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Mindfulness-based deep transverse friction on pain and anxiety in patients with tennis elbow: A preliminary study

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Abstract

Tennis elbow is lateral tendinosis with angiofibroblastic hyperplasia. It may cause psychological factors and anxiety. Nowadays, mindfulness is a cognitive-behavioral intervention that induces present-moment awareness of body sensations and reduces pain and anxiety. This study aimed to investigate the immediate effect of mindfulness deep transverse friction on pain and anxiety in tennis elbow patients. A comparative randomized study with a blinded assessor in University primary care unit. Eight females per group, aged 25-45 years who have meditation experience were conducted physical examination with pain in the lateral epicondyle and positive pain in wrist extension against resisted movements related to forceful activities. The experimental group (EG) was treated with mindfulness deep transverse friction (MDTF) which combined conventional deep transverse friction (DTF) to common extensor insertion with mindful attention on breathing in and out of nostrils by themselves. The control group (CG) was treated with conventional DTF. The Visual Analogue Scale (VAS) and Strait-Trait Anxiety Inventory (STAI) questionnaire were measured pre and post treatment. Intergroup comparison showed that EG was significant on pain to the median (range) 30.00 (24.00 - 52.00) and *p*-value (0.003) and anxiety 38.5 (34.00 - 42.00) and *p*-value (0.007) respectively. In intragroup comparison, EG was significant on VAS (p=0.012) and anxiety (p=0.011). However, there was no difference between pain and anxiety in CG. MDTF is beneficial to therapeutic approach when compared to friction. Even brief, guided meditation can support the effective relief of anxiety related to self-awareness in tennis elbow patients.

Keywords: Mindfulness, Transverse friction, Tennis elbow, Pain, Anxiety

1. Introduction

Tennis elbow is also known as lateral epicondylitis and tendinosis of the extensor carpi radialis brevis insertion, with one-third of patients also including extensor digitorum communis [1]. The prevalence is 1-3% in the general population [2] and 3.8% in a mountain village located in Japan [3]. One population-based study found that adults aged 25 to 64 years and 5% of patients who had lateral epicondylitis took sickness absence due to symptoms when compared to 3% of non-specific elbow pain [4]. The long-lasting pain experience may decrease physical activity and pose a socioeconomic burden due to absence from work, high health care costs and diminished quality of life. Therefore, psychological factors have been proposed to be a major role in the development of disabilities related to

musculoskeletal conditions. It also can cause a catastrophic sensation of incapacity, helplessness, and lack of confidence in symptom management or coping, which contributes to the development of depression or anxiety [5].

Pathological studies have found that there was the presence of angiofibroblastic hyperplasia (fibroblast proliferation, vascular hyperplasia, and disorganized collagen). The muscle becomes weak and causes microscopic tears in the tendon where it attaches to the lateral epicondyle, resulting in inflammation and pain [6].

Management of tennis elbow aimed to relieve pain, improve movement, grip strength, and return to normal function. Deep transverse friction (DTF) was first described by James Cyriax in 1940 and it has been used for tendinopathies such as tennis elbow, iliotibial band syndrome and supraspinataus tendinitis. DTF increases local circulation, decreases pain, and the reduction of adhesion to tendons [7].

DTF has been used widely for the treatment of tendinopathy. When DTF plus Mill's manipulation was compared to ultrasound therapy in lateral epicondylitis, DTF group has a significant progress in all variable outcomes and was more effective than the control group [8]. In 2016, one study has found that stretching exercise has a better effect than DTF in patients with tennis elbow. In this study, they used stretching exercises on one group and deep friction massage on another group while both groups received wearing wrist splints. This trial revealed that stretching is more effective than DTF in tennis elbow [9]. Although no study used only isolated deep transverse friction massage as a treatment modality, there has been evidence for the efficacy of DTF in the treatment of tendinopathy [10].

Meditation is effective for physical and mental health. Meditation is training of the mind to get focus attention. However, there are a number of meditation methods including mindfulness meditation, mantra meditation, transcendental meditation, body scan, vipassana meditation, mindfulness-based cognitive therapy (MBCT), mindfulness-based stress reduction (MBSR), mindfulness-based acceptance and commitment therapy (MBACT) and mindfulness-based cognitive behavioral therapy (MBCBT). Mindfulness meditation teaches individuals to focus attention to present moment experiences with openness, curiosity, and non-judgment [11], in MBSR mainly trains a non-judgmental approach towards all experiences; but MBCT trains to respond skillfully to opposite thoughts and moods. MBACT coaches to overcome harmful ideas and feelings by receiving the problems and by pleasing actions to good results [12]. In addition, therapies that used physical movements such as yoga, tai chi, qi gong rely on training attention or producing mental relaxation and they could be described as mind-body techniques. Moreover, mindfulness-based interventions are also one of the mind-body therapy methods [13].

Nowadays, mindfulness-based interventions are popular, and they have been used for many chronic pain conditions such as tension headache [14] and chronic low back pain [15]. Mindfulness-based interventions can be combined with other pharmacological and non-pharmacological treatments or can be used as a stand-alone treatment for pain and improving functional movements [12]. In 2014, one study proved that a 10 min audio body scan intervention can cause pain relief than the control group and received pain related to social relations [16]. By practicing mindfulness-based intervention, the client can benefit from the reduction of pain, distress and perceived interference of pain in social relations, and increases ratings for the perceived ability for daily activities [16]. Mindfulness-based intervention can be used as a preparatory intervention to be skilled treatment to tolerate manual therapy. Therefore, clients with hand dysfunction can use mindfulness-based intervention at home or in the clinic. Moreover, the practice of mindfulness-based intervention can raise mindfulness and body awareness during a functional task [17]. In this study, mindfulness friction means the treatment combination of mindfulness meditation and deep friction techniques in which the participant focuses on being intensely aware of what he is sensing and feeling in the moment, with directed meditative focus.

Pain is defined as a conscious nociceptive input disposed of by memories, emotions, and cognitive factors. According to experiential and neural mechanisms, even brief meditation practice can reduce pain [18]. Anxiety is related to pain and connected with anxiety than depression (e.g, lessened attention, absence of motivation, prolonged lassitude and poor sleep) and tends to reduce the benefits of intervention and recovery procedures. Although various types of interventions were used to treat tennis elbow, there was no study for mindfulness-based intervention for tennis elbow. Therefore, this pilot study aimed to investigate the effectiveness of mindfulness-based deep transverse friction massage mindfulness deep transverse friction (MDTF) on pain, and anxiety in patients with tennis elbow.

2. Materials and methods

2.1 Design

This was a single center, blocked randomized controlled pilot study (Figure 1). Participants were recruited from University primary care unit, Khon Kaen University. The clinical trials registry and the Ethical Committee have approved this protocol by following the typical ethical agreement of the Declaration of Helsinki. The consent form had been requested and signed by all eligible participants.

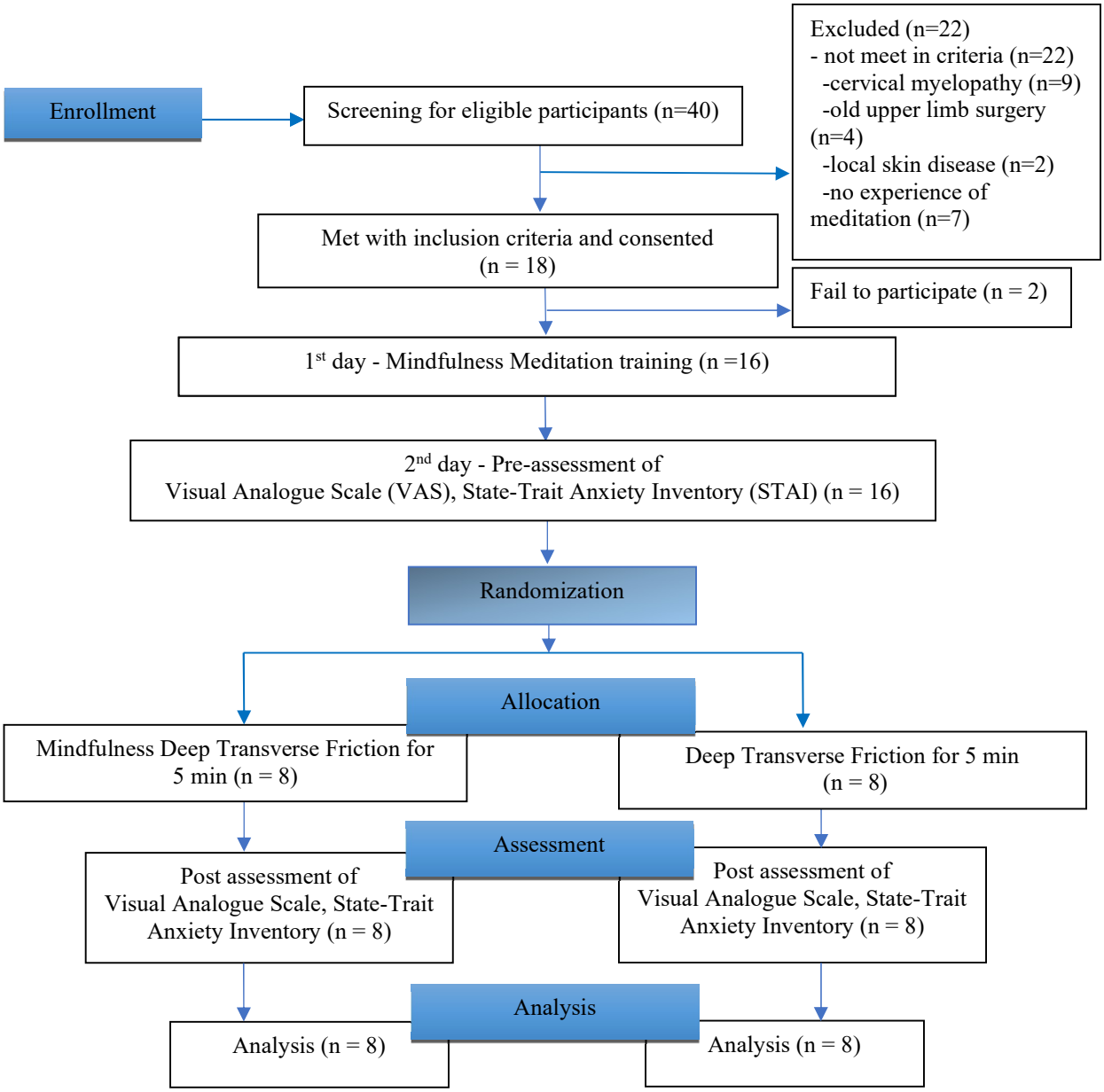

Figure 1 Recruitment flowchart.

2.2 Study sample size adjustment

The sample size needed for this pilot study was calculated with (effect size = 0.65, error = 0.05, power = 0.8) using the G*power software (Version 3.1., Heinrich Heine University, Duesseldorf, Germany). The effect size used in this study was calculated from a previous study [19]. The results showed that 13 participants were required. However, 18 participants were needed to recruit to account for the likelihood of 10% dropouts during the study. Two participants were drop out after signing informed consent. Participants in the experimental group (EG) (n = 8) and in control group (CG) (n = 8) were recruited.

2.3 Participants

In this study, the inclusion criteria are the participants who have tennis elbow pain for more than 3-months duration are (1) ages 25-45 years, (2) of both sexes, (3) pain on palpation on the lateral epicondyle, (4) resistance wrist extension

(Cozens test), (5) meditation experience. The study excluded the participant who has (1) old upper limb surgery, cervical radiculopathy and myelopathy, (2) neurological disorders, (3) recent use of central nervous system acting medications, (4) local sepsis and skin diseases and (5) BMI (more than 25kg/m^2).

2.4 Procedure

Data collection was done by screening procedures of participants to determine eligibility for the study and this study passed the ethical review committee for human research. After that, eligible participants were invited to join in this study. The researcher explained about objectives and procedures of the study to all participants until they understand clearly. If the participants willed to participate in the study, they signed a written informed consent form. Subsequently, participants were allocated either EG or CG with blocked randomization using block size 4.

Before giving the treatment, the participants in both groups were trained in mindfulness meditation to make sure they have meditation experiences**.** The researcher who has five years' experience in mindfulness meditation trained included participants for about 15 min. Firstly, the participants were explained about mindfulness, awareness and acceptance of the condition. The participants were explained to accept pain and its associated bad mood and allow becoming more objective, which will lessen the experienced pain-related suffering. The main points of the instructions were to put straight attention to the breath flow and to give awareness on breath flow, but not to try to control it. The participants should accept and observe feelings and sensations and not avoid or try to control them. When a discomfort feeling was experienced and thought such as 'This was sensitive to me' or 'I want to alter the state, the participants should not react to them urgently, nevertheless just attempt to notice these ideas and perceive them as a kind of inner practice every time [20].

Therefore, all participants were trained in individualized training about mindfulness meditation plus mindfulness deep transverse friction about 20 min in EG and deep friction massage for about 20 min in CG.

2.4.1 Experimental group

After training in meditation, eligible participants were trained MDTF. The participant sat in a comfortable position on the chair. The starting position was shoulder adduction, 90° elbow flexion and forearm pronation supported by the unaffected side**.** The thumb of the other hand palpated the lateral aspect of the lateral epicondyle and put the thumb on insertion of common extensor tendons and move transversely with moderate pressure (moving the skin) for slight discomfort feeling during the patient's tolerance [21] for about 5 min [22]. At the same time, the participant did mindfulness meditation by paying attention to breathing on nostrils and seeing the movement of transverse friction massage for 5 min.

2.4.2 Control group

After training in meditation, the participants were trained in transverse friction massage. The participant sat in a comfortable position on a chair. The starting position was shoulder adduction, 90° elbow flexion and forearm pronation supported by the unaffected side. The thumb of the other hand palpated the lateral aspect of the lateral epicondyle and put the thumb on insertion of common extensor tendons and moved transversely with moderate pressure (moving the skin) with slight discomfort feeling during the patient's tolerance [21] about 5 min [22].

2.5 Assessment

The pain was measured by the Visual Analogue Scale (VAS). The score was described by measuring the distance (mm) on the 10-cm line between the "no pain" anchor and the patient's point sport, presenting scores ranging from 0-100. Higher pain intensity was shown by a higher score. VAS has suggested no pain (0-4 mm), mild pain (5-44 mm), moderate pain (45-74 mm), and severe pain (75-100 mm) [23]. Test-retest reliability was ($r = 0.94$, $p=0.001$) in literate patients and illiterate patients ($r=0.71$, $p=0.001$) before and after treatment of a rheumatology patients. VAS has a high correlation with a 5-point verbal descriptive scale (0.71–0.78) and a numeric rating (0.62- 0.91) in construct validity in patients with a variety of rheumatic diseases [24].

Strait-Trait Anxiety Inventory (STAI) was used to measure anxiety. STAI scales were measured by participants choosing the number that was related to their feeling intensity: (1) not at all, (2) somewhat, (3) moderately, and (4) very much so. Each STAI item was set a 1 to 4 of a weighted score. The range of the total was from 20 to 80. Higher scores indicated higher levels of anxiety. The cut-point was 39-40 for clinically significant symptoms of a state of

anxiety [25], the cut-point was set at 44/45 in pre-operative patients [26]. VAS and the STAI were measured before and after the treatment.

2.6 *Blinding*

The allocated participants were assigned and given an intervention by the different researchers. The assessor was blinded to participants' intervention groups. A statistician who was blinded to the intervention allocation analyzed for outcome measures.

2.7 Statistical analysis

Statistical analysis was carried out using IBM (SPSS) version 25.0 (SPSS Inc., New York, USA) to describe each outcome measure, mean and standard deviation were used. Normal distribution was analyzed by using the Shapiro-Wilk test. Although variables were distributed normally, we used a nonparametric test because the sample size is too small. The Wilcoxon signed ranks test was used to compare the outcome variables immediately pre and post-treatment within each group and Mann–Whitney test was used to compare between groups. The level of significance in this study was 0.05.

3. Results

When we analyzed the baseline demographic data with the Shapiro-Wilk test for data distribution, all data in both groups had a normal distribution. There were no significant differences in baseline demographic characteristic data between groups. There were 8 participants with mean age (33.5) years entered into EG and 8 participants with mean age (31.38) years were entered into CG. As gender distribution, 6 participants are female, and 2 participants are male in both groups. The mean body max index (BMI) is (22.75) in EG and (19.43) in CG. All participants in both groups have BMI in the normal weight range although we collected the participants according to criteria. On the injury side, 87.5 % of participants were injured on the right side and 12.5% were injured on the left side in both groups. The duration of symptoms of participants was 16.75 ±4.09 in CG and 15.62±3.37 in EG. The baseline characteristics of participants in two groups were seen in (Table 1).

Table 1 Demographic data of participants in Deep Transverse Friction Group (n = 8) and Mindfulness Deep Transverse Friction Group (n = 8).

Characteristics	Deep Transverse Friction Group	Mindfulness Deep Transverse Friction Group
Gender		
Male	2 (25%)	2 (25%)
Female	6 (75%)	6 (75%)
Age (mean ±SD)	31.38 ± 3.02	33.5 ± 7.70
BMI (mean ± SD)	19.43 ± 1.37	22.75 ± 4.27
Injury side		
Right side	7 (87.5%)	7 (87.5%)
Left side	1 (12.5%)	1 (12.5%)
Duration of symptoms of weeks (mean ± SD)	16.75 ±4.09	15.62 ±3.37

BMI = Body Max Index, SD = Standard Deviation.

Intergroup comparison showed that EG was significant after treatment on pain to the median (range) 30.00 (24.00 - 52.00) and (p= 0.003) and anxiety 38.5 (34.00 - 42.00) and p= 0.007 respectively. In intragroup comparison, EG was significant on VAS (p=0.012) and anxiety (p=0.011). However, there were no significant differences in CG. (Table 2).

Table 2 Within-group comparison of pre- and post-intervention for Deep Transverse Friction Group (n = 8) and Mindfulness Deep Transverse Friction Group (n = 8).

Outcome Measures	Groups	Pre-intervention Median (Range)	Post-intervention Median (Range)	*p*-value
VAS	Deep Transverse Friction Group	59.00 (42.00 - 65.00)	48.50 (43.00 - 64.00)	0.830
	Mindfulness Deep Transverse Friction Group	55.86 (46.00 - 64.00)	30.00 (24.00 - 52.00)	0.012
STAI	Deep Transverse Friction Group	42.50 (41.00 - 46.00)	41.50 (41.00 - 43.00)	0.071
	Mindfulness Deep Transverse Friction Group	43.00 (41.00 - 50.00)	38.50 (34.00 - 42.00)	0.011

VAS = Visual Analogue Scale, STAI = State-Trait Anxiety Inventory.

For between-group comparisons, there were no significant differences in both VAS and STAI of EG when compared to CG in pre-intervention. However, it had a significant difference in EG in VAS (p=0.003) and STAI (p=0.007) in post-intervention when compared to CG (Table 3).

Table 3 Between-group comparison of pre and post-intervention for Deep Transverse Friction Group (n = 8) and Mindfulness Deep Transverse Friction Group (n = 8).

Outcome measures	Deep Transverse Friction Group Median (Range)	Mindfulness Deep Transverse Friction Group Median (Range)	*p*-value
VAS (pre-intervention)	59.00 (42.00 - 65.00)	55.86 (46.00 - 64.00)	0.645
VAS (post-intervention)	48.50 (43.00 - 64.00)	30.00 (24.00 - 52.00)	0.003
STAI (pre-intervention)	42.50 (41.00 - 46.00)	43.00 (41.00 - 50.00)	0.645
STAI (post-intervention)	41.50 (41.00 - 43.00)	38.50 (34.00 - 42.00)	0.007

VAS=Visual Analogue Scale, STAI=State-Trait Anxiety Inventory.

4. Discussion

This preliminary study assessed the immediate effects of MDTF on patients with tennis elbows. In the clinic, 5 min of MDTF reduced ratings of pain and pain-related anxiety. There was a significant difference in EG compared to CG for both pain and anxiety after treatment. In the current study, we assessed the effect of a combined intervention of mindfulness meditation and deep transverse friction in chronic tennis elbow patients. The main findings of this study indicated that meditation and manual therapy together were able to reduce pain and anxiety. To our knowledge, this specific therapy combination has not yet been tested in tennis elbow patients. One study has concluded that nonpharmacologic treatment programs are comparable to advantages and cannot get the risks of opioid therapy [14].

Mindfulness-based interventions were considered to use analgesic effects through bio-behavioral mechanisms such as better results in pain catastrophizing, psychological problems, the capacity of the affective shift from the sensory judgment of pain-evoking sensations, and top–down cadence of ascending nociceptive input [18]. Other nonclinical findings for 86 undergraduates who followed 15 min of audio body scan instruction in mindfulness of breath, body sensations, and pain caused a significant improvement in pain tolerance to cold-pressor than music listening and significantly fewer pain distress when compared to a pleasurable imagery state [20]. According to this literature, mindfulness-based interventions are effective in both clinical and nonclinical pain.

Related to anxiety conditions, one study found that mindfulness training improved the psychological benefits of anxiety and depression as the main ingredient of increased quality of life [27]. One study demonstrated that a mindfulness-based stress reduction program has effectiveness in reducing depression, anxiety, and pain scores after

giving intervention for herpetic patients with neuralgia [28]. These studies were consistent with our findings about anxiety. There was a correlation between depression and pain anxiety in patients with various upper limb conditions including lateral elbow pain [29]. Moreover, fear-avoidance in work was highly correlated with functional disability in daily living and work, more than to pain variables (e.g, anatomic and time patterns of pain, and severity) [30]. These results caused the lower functional tasks of daily living in tennis elbow patients as a consequence of pain severity. Even brief, guided meditation can support the effective relief of anxiety during an acute medical procedure and affect neuronal activity in regions related to attention, self-awareness, and emotion regulation [31].

Westenberg and colleagues studied a single-center, single-blind randomized controlled trial of the mindfulness-based video exercise (60 seconds duration, free online) versus an attention placebo control (reading an educational pamphlet about pain and stress about 60 seconds). This video exercise was also effective in improving momentary pain, anxiety, depression, and anger in this population [32]. A brief (3 day) mindfulness meditation intervention were effective in reducing pain ratings to experimentally induced pain and there were significant reductions in state anxiety after each mindfulness meditation session and increased mindfulness skills. Additionally, participants who had higher scores on mindfulness skills informed the greatest pain reductions. These data advocated that a decrease in anxiety and the ability to sustain focus on the present moment can attenuate the feeling of pain [18]. Moreover, reductions in anxiety state and increasing in mindfulness state may attenuate the subjective experience of pain and it was provided by evidence that 3 days of mental training can encourage a mindful state [33]. According to the literature, the minimal clinically important difference (MCID) for VAS was a 10 mm change on the 100 mm scale [34] so this study showed clinical significance.

As a limitation, this was only the preliminary study. Besides, we used only subjective outcome measures in this study so a more objective assessment such as pressure pain threshold on the effect of treatment on pain scale or must be done to confirm the results. To decrease the impact of confounding factors, we excluded patients with BMI > 25 because obesity has been associated with lateral epicondylitis [2]. The findings of our study coincided with the previous study which concluded that mindfulness can decrease pain and pain-related anxiety than another control group. Moreover, the acceptance and awareness of the pain experience are important to prevent disability and increase the psychological and quality of life. According to our study, this intervention can be a useful approach as an alternative treatment in the future, but we need to confirm in further study.

5. Conclusion

In conclusion, this study showed that MDTF is effective in reducing pain intensity and anxiety in a clinic setting, among patients with tennis elbow. Further study is needed to conclude not only in the tennis elbow population but also in other populations with chronic pain. As an advantage, the patients can do it by themselves and in their environments, so they can reduce the cost of treatments and the patients can do it any time. Furthermore, reducing the number of physiotherapy sessions may reduce the cost and reduces direct healthcare and non-healthcare costs as well as opportunity costs from lost leisure time.

6. Ethical approval

The Khon Kaen University Ethics Committee for Human Research reviewed and approved the study protocol (Reference No. HE622240) on March 13, 2020.

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