gelmini et al. [13] assessed the effect of ischaemic compression on the myoelectric activity of the upper trapezius muscle in patients with MTPs in this muscle. They concluded that the ischaemic compression could alter the myoelectric activity of muscles containing trigger points.

However, there is lack of research about its clinical effectiveness in the treatment of patellar tendinitis [14]. Therefore, this study was performed to investigate the effect of manual ischaemic compression on quadriceps trigger points in patients with patellar tendinitis. Also, the aim was to contrast the efficacy of kinesiotape and ischaemic compression in the refinement of pain and improving resting myoelectric activity in subjects with patellar tendinitis.

Currently, kinesiotaping plays a key role in treating patellar tendinitis as it helps to reduce pain and improve function and activity by (1) realignment of fascia; (2) lifting the fascia and soft tissue above skin to create a space above the area of pain and inflammation; (3) providing sensory stimulation to reduce or limit movement; and (4) eliminating exudates through the lymph ducts [15]. There are many reviews that support kinesiotaping role in decreasing pain [16–18], improving muscle power [19], and correcting muscle tone by stabilizing the weakened muscle [20]. Choi [18] emphasized its role in improving muscle performance via testing the effect of kinesiotape on muscle tone in patients with shoulder pain using Myotone Pro. He concluded that the physical therapy approach including kinesiotape, heat, and electrical stimulation was more beneficial than routine physical therapy in the treatment of shoulder pain. Muscle tone is usually defined as limb resistance to passive motion, where the resistance arises from passive and involuntary active forces [21].

Subjects and methods

Study design

A randomized controlled clinical trial was performed at the library of electromyography at the Faculty of Physical Therapy, Cairo University, Egypt, during the period of March 2017 to May 2019.

Sample size calculation

The G*Power software (version 3.1.9.2) was used to estimate the sample size. The calculation was based on the F-test. The rate of type I error was set at 5% (alpha < 0.05), with an effect size of 0.68 of pain, which was obtained from the pilot study, performed among 5 subjects in each group. Type II error rate was at 95% power. The minimum sample size suitable for the research was 27 subjects in 3 groups.

Subjects

A total of 36 subjects diagnosed with acute unilateral patellar tendinitis were recruited from the outpatient clinic of the College of Physical Therapy at Cairo University, Egypt. During assessment for eligibility (Figure 1), 3 individuals were excluded because they had received treatment within the previous 3 months. Overall, 33 subjects participated in the study. They received verbal and written explanation of the research purpose and procedures. The subjects who signed the consent form (to take part in the study for a total period of 6 weeks) were randomly assigned into 3 groups of equal numbers. The randomization was conducted with a random generator and permuted blocks of same size. Group A received ischaemic compression in addition to conventional treatment 3 times per week for 4 weeks. Group B received kinesiotape in addition to conventional treatment 3 times per week for 4 weeks. Group C received only conventional treatment for 4 weeks.

Inclusion criteria

The included subjects:
1. Were of both sexes [3].
2. Were aged 14–25 years [9].
3. Complained of unilateral acute patellar tendinitis.
4. Suffered from pain localized to the inferior pole of the patella [22]; the pain was aggravated with sustained positions (squatting, prolonged sitting, running) and with stair climbing [9].
5. Had at least 2 active MTPs in the quadriceps muscle [23].
6. Presented with a pain level of 3–4 in the numeric rating scale (NRS) [24].
7. Were characterized by a body mass index of 19–29 kg/m^2 [25].

Exclusion criteria

Subjects were excluded if they:
1. Had undergone knee surgery or had been diagnosed with rheumatoid arthritis or knee osteoarthritis [26].
2. Were diagnosed with patellofemoral pain syndrome [27].
3. Were obese [28] or pregnant [29].

Outcome measurements

The first measurement in the study was the level of pain intensity. It was evaluated with NRS. Physical function, another measured outcome, was established by using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). The last assessed outcome was the resting myoelectric activity, presented as root mean square (RMS). The assessments were performed 3 times: before the study, after the intervention, and after subsequent 2 weeks (follow-up).

Pain intensity assessment

NRS was used for measuring pain intensity level. The numbers were written from 0 to 10 in an ascending order. Each subject was asked to circle the number best describing their level of pain [30]. NRS has an outstanding test-retest reliability [31].

Physical function

The Arabic version of the WOMAC index was used to assess the physical function. It contains 24 questions, divided into the pain subscale (5 questions), the stiffness subscale (2 questions), and the physical function subscale (17 questions). The scale has 5 response levels for each item: none (0), mild (1), moderate (2), severe (3), and extreme (4).

Each participant was asked to answer the questions independently by choosing the number that described their case. The score was determined by adding the subscale

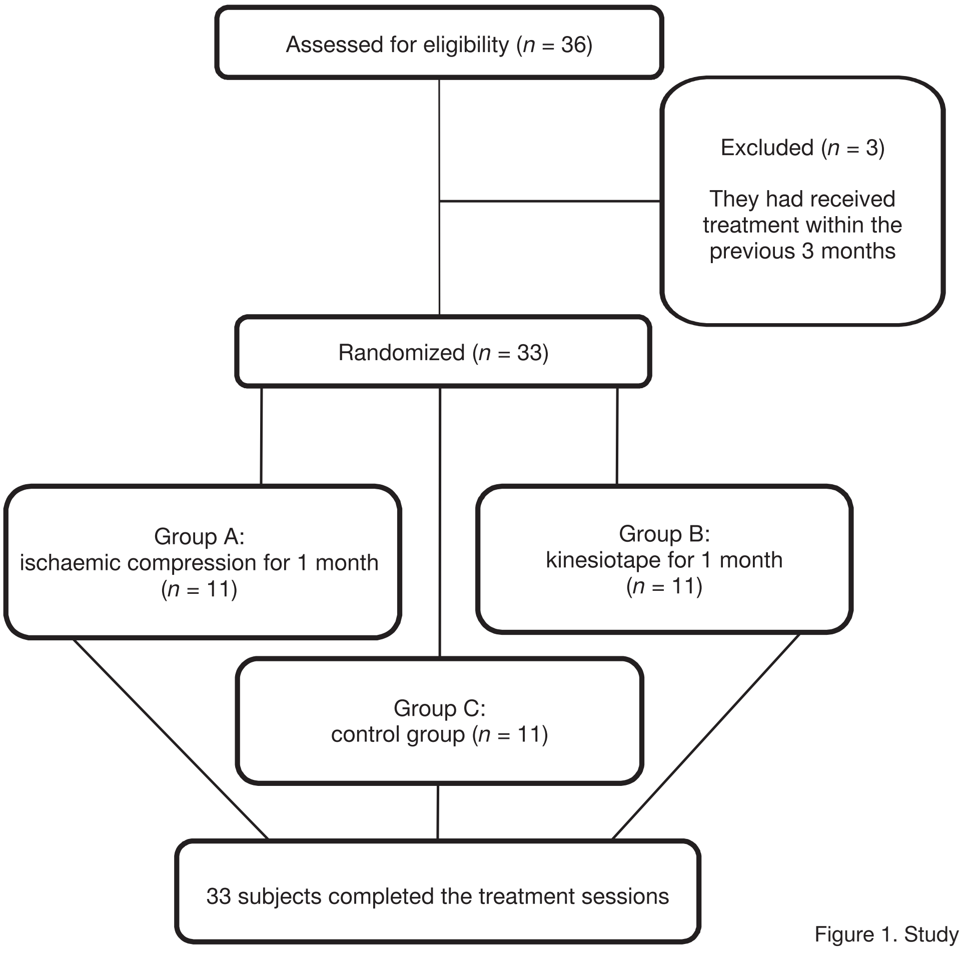

Figure 1. Study design

scores (pain: 0–20, stiffness: 0–8, physical function: 0–68). The final total scores collected (0–96) were determined by adding the scores for all subscales [32].

NRS can be used to qualify the disease prognosis or to check the utility of treatments (surgery, physiotherapy, etc.). The Arabic WOMAC index is a valid and reliable method for determining knee osteoarthritis severity, with metric properties in accordance [33].

Resting myoelectric activity

A 2-channel digital electromyography (EMG) device (Neuro-EMG-Micro, Neurosoft, Ivanovo, Russia) was used to assess the resting myoelectric activity of vastus medialis and vastus lateralis muscles. The subject was asked to sit in a relaxed position; then, the therapist cleaned the skin overlying the quadriceps and the knee joint with methylated alcohol to remove any elements that would increase skin resistance. The ground electrode was attached just above the tibial tuberosity and fixed by self-adhesive plastic. The vastus medialis and the vastus lateralis muscles were assessed separately [34].

For the vastus medialis muscle, 2 surface electrodes were placed 4 cm superior and 3 cm medial to the superomedial aspect of the patella in a longitudinal manner, with a 2-cm distance in between [35]. For the vastus lateralis muscle, 2 surface electrodes were placed at its mid belly (midpoint between the head of the greater trochanter and the lateral femoral epicondyle) [36] in a longitudinal manner, with a 2-cm distance in between [37].

Testing protocol

– At a resting position: the resting amplitude was recorded 3 times at a fully relaxed patient position; finally, the average was assumed.

– Normalization of the resting myoelectric activity: the therapist asked the patient to sit in a relaxed position (long sitting position). The subject was to perform an isometric contraction of knee extension with the knee in a fully extended position against resistance. Manual resistance was applied distal to the patella. Each contraction was sustained for 7 seconds and repeated 3 times, with a 30-second rest in between [38].

– RMS calculation: the estimation of the normalized values was as follows: normalized RMS % = EMG amplitude during resting / (average of EMGmax for the 3 trials) × 100 [20]. The use of RMS circuit provides a nearly instantaneous output of the EMG power. This technique has somewhat a sounder mathematical basis than a simple linear envelope (integration). In the time domain, the RMS of the EMG signal is considered the most reliable parameter [39].

Intervention

Group A received ischaemic compression plus a conventional program for patellar tendinitis – in the form of strengthening and stretching exercises for knee flexors and extensors (Figure 2), and thigh adductors and abductors (Figure 3), as well as eccentric single-leg squats [40, 41]. Group B received kinesiotape plus a conventional program for patellar tendinitis. Group C (control group) received only a conven-

Figure 2. Strengthening of knee extensors

Figure 3. Strengthening of thigh abductors

tional program for patellar tendinitis.

Ischaemic compression

From a relaxed supine position, the subject was asked to determine the region of discomfort because they had active MTPs. The area was checked by pincer palpation and marked. Then, a therapist pressed the trigger point intermittently for 10–20 seconds, depending on the participant's tolerance. Next, the pressure gradually increased in accordance with the patient's tolerance and lasted for 90 seconds until the patient reported that the pain had lessened [42].

Kinesiotape

Group B received an adhesive tape that was waterproof and porous (Kinesio Tex, Kinesio USA, Albuquerque, USA). The kinesiotape was 5 cm in width and 0.5 mm in thickness [20].

During the kinesiotape application, the subject was rested in a supine position. Then, the taped region was uncovered, shaved, and cleaned with alcohol. The knee was flexed to a 90° angle. The measurement of the tape began from mid-thigh to the tibial tuberosity. The tape was split at one end. It was stretched 10% amount of its original length and then applied vertically from mid-thigh down to the knee [43]. Each side of the split was applied around the patella [44].

Conventional treatment

The conventional program for patellar tendinitis [40, 41] included:

– Strengthening exercises for knee flexors and extensors, and thigh adductors and abductors. Each exercise was performed in 3 sets of 10 repetitions.

– Stretching exercises for knee flexors and extensors, and thigh adductors and abductors. Each stretch was maintained for 30 seconds and repeated 3 times, with a 1-minute rest in between.

– Eccentric single-leg squats with the use of a decline board with a 15–30° decline and keeping the knee flexion less than 60° in order not to excessively load the patellofemoral joint.

According to Dimitrios et al. [40], stretching exercises accompanied with eccentric squatting are effective in relieving pain and enhancing function in patients with patellar tendinitis.

Statistical analysis

The Shapiro-Wilk test was used to assess the normality of data distribution. All variables appeared normally distributed so the data were analysed by a parametric test. Mixed multilevel analysis of variance (MANOVA) served to determine the treatment and time effect at NRS, WOMAC, and normalized resting RMS of the vastus medialis and vastus lateralis muscles. The SPSS software, version 23 (IBM Corp, New York, USA) was applied, with an alpha level of < 0.05.

Ethical approval

The research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and has been approved by the research ethics committee of the Faculty of Physical Therapy, Cairo University (No. P.T. REC/01 21001513) and registered at the Pan African Clinical Trials Registry (Registry ID: PACTR-201702001948210).

Informed consent

Informed consent has been obtained from all individuals included in this study.

Results

Demographic data

All demographic data (age, weight, height, and BMI) were normally distributed, so analysis of variance (ANOVA) was used to compare the groups. There was no significant difference between the groups ($p > 0.05$), as shown in Table 1.

Outcomes results

In general, there was a significant effect for treatment and time on all variables ($p < 0.005$, $p < 0.0001$, respectively).

Table 1. Demographic data of the participants

Characteristics		Group A	Group B	Group C	*p*	Significance
Age (years)	Mean	20.23	24.54	22.36	0.08	NS
	SD	3.04	5.43	4.48		
Weight (kg)	Mean	64.27	65.97	61	0.43	NS
	SD	8.59	11.24	7.59		
Height (cm)	Mean	162.27	164.69	161.27	0.35	NS
	SD	7.69	5.15	4.65		
BMI (kg/m²)	Mean	24.41	24.11	23.34	0.65	NS
	SD	2.69	3.03	2.61		

NS – not significant, BMI – body mass index

Effect of treatment on NRS (Figure 4)

Within-group analysis

The results for group A showed a significant decrease in pain level after the treatment and at follow-up ($p < 0.0001$; percent of change: 73% and 82.6%, respectively). Also, for group B, there was a significant decrease after the treatment and at follow-up ($p < 0.0001$; percent of change: 83% and 91%, respectively). Finally, in group C, there was a significant decrease after the treatment and at follow-up ($p < 0.0001$; percent of change: 67% and 73%, respectively).

Between-group analysis

There was no statistically significant difference between the 3 groups before the treatment ($p > 0.05$). After the treatment, there was no significant difference between groups A and B or groups A and C ($p = 0.16$, $p = 0.87$, respectively). But, there was a significant difference between groups B and C ($p < 0.01$). At follow-up, there was no significant difference between groups A and B or groups A and C ($p = 0.12$, $p = 0.15$, respectively). But there was significant difference between groups B and C ($p < 0.001$).

Effect of treatment on vastus medialis RMS (Figure 5)

Within-group analysis

The results for group A showed no significant decrease in RMS after the treatment and at follow-up ($p > 0.99$, $p > 0.86$, respectively; percent of change: 3% and 13%, respectively). But, for group B, there was a significant decrease after the treatment and at follow-up ($p < 0.001$, $p < 0.0001$, respectively; percent of change: 83% and 91%, respectively). Finally, in group C, there was no significant decrease after the treatment ($p > 0.104$) but there was a significant decrease at follow-up ($p < 0.02$; percent of change: 67% and 73%, respectively).

Between-group analysis

Before the treatment, there was no significant difference between groups A, B, and C ($p > 0.05$). After the treatment, there was no significant difference between groups A and B, groups A and C, or groups B and C ($p = 0.06$, $p = 0.9$, $p = 0.31$, respectively). At follow-up, there was a significant difference between groups A and B, and groups B and C ($p = 0.004$, $p = 0.03$, respectively). But there was no significant difference between groups A and C ($p > 0.9$).

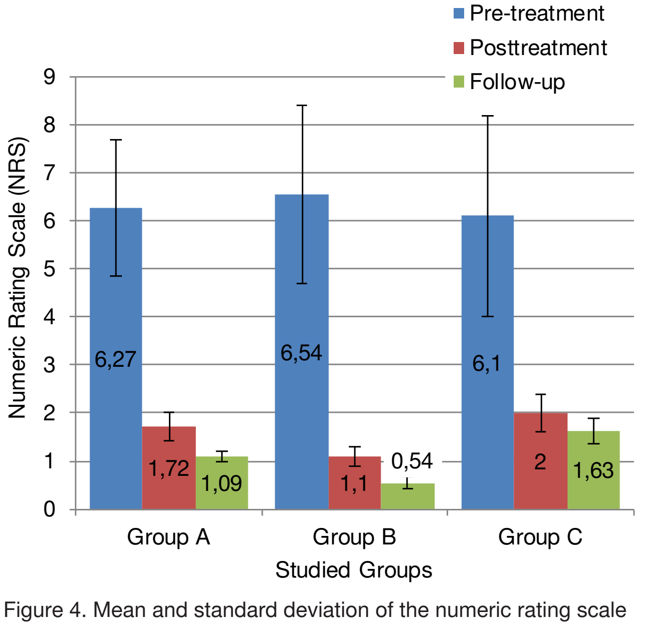

Figure 4. Mean and standard deviation of the numeric rating scale in the studied groups

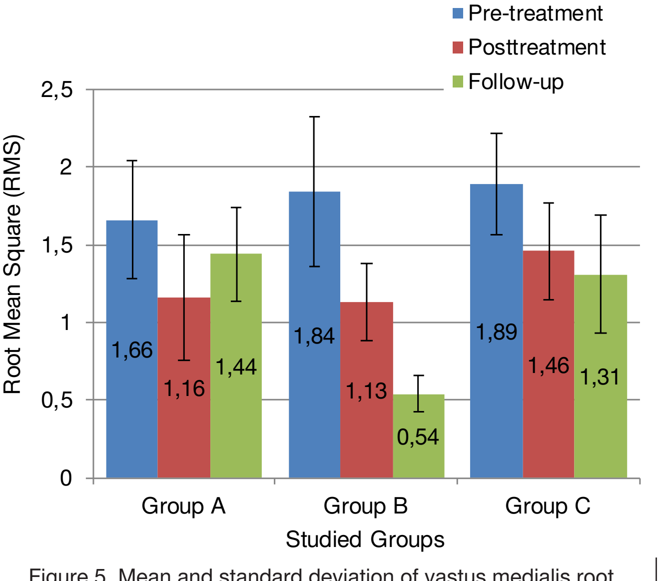

Figure 5. Mean and standard deviation of vastus medialis root mean square in the studied groups

Effect of treatment on vastus lateralis RMS (Figure 6)

Within-group analysis

The results of group A showed a significant decrease in RMS after the treatment and at follow-up ($p < 0.001$, $p < 0.008$, respectively; percent of change: 29% and 32%, respectively). Also, for group B, there was a significant decrease after the treatment and at follow-up ($p < 0.0001$, $p < 0.0001$, respectively; percent of change: 48% and 59%, respectively). Finally, in group C, there was no significant decrease after the treatment or at follow-up ($p > 0.44$, $p > 0.31$, respectively; percent of change: 10.3% and 16%, respectively).

Between-group analysis

Before the treatment, there was no significant difference between groups A, B, and C ($p > 0.05$). After the treatment, there was no significant difference between groups A and B or groups A and C ($p = 0.13$, $p = 0.17$, respectively). But, there was a significant difference between groups B and C ($p < 0.001$). At follow-up, there was a significant difference between groups A and B, and groups B and C ($p < 0.02$, $p < 0.0001$, respectively). But there was no significant difference between groups A and C ($p > 0.3$).

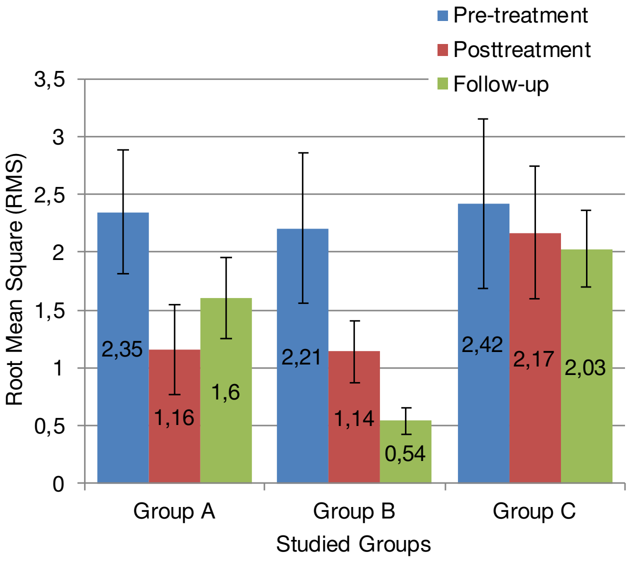

Figure 6. Mean and standard deviation of vastus lateralis root mean square in the studied groups

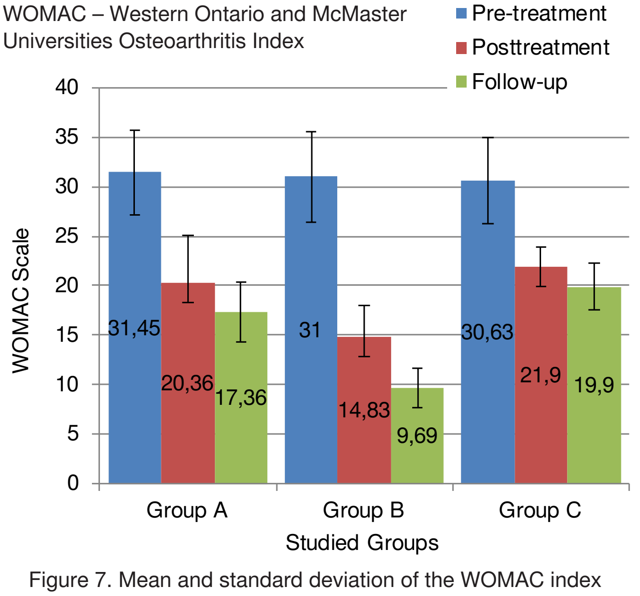

Figure 7. Mean and standard deviation of the WOMAC index in the studied groups

Effect of treatment on the WOMAC index (Figure 7)

Within-group analysis

The results of group A showed a significant decrease of the WOMAC index after the treatment and at follow-up ($p < 0.0001$; percent of change: 35.5% and 45%, respectively). Also, for group B, there was a significant change after the treatment and at follow-up ($p < 0.0001$; percent of change: 53% and 68%, respectively). Finally, in group C, there was a significant decrease after the treatment and at follow-up ($p < 0.0001$; percent of change: 28% and 35%, respectively).

Between-group analysis

Before the treatment, there was no significant difference between groups A, B, and C ($p > 0.05$). After the treatment, there was a significant difference between groups A and B and groups B and C ($p = 0.002$, $p = 0.001$, respectively). But there was no significant difference between groups A and C ($p = 0.98$). At follow-up, there was a significant difference between groups A and B and groups B and C ($p = 0.001$, $p = 0.001$, respectively). But there was no significant difference between groups A and C ($p = 0.142$).

Discussion

The current study was designed to compare the effects of kinesiotape and ischaemic compression on the rehabilitation of acute patellar tendinitis. The group that received kinesiotape showed more refinement than the ischaemic compression group and the control group. Kinesiotape has a key role in inhibiting myofascial pain by lifting the skin, which leads to increased circulation, enhanced lymphatic drainage (helping remove oedema by directing the exudates towards a lymph duct), and decreased pressure on nociceptors [20]. Kinesiotape application stimulates ligament/tendon correction: an increased stimulus over a ligament/tendon area results in an increased stimulus of mechanoreceptors to be perceived as proprioceptive stimulus that stimulates more normal tissue [45].

According to Kumbrink [46], the tape enhances tonus regulation as it causes change in muscle tonus via activation of skin receptors which strengthen additional peripheral afferent signals (joint, muscle, skin). The change in the resting myoelectric activity in the kinesiotape group may be due to the application form. The application of kinesiotape from insertion to origin results in an eccentric pull on the underlying fascia that inhibits muscle activity [20].

The results of the present study are in agreement with those obtained by Ptaszkowski et al. [47], who studied the effect of muscle energy techniques vs. kinesiotape on resting bioelectric activity and visual analogue scale in upper trapezius pain. The results showed a reduction in muscle activity and visual analogue scale in the kinesiotape group. Similarly, the current study is matched with the results achieved by Massei et al. [44], who tested the effectiveness of therapeutic taping (kinesiotape and leukotape) on pain, range of motion, power, balance, and strength in individuals with and without acute patellar tendinopathy – and stated that kinesiotape and leukotape had an effect on some variables in certain individuals.

In the same line, Cho [48] et al. investigated the effect of kinesiotaping on pain, proprioception, and range of motion in older patients with knee osteoarthritis and demonstrated that kinesiotape attenuated various types of pain and improved range of motion and proprioception in osteoarthritis patients.

Also, the results of the present study showed that ischaemic compression was an effective manual therapy technique for MTP release as the ischaemia following long pressure allows a circulatory influence, enhances blood circulation, relieves transient blood flow occlusion, produces a reactive hyperaemia, and helps get rid of waste products. These wastes stimulate pain receptors, causing continuous pain. So, hyperaemia following ischaemic compression leads to pain relief [49]. This idea is supported by Gazbare et al. [50], who compared the effects of ultrasound therapy and ischaemic compression in the treatment of trigger points and found that ischaemic compression should be a preferred therapy for MTPs in a physical therapy setup as it was effective, easily available, accessible, cost effective, and nondependent on any machines; moreover, the results can be seen in a short period.

This study validates the idea that pain in the front of the knee may be initiated by trigger points in the quadriceps muscle causing muscle weakness. It is supported by Elsayed et al. [14], who stated that the presence of trigger points in the quadriceps muscle was considered one of the most important causes of anterior knee pain, and manual ischaemic compression had been reported to be effective in treating trigger points. Also, the present results agree with a study by Ravichandran et al. [42], who compared ischaemic compression and ultrasound therapy of MTPs in the trapezius muscle. They used a visual analogue scale to test the pain threshold before and after application. The results confirmed that the ischaemic compression technique led to better improvement in the functional outcome in neck pain.

The current study revealed that kinesiotaping decreased RMS. This result is supported by a study performed by Abd El-Azeim et al. [20], who tested the effect of kinesiotape on the normalized bioelectric activity of trapezius trigger points and concluded that the method was effective in decreasing the muscle activity in the resting state.

Aguilar-Ferrándiz et al. [17] investigated the effect of kinesiotape on the gastrocnemius muscle activity. They recorded the muscle activity by means of a Kine-Pro Motion Wireless surface EMG for a total of 7 seconds and rectified and normalized by the EMG value of the maximum voluntary isometric contraction. The study reported that kinesiotape could enhance muscle activity.

The current study revealed that ischaemic compression might improve the electromagnetic activity of the quadriceps muscle after releasing the trigger points. These results are supported by those achieved by Gelmini et al. [13], who assessed the effect of ischaemic compression on the myoelectric activity of the upper trapezius muscle in patients with MTPs in this muscle and concluded that the ischaemic compression could alter the myoelectric activity of muscles containing trigger points.

Limitations

The time of treatment was 4 weeks only, which is considered relatively short.

Conclusions

Kinesiotape is more effective than ischaemic compression in decreasing pain intensity, improving physical function, and enhancing activity of vastus lateralis and vastus medialis muscles in patients with unilateral acute patellar tendinitis.

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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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