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Effect of Kinesiotape on Ankle Range of Motion in Plantar Fasciitis: Experimental Study

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Abstract Plantar fasciitis is an inflammation of the plantar fascia. This study was conducted to determine the effect of short term treatment of KT in addition to traditional physical therapy treatment in comparison to traditional physical therapy treatment only in plantar fasciitis on ankle dorsi and plantar flexion range of motion and on plantar fascia thickness. A total of 30 patients from outpatient clinic of Damietta general hospital were included in the study. The universal goniometer was used to assess ankle range of motion in degrees and diagnostic ultrasonography was used to assess plantar fascia thickness in cm.The statistical analysis revealed that there was significant difference in ankle dorsi flexion range of motion and in plantar fascia thickness at 5cm distal to the anterior calcaneal margin(site 1) pre and post treatment within groups while there was no significant difference in ankle plantar flexion ROM and in plantar fascia thickness at the anterior calcaneal margin which is the fascial insertion site(site 2)($P<0.05$).Short term application of KT in addition to traditional physical therapy treatment in plantar fasciitis is more effective than traditional physical therapy treatment only for ankle dorsi flexion ROM and for plantar fascia reduction at site 1.
Keywords: Chronic plantar fasciitis, Ankle joint, Range of Motion, Ultrasonography, Kinesiotaping, Traditional physical therapy.

Introduction

Plantar Fasciitis (PF) is the most common and widely recognized musculoskeletal pathology of foot. PF is an overuse condition that is caused by biomechanical overuse from prolonged standing or running results in creating microtrauma and microtears to the plantar fascia at its attachment to the calcaneus, and it is because of collagen confuse in the absence of inflammation [1,2,3].It was assessed that 10 in 100 individuals are influenced by PF sooner or later during their life span [4].

Various treatment modalities have been utilized with various outcomes. One intervention growing in popularity is KinesioTape (KT). KT is showcased to be a simple to utilize effortlessly available and cost-effective treatment option[5]. Several theories have been proposed to describe its impact. The most generally acknowledged hypothesis expresses that the tape recreates the skin elasticity and serves to pull the external layer of skin off the underlying muscle and soft tissue structures [6].

Due to its elasticity, KT is theorized to increase interstitial space by lifting the skin over the area treated henceforth diminishing pressure on soft tissues which is the mechanism believed to decrease pain, creating a larger space and channel that upgrade blood and also lymphatic stream which promote edema reduction[7,8] correcting muscle activity, improving muscle function, improve kinesthetic awareness and increase joint range of movement[9,10,11,12].

Previous study have determined the effect of KT instantly after its application and after a duathlon competition on ankle range of motion and calf pain in duathletes, the results revealed a significant increase in ankle range of motion instantly after its application but not after the completion of the competition while there was no significant difference in pain scores[13].

Another review was done to figure out whether KT is effective in treatment of plantar fasciitis using KT on plantar fascia only whereas plantar fasciitis thickness and pain level were measured, there view uncovered that there was significant diminishing in both plantar fascia thickness and pain level[14].

Likewise another review was done to determine the impact for short term treatment of KT in addition to traditional physical therapy treatment in comparison to traditional physical therapy treatment only in plantar fasciitis on pain level and fascia thickness, the study revealed that there was significant reduction in mean scores of pain particularly in experimental group also there was a significant reduction in fascia thickness at its insertion in experimental group than in control one while there was no significant difference in the two groups at 5cm distal to the fascial insertion site[15].

The purpose of this study was to determine the effect of short term treatment of KT in addition to traditional physical therapy treatment in comparison to traditional physical therapy treatment only in plantar fasciitis on ankle dorsi flexion range of motion, ankle plantar flexion range of motion and its effect on plantar fascia thickness at 5cmdistal to the anterior calcaneal margin (site 1) and at the anterior calcaneal margin which is the fascial insertion site (site 2).

Materials and Methods

Thirty patients with chronic plantar fasciitis from both genders were recruited from outpatient clinic of Damietta general hospital, the onset of symptoms within 10 months at the time of this study. They were assigned randomly into two equal groups, control group (A) had received traditional physical therapy treatment in form of ultrasound (3MHz) and TENS (120 Hz/ 40 ms) while experimental group (B) had received KT in addition to traditional physical therapy treatment. Ankle dorsi flexion ROM, ankle plantar flexion ROM and plantar fascia thickness scores at site 1 and at site 2were collected before treatment and one week after the treatment. Patients with any foot disorder such as arthritis, trauma, tumor or history of foot surgery were excluded from the study. All Patients were asked to provide an informed written consent before they were enrolled in the study.

Study Design

Experimental study.

Instrumentations

Measurement Procedure

Goniometric measurement of active ankle dorsi flexion ROM and ankle plantar flexion ROM was done with the patient lying supine with knee extended and foot over the plinth edge. The goniometer was positioned on lateral side of the ankle with the axis over the lateral malleolus ,the patient was asked to dorsiflex his/her ankle as much as possible for ankle plantar flexion measurement. The patient was asked to plantar flex the ankle as much he/she could then the ROM was taken in degrees[16,17].

Ultra sonography with a7.5MHz linear transducer was utilized to gauge the thickness of plantar fascia, the ultra sound probe was placed on plantar surface and moved along the mid axis in longitudinal course from the calcaneal end to the toe end of the foot to identify the plantar fascia. Precise situating of transducer was affirmed on a transverse view of the heel. Plantar fasciitis was viewed as present when the plantar fascia

thickness was or approach 4.5 mm, in association with loss of definition of the borders of the fascia distal to the antero-inferior border of the calcaneus [18].The patient was in prone position with knees at 90 degrees of flexion and ankles in neutral position. The measuring sites for the plantar fascia thickness determined according to that defined by wall, the initially measured site was at 0.5cm distal to the anterior calcaneal margin where inflammation is usually discovered (site 1) while the secondary site was over calcaneal bone beneath plantar fascia insertion site (site 2)[19].

Treatment Procedure

For both group: US 3 MHz continuous mode was applied at the most painful points in the sole of the foot for 5 minutes followed by TENS 120 Hz/ 40 ms that was applied for 25 minutes at the same painful points while for experimental group (B) KT was added. The treatment sessions were done 6 sessions per week for one week.

Kinesiotaping

The tape utilized for this study was waterproof, permeable and adhesive with 5 cm width and a thickness of 0.5 mm.

Taping on Gastrocnemius Muscle

The reference points for taping were set apart on the skin of the posterior leg. As shown in Fig 1, the original site for taping was marked on the Achilles tendon at the level of medial and lateral malleoli. The two end sites of taping were set apart on both medial and lateral heads [most prominent area] of the gastrocnemius muscle. During taping, the patient was in a prone position on a table with feet placed outside the edge of the table. The knee joints were fully extended and the ankle joints were maintained at the neutral position. The procedure of "Y-shape" taping was applied to the gastrocnemius muscle in the affected side,the tape was cut longitudinally up to about two-third of the whole length of the tape to be used while the common end of the tape was firmly adhered to the marked original site on the Achilles tendon and then stretched proximally to stick the two ends of the bivalve tape on the marked sites of two gastrocnemius heads. The tape was extended to be 33% longer than the first length, so that the length was expanded to around 133 percent of the original length in order to provide a negative tension to the muscle. The original length of the tape was about one-half of the leg length measured from the fibular head to the lateral malleolus.

Fig 1:Taping on Gastrocnemius muscle

Taping on Plantar Fascia

The original site for taping was marked on the posterior margin of the calcaneal bone. The four end sites of taping were marked on the metatarsal joints of the first to fifth toes, except the third. During the taping, the patient was in a prone position with knee joints at 90 degrees of flexion and the ankle joints at a neutral position; the procedure of "palm-shape" taping was applied to the plantar fascia. The tape was cut longitudinally into four slices of equal width extended up to about two-thirds of the whole length of the tape to be used. The common end of the tape was firmly adhered to the marked original site over the calcaneal bone and then stretched distally to stick the four ends of the sliced tape on the marked sites of forefoot, the tape was stretched so that the length was increased to about 133 percent of the original length in order to provide a negative tension

to the plantar fascia. The original length of the tape was about one-half of the foot length measured from the calcaneal end to the tip of the big toe[10]**.**

Fig 2: kinesiotaping on Gastrocnemius muscle and plantar fascia

Data analysis

Collected data were analyzed and compared statistically through using SPSS (version 18, Chicago, USA). Unpaired t test was used to compare the sample's age, weight, height and BMI between the control and experimental group. The same test was also used to compare ankle dorsi flexion ROM, ankle plantar flexion ROM, fascia thickness at site 1 andfascia thickness at site 2 within groups for pre and post treatment. The significance level was set at P-value less than 0.05.

Results

Subjects characteristics

The study sample consisted of 30 patients with chronic plantar fasciitis divided equally into two groups;control group (A) and experimental group (B). The unpaired t-test proved that there was no significant difference between their ages, weight, height and BMI values. Demographic characteristics are presented in Table 1.Table 2demonstrates the scores of mean values for ankle dorsi flexion ROM, ankle plantar flexion ROM, fascia thickness at site1 and fascia thickness at site 2 for pretreatment and post treatment to each group while table 3 demonstrates the scores of mean values for ankle dorsi flexion ROM, ankle plantar flexion ROM, fascia thickness atsite1 and fascia thickness at site2 for pretreatment and post treatment within groups.

There was a significant difference in ankle dorsi flexion ROM and inplantar fascia thickness at site 1 pre and post treatment within groups while there was no significant difference in ankle plantar flexion ROM and in plantar fascia thickness at site 2. There was a significant improvement in ankle dorsi flexion ROM and in plantar fascia thickness at site 1 in experimental group (B).

Table 1 Demographic data of subjects

General characteristics		**Age (years)**	**Height (cm.)**	**Weight (kg)**	**BMI (kg/m2)**
Control group	Mean ±SD	46.87 ±9.80	160.9 ±17.4	81.6 ±12.1	29.40±3.96
Experimental group	Mean ±SD	42.07±9.65	166.60 ±7.79	80.6 ±12.1	29.00 ±3.42
Comparison	t-value	1.35	-1.15	0.23	0.30
	P-value	0.188	0.265	0.823	0.770
S		NS	NS	NS	NS

SD: standard deviation, P: probability, S: significance, NS: non significant

Table 2: Pre treatment and post treatment scores of mean values for ankle dorsi and plantar flexion ROM, fascia thickness at site 1 and at site 2:

Items	pre treatment		Post treatment		Comparison		Significance
	Mean	±SD	Mean	±SD	t-value	p-value	
Ankle dorsi flexion ROM for control group (0)	6.667	±1.234	7.067	±0.961	-3.06	0.009	S
Ankle dorsi flexion ROM for experimental group (0)	6.733	±0.961	7.867	±0.834	-6.86	0.000	S
Ankle plantar flexion ROM for control group (0)	19.400	±0.986	19.800	±1.320	-1.47	0.164	N.S
Ankle plantar flexion ROM for experimental group (0)	19.200	±1.320	20.267	±1.223	-9.03	0.000	S
US bindings (D1) for control group (cm)	0.3660	±0.0963	0.3353	±0.1205	2.76	0.015	S
US bindings (D1) for experimental group (cm)	0.3593	±0.1019	0.2227	±0.0430	6.35	0.000	S
US bindings (D2) for control group (cm)	0.5160	±0.0756	0.05107	±0.0662	0.97	0.349	NS
US bindings (D2) for experimental group (cm)	0.5320	±0.0762	0.4833	±0.0772	3.19	0.000	S

SD: standard deviation, P: probability, S: significance, NS: non significant

Table 3 Pretreatment and post treatment within groups mean values scores for ankle dorsi flexion ROM, ankle plantar flexion ROM, fascia thickness at site1 and fascia thickness at site 2

Points of comparison		Pre treatment		Post treatment	
		Control group (n=15)	Experimental group (n=15)	Control group (n=15)	Experimental group (n=15)
Ankle dorsi flexion ROM (o)	**Mean**	6.67	6.733	7.067	7.867
	±SD	1.23	0.961	0.961	0.834
	t-value	-0.17		-2.44	
	P-value	0.870		0.022	
	S	NS		S	
Ankle plantar flexion ROM (o)	**Mean**	19.400	19.20	19.80	20.27
	±SD	0.986	1.32	1.32	1.22
	t-value	0.47		-1.00	
	P-value	0.642		0.324	
	S	NS		NS	
Plantar fascia thickness at site 1 (cm)	**Mean**	0.3660	0.359	0.335	0.2227
	±SD	0.0963	0.102	0.120	0.0430
	t-value	0.18		3.41	
	P-value	0.855		0.003	
	S	NS		S	
Plantar fascia thickness at site 2 (cm)	**Mean**	0.5160	0.5320	0.5107	0.4833
	±SD	0.0756	0.0762	0.0662	0.0772
	t-value	-0.58		1.04	
	P-value	0.568		0.307	
	S	NS		NS	

Site 1: It is the plantar fascia thickness at 5cm distal to the anterior calcaneal margin
Site 2: It is the plantar fascia thickness at the anterior calcaneal margin which is fascial insertion site

Discussion

This study was conducted to determine the effect of short term treatment of KT in addition to traditional physical therapy treatment in comparison to traditional physical therapy treatment only in plantar fasciitis on ankle dorsi flexion ROM, ankle plantar flexion ROM and on plantar fascia thickness at site 1 and at site 2. The results showed that there was statistical significant difference in ankle dorsi flexion ROM and in plantar fascia thickness at site 1 pre and post treatment within groups, where ankle dorsi flexion ROM increased and reduction in plantar fascia thickness at site 1 post treatment in the experimental group.

There are two theories that may clarify how the KT enhances ROM. One hypothesis sets that the KT increases blood flow in the taped zone that may encourage the resolution of inflammation that results from injury and that this physiological change may influence the muscle, myofascial functions after KT application [20]. Another hypothesis proposes that the KT stimulates cutaneous mechanoreceptors led to greater muscular activation at the taped zone and this process may influence the ROM [21,22,23].

In this line, previous controlled studies exhibited an impact of the KT on ROM immediately after its application. Yoshida andKahanov[24]observed a significant increases inactive lower back flexion ROM in 30 healthy university students after KT application on the lower back. Gonzalez-Iglesias et al. [25]found that following the application of the KTimmediately, patients with acute whiplash exhibited statistically significant improvements in cervical ROM. Castro-Sánchez et al. [26]revealed that there was a statistically significant improvement immediately after application of KT in trunk flexion ROM in patients with chronic non-specific low back pain.

Also there are causes that may explain how the KT reduces fascial thickness; in case of high foot arch the plantar fascia, calf muscles and the Achilles tendon becomes too tight which led to ineffective extension during strike phase of walking, the process that cause reduction in foot-anterior-rocking angle and the counter force from the floor cannot be adequately absorbed by foot arch due to plantar fascia tightness results in overstretching. But when there is low foot arch the supporting mechanics for the foot arch through ligaments become loose and weak. The weight loading shifts to the plantar fascia causing increase in angle of foot anterior-rocking,and the foot is not stable during the stance phase of the other foot hence the plantar fascia is also overstretched, in both cases plantar fasciitis occurs due to overstretching[27]. By applying KT on calf muscles and on the plantar fascia, their pulling can be reduced. Therefore, repetitive injury to the plantar fascia can be avoided and the tissue repair can be facilitated[28]. Also KT application created convulsions on the skin which increased the interstitial spaces between the sheets of fascia[29], decrease pressure over lymphatic channels that provide a path for exudates removal [30].

The results of the present study disagree with those obtained by Salvat and Salvat[31], who concluded that there was no significant increase in lumbar mobility after application of KT.

Limitation of study

Further research is warranted on outcomes after K T applications for more than one week , also larger sample is needed to allow generalization of data.

Conclusion

On the basis of study findings, the results showed that short term application of KT in addition to traditional physical therapy treatment in plantar fasciitis is more effective than traditional physical therapy treatment only for ankle dorsi flexion ROM and plantar fascia thickness at site 1.

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