Journal of Health Research
eISSN 2586-940X

Volume 37 | Issue 6 Article 3

2023

Comparing Treatment Efficacy of Court-type Traditional Thai Massage, Elastic Taping, and Stretching for Plantar Fasciitis: A Three-Armed Randomized Controlled Trial

Phiyaphon Poonsuk
Department of Applied Thai Traditional Medicine, Faculty of Medicine, Thammasat University, Thailand

Junya Pattaraarchachai
Chulabhorn International College of Medicine, Thammasat University, Thailand

Sunyarn Niempoog
Department of Orthopedic Faculty of Medicine, Thammasat University, Thailand

Watchara Damjuti
Department of Integrative Medicine, Faculty of Integrative Medicine, Rajamangala University of Technology Thanyaburi, Thailand

Jurairat Boonruab
Department of Applied Thai Traditional Medicine, Faculty of Medicine, Thammasat University, Thailand

ORIGINAL STUDY

Comparing Treatment Efficacy of Court-type Traditional Thai Massage, Elastic Taping, and Stretching for Plantar Fasciitis: A Three-Armed Randomized Controlled Trial

Phiyaphon Poonsuk [a], Junya Pattaraarchachai [b], Sunyarn Niempoog [c], Watchara Damjuti [d], Jurairat Boonruab [a,*]

[a] Department of Applied Thai Traditional Medicine, Faculty of Medicine, Thammasat University, Thailand
[b] Chulabhorn International College of Medicine, Thammasat University, Thailand
[c] Department of Orthopedic Faculty of Medicine, Thammasat University, Thailand
[d] Department of Integrative Medicine, Faculty of Integrative Medicine, Rajamangala University of Technology Thanyaburi, Thailand

Abstract

Background: **Plantar fasciitis is a chronic inflammatory disease originating at the medial calcaneal tuberosity. Eight-five percent of people who walk extensively at work have plantar fasciitis. The efficacy of court-type Thai traditional massage (CTTM) has never been established. This study investigated the efficacies of CTTM, elastic taping (ET), and stretching (ST) in plantar fasciitis patient.**

Methods: **Ninety patients were randomly assigned for 4 weeks to receive either: 1) CTTM twice a week, 2) ET once a week, or 3) ST of the Achilles tendon and plantar fascia every day. Pain intensity visual analogue scale (VAS), pressure pain threshold (PPT), and the foot and ankle ability measure (FAAM) were assessed at baseline, 4 weeks (treatment completion), and 8 weeks (follow-up). These outcome measures were compared within and between groups.**

Results: **Patient characteristics were not significantly different among the three groups. Comparing baseline to follow-up at 4 and 8 weeks, pain intensity at the first step in the morning (VAS-M), foot pain over the past 24 hours (VAS-24 h), PPT, and FAAM significantly improved ($p < 0.001$) for all three groups. The CTTM group exhibited the largest improvements in VAS-24 h at follow-up ($p < 0.05$). Meanwhile, there were significant differences between groups for VAS-M and PPT at 8 weeks ($p < 0.05$), but not 4 weeks. Differences in FAAM between groups at follow-up were small ($p > 0.05$).**

Conclusion: **CTTM is an effective treatment that can be used as an optional therapeutic technique for plantar fasciitis patients.**

Keywords: Plantar fasciitis, Court-type traditional Thai massage, Heel pain

1. Introduction

Plantar fasciitis is a chronic inflammatory disease that originates at the medial calcaneal tuberosity. It results from repeatedly injuring or being exposed to enormous forces at the calcaneus insertion, leading to inflammation and eventually tearing the fascia [1]. In a previous study, reports indicated that the prevalence of foot conditions varies in the UK from 61 to 79%, which severely impacts the quality of life [2]. Moreover, 85% of plantar fasciitis patients aged between 25 and 65 years who walk extensively at work have a severe condition that affects their quality of life [3]. Moreover, the incidence and prevalence of plantar heel pain in Dutch patients were determined to be 3.83 cases per 1000 patient years and 0.4374%, respectively [4]. The most frequent symptom of plantar fasciitis is heel pain

Received 15 August 2022; revised 18 October 2022; accepted 4 November 2022.
Available online 6 June 2023

* Corresponding author.
E-mail address: Jurairat@tu.ac.th (J. Boonruab).

https://doi.org/10.56808/2586-940X.1037

after stepping out of bed or after a long period of inactivity [1].

There are various treatment methods for this condition, such as nonsteroidal anti-inflammatory drugs and steroid injections. However, these treatments only provide an initial short-term pain reduction [5]. The American Physical Therapy Council suggested conservative treatments for this condition, such as stretching the plantar fascia and Achilles tendon and applying tape to the foot [6]. Stretching (ST) of the plantar fascia and Achilles tendon are exercises of the calf and foot that also intensify the condition. Thus, stretching helps relieve ligament tension. Previous studies have shown that stretching the calf muscle and fascia under the foot decreases foot pain better than other methods [7,8]. Elastic taping (ET) is commonly used by physiotherapists to support the joint, and thereby controlling tearing of the ligament and reducing the activity of the injured muscle. The pulling force exerted by the tape reduces the tension from muscle contraction [9]. In a previous systematic review, 3 out of 6 studies found that applying tape was associated with pain reduction [10].

In traditional Thai medicine, there are several treatments for plantar fasciitis, including stepping on a coconut shell, stepping on wild radish, and court-type traditional Thai massage. Court-type traditional Thai massage (CTTM) is a combination massage method that includes deep tissue massage, friction massage, and trigger point massage [11]. As a result, CTTM is different from other types of massage. Full effectiveness of CTTM stipulates that the massage be performed by a licensed practitioner. The practitioner primarily uses his or her thumbs with deep pressure to diminish muscle and tendon tension, resulting in pain reduction and increased blood flow [12,13].

It is well-known that court-type traditional Thai massage, especially leg and foot massage, may help relieve plantar fasciitis. However, few scientific reports have examined the use of court-type traditional Thai massage in the treatment of plantar fasciitis. Also, studies measuring the comparative efficacy of court-type traditional Thai massage to relieve plantar fasciitis compared to conservative treatments, including elastic taping and stretching, remain limited [5]. In the present study, the efficacies of CTTM, ET, and ST in relieving plantar fasciitis were assessed and compared. This research contributes to developing and preserving local wisdom, and the findings can be utilized as a therapeutic guide for plantar fasciitis.

2. Methods

2.1. Study design

This study was designed as a comparative randomized controlled trial using a simple random sampling method. A pre-generated scheme assigning participants randomly to one of three groups enclosed in an envelope by a single researcher. The study was conducted between April 2021 and March 2022.

2.2. Participants

A total of 90 patients volunteered to participate in the present study. The sample size was determined from a previous study using a calculation based on variance, an alpha of 0.05, and power = 0.90 with 20% dropout [14]. The patients had been diagnosed with plantar fasciitis by orthopedists at either Thammasat Hospital or the Faculty of Medicine at Thammasat University. A total of 90 patients were randomly allocated into three groups: the CTTM group (n = 30), the ET group (n = 30), and the ST group (n = 30), Fig. 1.

2.3. Inclusion criteria

The inclusion criteria for patients included:

- Male or female patients between 25 and 70 years of age.
- Patients clinically showing active plantar fasciitis and the following symptoms:
  - o Heel pain in the medial plantar calcaneal region.
  - o Pain during the first steps after awakening [15].
- Expression of foot and heel pain for between 1 and 3 months.
- Patients experiencing a pain level between 4 and 7 on the visual analogue scale (VAS) for pain.

2.4. Exclusion criteria

Patients were excluded based on the following criteria:

- Receipt of physical therapy for plantar fasciitis and steroid injections on the heel within the past month.
- Treatment with anti-inflammatory drugs and steroids within the past 2 weeks.

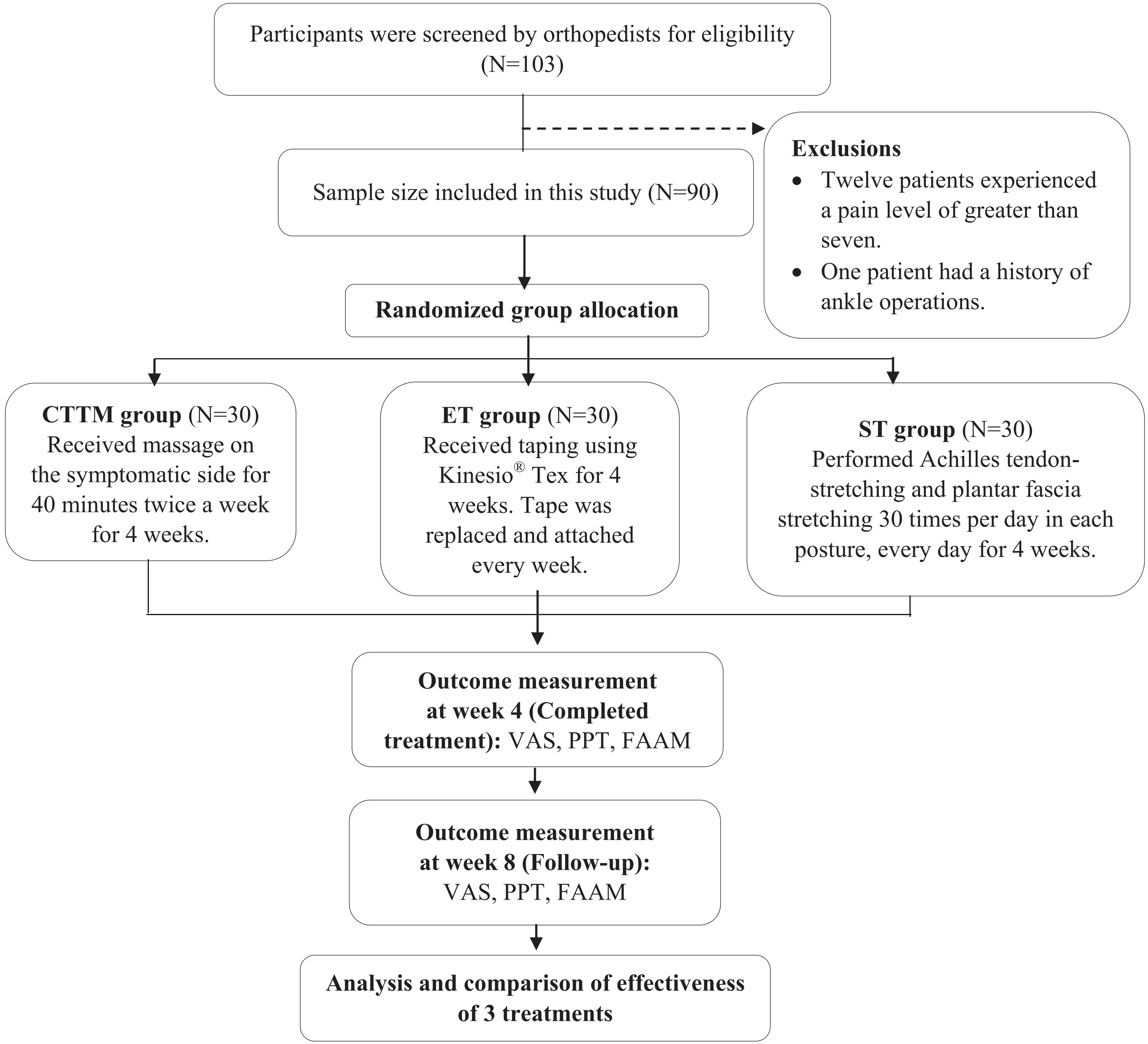

Fig. 1. Patient flow diagram. Abbreviations: CTTM = court-type traditional Thai massage; ET = elastic taping; ST = stretching; VAS=Pain intensity; PPT=Pressure pain threshold; FAAM=Foot and ankle ability measure.

- History of foot and ankle surgery, calcaneal fracture, or foot deformity.
- Diagnosis of rheumatoid arthritis, cardiovascular disorder, paralysis, amyotrophic lateral sclerosis, or deep vein thrombosis.
- Were currently pregnant.
- Were runners.

2.5. Study intervention

All the patients were randomly assigned by drawing lots into three groups: the CTTM group [16], the ET group [9], and the ST group [7].

CTTM group: The patients received court-type traditional Thai massage on the diagnosed pathological side for 40 minutes twice a week for 4 weeks (total of 8 times). The standard protocol of CTTM used in this study was based on the Thai traditional therapeutic massage and manipulation (court-type massage) guidelines [16]. Throughout the study, therapy was conducted by a single Thai traditional medical practitioner with over 10 years of experience. The CTTM procedures consisted of 7 steps, as follows:

Step 1. Leg massage covering the tibialis anterior, fibularis longus, quadriceps femoris, and iliotibial band muscle for 5 minutes each side.

Step 2. Open the wind-gate massage and placing of the palm 45° below the anterior superior iliac spine for 45 seconds on each side.

Step 3. Ankle massage on the center of the ankle, which is located on the anterior talofibular ligament, with the calf stretched for 45 seconds per point, at 3-time intervals.

Step 4. Massage of the outer aspect of the leg, at five signal press points. These points were on the gluteus medias, gluteus minimus, piriformis, and distal part of the ilio-tibial band, massaged for 10 minutes on each side.

Step 5. Massage of the inner side of the leg at five signal press points. These points were on the pectineus, adductor magnus, vastus medialis, and popliteus muscles, massaged for 10 minutes on each side.

Step 6. Calf massage at the centerline of the calf, with points located on the gastrocnemius, soleus, and Achilles tendon, for 5 minutes each side (Fig. 2).

Step 7. Plantar fascia and heel massage at the sole and medial tubercle of calcaneus with focus pressing at 9 points on the heel, for 45 seconds at each point (Fig. 2).

ET group: The patients received taping by Kinesio® Tex for 4 weeks. A physiotherapist trained in Kinesio® taping replaced and attached the tape every week (Fig. 2). The standard protocol of ET used in this study was based on the clinical therapeutic applications of the Kinesio taping method guidelines [9], which provided a pattern for therapeutic elastic taping. The ET procedures consisted of 4 steps, as follows:

Step 1. The entire length of the Kinesio® Tex was measured from the metatarsal heads to the calf. At one end of the tape on the middle calf, a 4-strip fan method was used to release all tension from the metatarsal heads to the calcaneal tubercle.

Step 2. The Kinesio strip was started on the heel with the foot in dorsiflexion. A tendon correction method was attached using moderate tension (50% of available) over the Achilles tendon. The end of the Kinesio strip was laid with light tension (25% of available) until the last two inches, which were put down with no tension. Finally, the glue was activated by rubbing it onto the tape area.

Step 3. One of the four strips was attached with full tension (100% of available) from the calcaneus to the metatarsal head while the foot was in dorsiflexion. A strip of Kinesio® Tex was affixed between all five toes.

Step 4. The Kinesio strip was used for mechanical correction of the metatarsal arch. The base of the Kinesio I strip was affixed with no tension at the fifth metatarsal base on the lateral side of the foot while the foot was in dorsiflexion. Then, the strip was affixed with moderate tension (50% of available) from the fifth metatarsal base to the tarsal navicular joint.

ST group: The patients received stretching in 2 postures. The standard stretching protocol used in this study was based on the previous research by Digiovanni et al. [7], which provided a pattern and the steps for stretching among plantar fasciitis patients.

2.5.1. Achilles tendon stretching

The patients were told to place the symptomatic leg behind the contralateral foot, and to point

Fig. 2. (A) Pressure points on the centerline of the calf in the court-type traditional massage (CTTM) group. (B) Pressure points of the heel in the CTTM group. (C) Taping by Kinesio® Tex in the elastic taping (ET) group. (D) Stretching of the Achilles tendon in the stretching (ST) group: symptomatic leg was placed behind the contralateral foot; then, (E) Front leg knee was bent, while keeping the back leg straight. (F) Stretching of the plantar fascia in the ST group: symptomatic leg was raised in a cross-legged position; then, (G) Toes were pushed back toward the shin.

toward the heel of the front foot with the toes of the painful foot. Next, patients leaned into the wall, while keeping the back knee straight and the heel firmly on the floor. Finally, the patients were advised to bend their front knee (Fig. 2).

2.5.2. Plantar fascia stretching

The patients sat on a chair and raised the symptomatic leg in a cross-legged position. They were taught to push the toes back toward the shin by themselves while positioning their fingertips around the toe base until they felt a stretch in the arch foot (Fig. 2).

Each posture was held for 10 seconds and repeated 10 times per set, with 3 sets per day every day for 4 consecutive weeks. The Achilles tendon stretching posture for the first set of stretching was performed before taking the first step in the morning. The plantar fascia stretching for the first set of stretching was performed immediately after getting out of bed in the morning. A single researcher evaluated each patient to verify that they were stretching correctly. The patients were instructed to stretch every day at home and record their activity in a logbook. Patients also attended weekly stretching practice and motivating reinforcement at the Faculty of Medicine, Thammasat University.

The first research assistant, a Thai traditional medical practitioner, performed massages on the patients. The second research assistant, who is a physical therapist, attached the tape and taught the stretching procedure. The third research assistant collected pain intensity data at the first step in the morning (VAS-M) from the data recorded every morning in the patient logbook. The third research assistant also collected foot pain scores over the past 24 hours (VAS-24 h), the pressure pain threshold (PPT), and the Thai version of the foot and ankle ability measure (FAAM-TH) three times at baseline, week 4 (treatment completion), and week 8 (follow-up after treatment). The same instrument was used to assess VAS-M and VAS-24 h. This research assistant was blinded to the patient's treatment group assignment prior to the intervention, which prevented conflict of interest with the present study.

2.6. Outcome measurements

2.6.1. Primary outcomes

2.6.1.1. Pain intensity (visual analogue scale, VAS). Pain intensity was measured using the visual analogue scale (VAS) for pain. The VAS uses a straight line of 10 cm, starting from 0 representing no pain, 1–3 representing mild pain, 4–7 representing moderate pain, and 10 representing the worst pain imaginable. The patients marked the pain level on a straight line to assess the pain they experienced [17]. Two pain variables were measured: 1) pain during the first steps after awakening in the morning, and 2) foot pain over the past 24 hours.

2.6.1.2. Pressure pain threshold (PPT). For pressure pain threshold measurements, a pressure algometer was used (JTECH Medical, Midvale, UT) with a

round tip area of 1 cm^2. The instrument was determined to be dependable, with a Cronbach's alpha (α) of 0.94–0.98 [18]. The algometer probe tip was gradually placed perpendicularly over the tender point of the plantar fascia at the same point in each patient. The trigger point was measured in triplicate, and the average pressure pain threshold was assessed. The measurement accuracy was 0.1 kg/cm^2 [18].

2.6.2. Secondary outcomes

2.6.2.1. Foot and ankle ability measure (FAAM). The foot and ankle ability measure (FAAM) is a functional activities of daily living (ADL) subscale. The FAAM was measured by the Thai version of the foot and ankle ability measure (FAAM-TH). The FAAM-TH was translated into Thai using the forward-backward translation protocol [19]. Reliability and validity were then tested. FAAM-TH reliability testing revealed high intraclass correlation coefficients of 0.8 and 0.77. The internal consistency was strong (Cronbach alpha = 0.94 and 0.88) [19].

2.7. Ethical considerations

The study was approved by the Human Ethics Committee of Thammasat University No. 1 (Faculty of Medicine), Thammasat University (Project number: MTU-EC-TM-1-225/63; Number of COA: 239/2020) and registered under the Thai Clinical Trials Registry (TCTR20210831005).

2.8. Data analysis

A total of three dependent variables were analyzed: VAS, including pain during the first steps in the morning and foot pain over the past 24 hours, in addition to PPT and FAAM. Means and standard deviation (SD) were calculated. Repeated measures ANOVA was used to evaluate differences within groups and between groups. The data in this study were normally distributed. The Statistical Package for the Social Sciences (SPSS Inc., USA) software was used for all analyses. We considered that a p-value of 0.05 was statistically significant for between group comparisons; while, we utilized a significance level of less than 0.001 for within group comparisons between baseline with week 4 (treatment completion) and week 8 (follow-up).

3. Results

3.1. Demographic characteristics

The current study enrolled 90 patients, including 84 females and 6 males. Thirty patients were allocated to each of 3 groups (CTTM, ET, and ST). The distribution of the study participants' baseline characteristics, including demographics (sex, age, BMI, pain duration, walking duration) and the outcome parameters (VAS, PPT, FAAM) among the three groups were not significantly different (Table 1).

3.2. Pain intensity

Pain intensity was the primary outcome measurement in our study. We assessed pain intensity using two measures, pain during the first step in the morning (VAS-M) and foot pain over the past 24 hours (VAS-24 h).

3.2.1. Pain during the first step in the morning (VAS-M)

The CTTM, ET, and ST groups had similar baseline mean VAS-M scores of 5.40, 5.26, and 5.40, respectively ($p = 0.857$). At week 4 (after treatment),

Table 1. Baseline study participant characteristics.

Characteristics	CTTM (N = 30)	ET (N = 30)	ST (N = 30)	*p-value*
Sex, (M/F)[a]	1 (3.3)/29 (96.7)	2 (6.7)/28 (93.3)	3 (10)/27 (90)	0.585[†]
Pain duration (Months)[a]				0.753[†]
1	8 (26.6)	7 (23.3)	8 (26.6)	
2	5 (16.7)	2 (6.7)	3 (10.0)	
3	17 (56.7)	21 (70.0)	19 (63.3)	
Age (years)[b]	48.80 ± 7.16	49.37 ± 9.29	49.37 ± 11.04	0.964[‡]
Body mass index (kg/m^2)[b]	27.08 ± 5.60	27.96 ± 6.40	26.00 ± 5.42	0.427[‡]
Walking duration (hr./day)[b]	3.55 ± 2.52	4.65 ± 2.19	4.23 ± 1.36	0.124[‡]
Pain intensity				
Pain during the first step in the morning[b]	5.40 ± 1.07	5.26 ± 1.11	5.40 ± 1.06	0.857[‡]
Foot pain over the past 24 hours[b]	5.49 ± 1.01	5.48 ± 1.25	5.43 ± 1.05	0.975[‡]
Pressure pain threshold (kg/cm^2)[b]	4.94 ± 1.14	5.38 ± 1.31	5.20 ± 1.20	0.371[‡]
Foot and Ankle Ability Measure (Percentage)[b]	69.52 ± 17.96	69.87 ± 15.28	67.49 ± 13.45	0.817[‡]

Note(s): [a]Number (percentage) [b]Mean ± SD. [†]Data analyzed by Chi-square tests. [‡] Data analyzed by one-way ANOVA tests.
Abbreviations: N = Number of patients, CTTM = Court-type traditional Thai massage, ET = Elastic taping, ST = Stretching.

there were decreases in mean VAS-M scores among the three groups to 1.80 (CTTM), 2.56 (ET), and 2.76 (ST); also, mean scores among the groups were similar ($p = 0.058$). At week 8 (follow-up), there were significant decreases in mean VAS-M scores in the three groups to 1.25 (CTTM), 2.07 (ET), and 2.36 (ST); there were also significant differences in mean VAS-M scores among the three groups ($p < 0.05$). Furthermore, we observed significant improvements in mean VAS-M scores for all groups at both weeks 4 and 8 compared to their respective baseline scores ($p < 0.001$) (Fig. 3).

3.2.2. Foot pain over the past 24 hours (VAS-24 h)

The CTTM, ET, and ST groups had baseline mean VAS-24 h scores of 5.49, 5.48, and 5.43, respectively; mean scores were similar among the 3 groups ($p = 0.975$). At week 4, the mean VAS-24 h scores significantly decreased in all three groups to 1.31 (CTTM), 2.24 (ET), and 2.39 (ST); there were also statistically significant differences in mean scores among the 3 groups ($p < 0.05$). At week 8 (follow-up), there were statistically significant decreases in mean VAS-24 h scores for the three groups to 0.84 (CTTM), 1.70 (ET), and 1.99 (ST); significant differences in mean VAS-24 h scores between groups persisted ($p < 0.05$). In addition, there were significant improvements in mean VAS-24 h scores at week 4 and week 8 compared to the baseline scores for all 3 groups ($p < 0.001$) (Fig. 3).

3.3. Pressure pain threshold (PPT)

Another primary outcome was PPT. The within-group comparison indicated that the CTTM, ET, and ST groups had significantly increased PPTs after 4 and 8 weeks ($p < 0.001$). A comparison of the groups at week 4 showed no significant differences in PPT among the three groups ($p > 0.05$). However, at the week 8, there was a significant difference in PPT among groups ($p < 0.05$), with the CTTM group having the highest PPT (Fig. 4).

3.4. Foot and ankle ability measure (FAAM)

The FAAM was used to examine functional disability parameters. The within-group comparison indicated that all three groups had significantly improved FAAM at 4 and 8 weeks ($p < 0.001$). Comparison among groups showed that FAAM was not significantly different among the three groups at 4 and 8 weeks ($p > 0.05$). The differences between the means of each group was tested by using post-hoc tests with ANOVA. These results showed that there was a significant difference in FAAM between the CTTM group and ET group at week 8 ($p < 0.05$). Also, there were significant improvements within each group when comparing FAAM at baseline to follow-up ($p < 0.001$, Fig. 5). The CTTM group improved by 24.82% (week 4) and 30.23% (8 weeks) compared to the baseline; while the ET group improved by 17.03% (week 4) and 17.40% (8 weeks). Similarly, the ST group improved by 18.58% (week 4) and 22.77% (8 weeks). However, in the ET group, two patients had mild skin irritation during the last week of treatment due to the dampness of the tape.

4. Discussion

Plantar fasciitis is a common foot disorder characterized by degeneration and inflammation of the fascia underneath the foot resulting from repeated injury [1]. Based on demographic characteristics, a majority of plantar fasciitis patients were

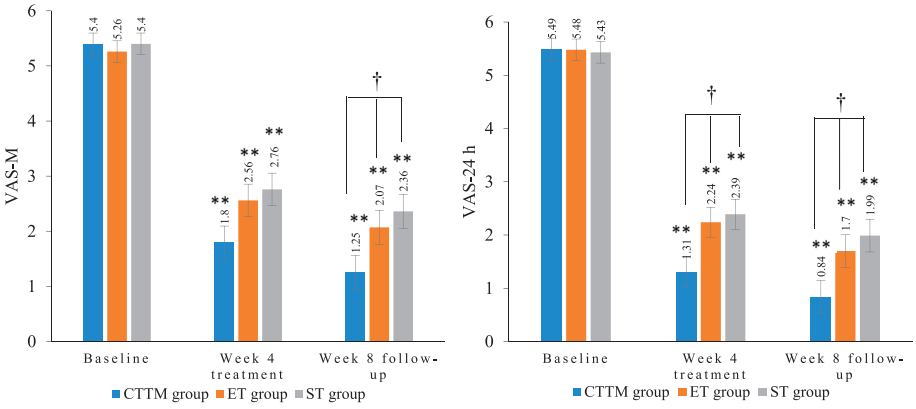

Fig. 3. VAS-M and VAS-24 h comparison of CTTM, ET, and ST groups showing decreasing pain. ***Note(s):*** *** = p value < 0.001 is considered a statistically significant difference when compared with the baseline. † = p value < 0.05 is considered a statistically significant difference when compared among the groups. Abbreviations: VAS-M = Pain during the first step in the morning, VAS-24 h = Foot pain over the past 24 hours, CTTM = Court-type traditional Thai massage, ET = Elastic Taping, ST = Stretching.*

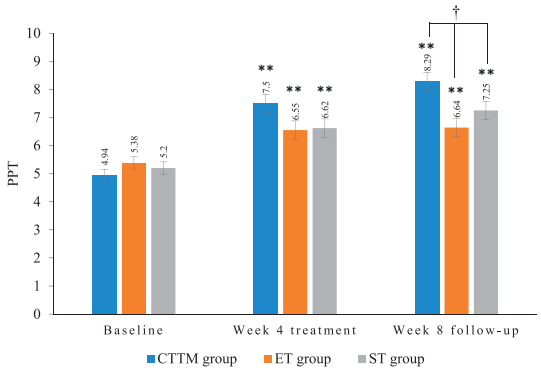

*Fig. 4. Comparison of the CTTM, ET, and ST groups showing increasing pressure pain thresholds. **Note(s):** ** = p value < 0.001 is considered a statistically significant difference when compared with the baseline. † = p value < 0.05 is considered a statistically significant difference when compared among the groups. Abbreviations: PPT = pressure pain threshold, CTTM = court-type traditional Thai massage, ET = elastic taping, ST = stretching.*

overweight (BMI >25 kg/m^2) [20] in all three groups. Being overweight can cause the plantar fascia to become thicker [21], which can cause heel pain in plantar fasciitis patients. Similarly, a systematic review indicated that excess BMI is a risk factor for plantar fasciitis [5]. Our within-group analysis indicated that pain intensity was significantly reduced in all three groups. Similarly, the PPT and FAAM scores significantly increased from baseline to follow-up for all three groups.

Our study's findings support the explanation that CTTM may reduce inflammation, increase recovery

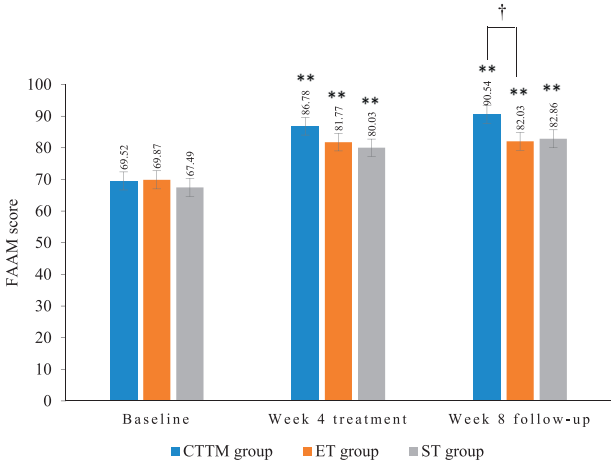

*Fig. 5. Comparison of the CTTM, ET, and ST groups showing increasing foot and ankle ability scores. **Note(s):** ** = p value < 0.001 is considered a statistically significant difference when compared with the baseline. † = p value < 0.05 is considered a statistically significant difference when compared among the groups using post-hoc analysis. Abbreviations: FAAM = Foot and ankle ability measure, CTTM = Court-type traditional Thai massage, ET = Elastic taping, ST = Stretching.*

and relieve pain. CTTM could also reduce secondary injury, nerve sensitization, and collateral sprouting by modifying signaling pathways involved in the inflammatory process, resulting in improved recovery and pain reduction [22]. Massage induces the neural-gating process in the spinal cord, which may help to relieve pain. In addition, massage may activate large fast nerve fibers, inhibiting small slow nerve fibers that detect pain. Local lateral inhibition in the spinal cord is considered responsible for this effect [23]. The pain control theory states that stimulation of large-diameter fibers in the substantia gelatinosa of the spinal cord inhibits type-A delta fibers and C nerve fibers [24]. Therefore, when foot pain decreases, it may result in greater PPT and improvements to FAAM. Similarly, a past systematic review indicated that the use of manual therapy (especially ankle and foot mobilization and soft tissue mobilization techniques to include trigger point therapy) and deep massage reduced pain and improved function in plantar fasciitis patients [25]. In addition, cross-friction massage on the plantar fascia reduced pain, improved disability, and increased PPT [26].

Kinesiology tape, a medical tape made from cotton and an acrylic adhesive, was applied in the ET group. This tape is used to reduce pain and impairment caused by physical injuries. This study investigated the mean reduction in pain during the first step in the morning and foot pain over the past 24 hours and the mean increase in both parameters on PPT and FAAM. Despite previous studies showing that kinesiology tape reduces pain, the mechanism for this recovery has yet to be determined [27]. The analgesic mechanism could be that kinesiology tape reduces subcutaneous nociceptor pressure in the skin. Another theory involves applying sensory stimulation to soft tissue, which facilitates a pain-inhibiting process while also activating the gait control method [28]. In addition, the taped skin area is elevated, and the interstitial space between the layers of fibrosis underfoot is increased, resulting in increased blood flow, lymphatic fluid drainage, and lymphatic fluid circulation [10,29]. Thus, kinesiology treatment relieves pain and improves functional ability. The results of the present study are in agreement with some previous studies in that kinesiology taping improved pain levels and functional disability in individuals with plantar fasciitis [10]. Taping may also reduce the plantar fascial thickness, which is the cause of heel pain in plantar fasciitis patients [30].

With stretching of the calves and the feet, the ST group exhibited improved VAS, PPT, and FAAM after treatment and during the follow-up. ST

decreases the stress in the plantar fascia and Achilles tendon, which tightens in plantar fasciitis patients. ST also results in inactivity that improves the windlass mechanism, which reduces recurrent microtrauma and related inflammation [7]. Therefore, the hypoalgesic effect of stretching contributed to increased PPT and an improvement in FAAM. The excellent results in this study were achieved by using an approach that required patients to stretch at least 3 times per week, hold each stretch for 10 seconds, and repeat the stretches 2−4 times per day [7]. The findings on stretching are similar to those previously reported that stretching techniques reduce plantar heel pain [8] and improve FAAM in the short-term (4 weeks) and at long-term follow-ups (6 months) [31].

In addition, the decreases in the VAS-M from baseline to week 4 in the CTTM, ET, and ST groups were 3.6, 2.7, and 2.64 points, respectively. Meanwhile, the decreases in VAS-24 h from baseline to week 4 for the CTTM, ET, and ST groups were 4.18, 3.24, and 3.04 points, respectively. Furthermore, the increase in mean PPT score in the CTTM, ET, and ST groups from baseline to week 4 was 2.56, 0.73, and 1.42 kg/cm^2, respectively. The changes in mean VAS-M and VAS-24 h between baseline and week 4 (treatment completion) were clinically significant in all 3 groups, since they were higher than the minimum clinically important difference (MCID) criteria. These findings are similar to the previous studies that have shown a minimum of 2 clinically important differences in pain intensity [32,33]. Only the CTTM group had an increase in pressure pain threshold (PPT) score that was considered clinically significant, since it was above the MCID of 1.6 kg/cm^2 [34]. These findings show that the treatments used in this study were associated with clinically significant improvements.

The CTTM group experienced the greatest reduction in pain intensity scores of the three groups (Fig. 3). Likewise, the CTTM group had higher improvement scores for PPT and FAAM than the other groups (Figs. 4 and 5). Therefore, CTTM was found to be more effective than the ET and ST treatments. This result indicates that CTTM had a greater pain-relieving effect because the pressure applied to the signal point on the muscles may have inhibited the trigger points in the heel regions [35]. In addition, the PPT in the ET group improved less than that in the other groups (Fig. 4). PPT measurements were taken by an algometer, which is an instrument used to measure deep muscles. While CTTM and ST treated the deep muscles, ET treated an elevated space under skin and soft tissue. Therefore, the ET group showed a smaller increase in PPT than the CTTM and ST groups. Nevertheless, the three treatments in this study also affected pain intensity and functional ability. As in previous research, manual therapy and stretching positively affected pain and function [5]. Future studies should include the additional parameter of plantar fascia thickness, since a thicker plantar fascia is associated with increased pain levels [36].

5. Conclusion

CTTM, ET, and ST were found to reduce heel pain as measured by the VAS-M, VAS-24 h, and PPT. The three treatments also improved functional ability assessed by the FAAM. In addition, the CTTM group exhibited greater pain and functional ability improvements than the other two groups. Finally, this study scientifically documents that CTTM can be effectively used as an alternative treatment for plantar fasciitis.

Funding

This work was supported by the Medical Research Scholar Fund, Faculty of Medicine, Thammasat University, Thailand.

Conflict of interest

None.

Acknowledgments

The author(s) gratefully acknowledge the Faculty of Medicine, Thammasat University, for their sponsorship and for allowing their facility to be used throughout the research. In addition, the author(s) gratefully acknowledge the Department of Integrative Medicine, Faculty of Integrative Medicine, Rajamangala University of Technology Thanyaburi for supporting the algometer used in this research.

References

[1] Giordani F, Bernini A, Muller-Ehrenberg H, Stecco C, Masiero S. A global approach for plantar fasciitis with extracorporeal shockwaves treatment. Eur J Transl Myol 2019;29(3):8372. https://doi.org/10.4081/ejtm.2019.8372.

[2] Lopez-Lopez D, Perez-Rios M, Ruano-Ravina A, Losa-Iglesias ME, Becerro-de-Bengoa-Vallejo R, Romero-Morales C, et al. Impact of quality of life related to foot problems: a case-control study. Sci Rep 2021;11(1):14515. https://doi.org/10.1038/s41598-021-93902-5.

[3] Cotchett M, Lennecke A, Medica VG, Whittaker GA, Bonanno DR. The association between pain catastrophising and kinesiophobia with pain and function in people with plantar heel pain. Foot 2017;32:8−14. https://doi.org/10.1016/j.foot.2017.03.003.

[4] Rasenberg N, Bierma-Zeinstra SM, Bindels PJ, van der Lei J, van Middelkoop M. Incidence, prevalence, and management of plantar heel pain: a retrospective cohort study in Dutch primary care. Br J Gen Pract 2019;69(688):e801−8. https://doi.org/10.3399/bjgp19X706061.

[5] Rhim HC, Kwon J, Park J, Borg-Stein J, Tenforde AS. A systematic review of systematic reviews on the epidemiology, evaluation, and treatment of plantar fasciitis. Life 2021;11(12). https://doi.org/10.3390/life11121287.

[6] Martin RL, Davenport TE, Reischl SF, McPoil TG, Matheson JW, Wukich DK, et al. Heel pain-plantar fasciitis: revision 2014. J Orthop Sports Phys Ther 2014;44(11):A1−33. https://doi.org/10.2519/jospt.2014.0303.

[7] DiGiovanni BF, Nawoczenski DA, Lintal ME, Moore EA, Murray JC, Wilding GE, et al. Tissue-specific plantar fascia-stretching exercise enhances outcomes in patients with chronic heel pain. A prospective, randomized study. J Bone Joint Surg Am 2003;85(7):1270−7. https://doi.org/10.2106/00004623-200307000-00013.

[8] Siriphorn A, Eksakulkla S. Calf stretching and plantar fascia-specific stretching for plantar fasciitis: a systematic review and meta-analysis. J Bodyw Mov Ther 2020;24(4):222−32. https://doi.org/10.1016/j.jbmt.2020.06.013.

[9] Kase K, Wallis J, Kase T. Clinical therapeutic applications of the Kinesio taping method. Tokyo: Ken Ikai; 2003.

[10] Kalron A, Bar-Sela S. A systematic review of the effectiveness of Kinesio Taping–fact or fashion? Eur J Phys Rehabil Med 2013;49(5):699−709.

[11] Laohapand T, Jaturatamrong U, Jantabut C, Tonglue T, Kamkaew P, Punpeng P. Thai traditional medicine in the faculty of medicine siriraj hospital. Bangkok: Supavanich Press; 2009.

[12] Boonruab J, Poonsuk P, Damjuti W, Supamethangkura W. Myofascial pain syndrome focused on the upper trapezius muscle: a comparative randomized controlled trial of the court-type traditional Thai massage versus the Thai hermit. J Evid Based Integr Med 2021;26. https://doi.org/10.1177/2515690X211030852. 2515690X211030852.

[13] Plakornkul V, Vannabhum M, Viravud Y, Roongruangchai J, Mutirangura P, Akarasereenont P, et al. The effects of the court-type Thai traditional massage on anatomical relations, blood flow, and skin temperature of the neck, shoulder, and arm. BMC Compl Alternative Med 2016;16(363):363. https://doi.org/10.1186/s12906-016-1282-y.

[14] Li S, Shen T, Liang Y, Zhang Y, Bai B. Miniscalpel-needle versus steroid injection for plantar fasciitis: a randomized controlled trial with a 12-month follow-up. Evid Based Complement Alternat Med 2014;2014:164714. https://doi.org/10.1155/2014/164714.

[15] Buchbinder R. Clinical practice. Plantar fasciitis. N Engl J Med 2004;350(21):2159−66. https://doi.org/10.1056/NEJMcp032745.

[16] Foundation for the Promotion of Thai Traditional Medicine. Thai traditional therapeutic massage and manipulation (court-type massage). Bangkok: Usa Printing; 2012.

[17] Boonstra AM, Schiphorst Preuper HR, Reneman MF, Posthumus JB, Stewart RE. Reliability and validity of the visual analogue scale for disability in patients with chronic musculoskeletal pain. Int J Rehabil Res 2008;31(2):165−9. https://doi.org/10.1097/MRR.0b013e3282fc0f93.

[18] Park G, Kim CW, Park SB, Kim MJ, Jang SH. Reliability and usefulness of the pressure pain threshold measurement in patients with myofascial pain. Ann Rehabil Med 2011;35(3):412−7. https://doi.org/10.5535/arm.2011.35.3.412.

[19] Arunakul M, Arunakul P, Suesiritumrong C, Angthong C, Chernchujit B. Validity and reliability of Thai version of the foot and ankle ability measure (FAAM) subjective form. J Med Assoc Thai 2015;98(6):561−7.

[20] Weir CB, Jan A. BMI classification percentile and cut off points. StatPearls. Treasure Island (FL). StatPearls Publishing LLC.; 2022.

[21] Tas S, Bek N, Ruhi Onur M, Korkusuz F. Effects of body mass index on mechanical properties of the plantar fascia and heel pad in asymptomatic participants. Foot Ankle Int 2017;38(7):779−84. https://doi.org/10.1177/1071100717702463.

[22] Waters-Banker C, Dupont-Versteegden EE, Kitzman PH, Butterfield TA. Investigating the mechanisms of massage efficacy: the role of mechanical immunomodulation. J Athl Train 2014;49(2):266−73. https://doi.org/10.4085/1062-6050-49.2.25.

[23] Weerapong P, Hume PA, Kolt GS. The mechanisms of massage and effects on performance, muscle recovery and injury prevention. Sports Med 2005;35(3):235−56. https://doi.org/10.2165/00007256-200535030-00004.

[24] Boswell MV, Cole BE. Weiner's pain management: a practical guide for clinicians. Boca Raton: CRC Press; 2005.

[25] Fraser JJ, Corbett R, Donner C, Hertel J. Does manual therapy improve pain and function in patients with plantar fasciitis? A systematic review. J Man Manip Ther 2018;26(2):55−65. https://doi.org/10.1080/10669817.2017.1322736.

[26] Yelverton C, Rama S, Zipfel B. Manual therapy interventions in the treatment of plantar fasciitis: a comparison of three approaches. Health SA 2019;24:1244. https://doi.org/10.4102/hsag.v24i0.1244.

[27] Baltzer H, Novak CB, McCabe SJ. A scoping review of disabilities of the arm, shoulder, and hand scores for hand and wrist conditions. J Hand Surg Am 2014;39(12):2472−80. https://doi.org/10.1016/j.jhsa.2014.07.050.

[28] Williams S, Whatman C, Hume PA, Sheerin K. Kinesio taping in treatment and prevention of sports injuries: a meta-analysis of the evidence for its effectiveness. Sports Med 2012;42(2):153−64. https://doi.org/10.2165/11594960-000000000-00000.

[29] O'Sullivan D, Bird SP. Utilization of Kinesio taping for fascia unloading. Int J Athl Ther Train 2011;16(4):21−7. https://doi.org/10.1123/ijatt.16.4.21.

[30] Ratna ST, Dowle P, Prasad V, Paruchuri RK. Effect of Kinesio taping in adjunct to conventional therapy in reducing pain and improving functional ability in individuals with plantar fasciitis a randomized controlled trial. Int J Physiother 2015;2(4):587−93. https://doi.org/10.15621/ijphy/2015/v2i4/67737.

[31] Veena KS, Selvaraj S, Padmanabhan K, Mohan KG, Senthil KN, Vijayakumar M, et al. Effectiveness of Kinesio taping on balance and functional performance in subjects with plantar fasciitis. Res J Pharm Technol 2018;11(10):4671−4. https://doi.org/10.5958/0974-360X.2018.00854.5.

[32] Ostelo RW, Deyo RA, Stratford P, Waddell G, Croft P, Von Korff M, et al. Interpreting change scores for pain and functional status in low back pain: towards international consensus regarding minimal important change. Spine (Phila Pa 1976) 2008;33(1):90−4. https://doi.org/10.1097/BRS.0b013e31815e3a10.

[33] Salaffi F, Stancati A, Silvestri CA, Ciapetti A, Grassi W. Minimal clinically important changes in chronic musculoskeletal pain intensity measured on a numerical rating scale. Eur J Pain 2004;8(4):283−91. https://doi.org/10.1016/j.ejpain.2003.09.004.

[34] Saban B, Masharawi Y. Pain threshold tests in patients with heel pain syndrome. Foot Ankle Int 2016;37(7):730−6. https://doi.org/10.1177/1071100716642038.

[35] Renan-Ordine R, Alburquerque-Sendin F, de Souza DP, Cleland JA, Fernandez-de-Las-Penas C. Effectiveness of myofascial trigger point manual therapy combined with a self-stretching protocol for the management of plantar heel pain: a randomized controlled trial. J Orthop Sports Phys Ther 2011;41(2):43−50. https://doi.org/10.2519/jospt.2011.3504.

[36] Latt LD, Jaffe DE, Tang Y, Taljanovic MS. Evaluation and treatment of chronic plantar fasciitis. Foot Ankle Orthop 2020;5(1):2473011419896763. https://doi.org/10.1177/2473011419896763.