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Effectiveness of neuromuscular taping on pronated foot posture and walking plantar pressures in amateur runners

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ABSTRACT

Objectives: To determine the effect kinesiotaping (KT) versus sham kinesiotaping (sham KT) in the repositioning of pronated feet after a short running.
Design: Prospective, randomised, double-blinded, using a repeated-measures design with no cross-over.
Methods: 116 amateur runners were screened by assessing the post-run (45 min duration) foot posture to identify pronated foot types (defined by Foot Posture Index [FPI] score of ≥6). Seventy-three runners met the inclusion criteria and were allocated into two treatment groups, KT ($n = 49$) and sham KT ($n = 24$). After applying either the KT or sham KT and completing 45 min of running (mean speed of 12 km/h), outcome measures were collected (FPI and walking Pedobarography).
Results: FPI was reduced in both groups, more so in the KT group (mean FPI between group difference = 0.9, CI 0.1–1.9), with a score closer to neutral. There were statistically significant differences between KT and sham KT ($p < .05$ and $p < .01$) in pressure time integral, suggesting that sham KT had a greater effect.
Conclusions: KT may be of some assistant to clinicians in correction of pronated foot posture in a short-term. There was no effect of KT, however on pressure variables at heel strike or toe-off following a short duration of running, the sham KT technique had a greater effect.
Level of evidence: Therapy, level 1b.

1. Introduction

A pronated foot type has been associated with a number of lower limb injuries, including medial tibial stress syndrome[1] and patellafemoral pain syndrome.[2] Extremes of foot posture such as a pronated (flat) foot type can present with an increased medial contact area and greater medial forces and pressures.[3] Consequently there is a greater risk of injury in those with pronated foot types in comparison to normal foot types.[4] A pronated foot type is associated with excessive foot pronation; defined as a flattening or loss of the medial longitudinal arch,[5] where hindfoot and midfoot joints exhibit movement that is greater than those in the comparative normal groups.[6] In the lower limb, there is a high prevalence (79–90%) of running injuries and pronation has been cited as a contributing factor, particularly in collegiate and military populations[7]. For example, long distance runners show greater peak pressure in the medial forefoot during running[8] and static pronated foot posture has been associated with knee injuries.[7]

In sports, taping is widely used as a treatment in the prevention and treatment of foot and ankle disorders. Evidence suggests that traditional (low-dye) taping can be an effective treatment by controlling foot motions, specifically excessive pronation.[9] Rather than utilising firm restrictive traditional tape, there is growing popularity in the use of kinesiotaping (KT). The effect of KT to control foot pronation, however is unclear due to a lack of published studies.

Kinesiotaping is applied using traditional taping techniques and designed to mimic the qualities of human skin; it is as thin as the epidermis and can be stretched between 30% and 40% of its resting length longitudinally.[10] The mechanism of action of KT has been speculated, however only a limited number of studies have investigated the effect of KT on pain and joint motion.[11] In the foot and ankle for instance, a study to assess the effect of KT on ankle proprioception no enhancement of joint proprioception was shown, however the study was limited by a small sample size and an absent control group.[12] More recently there has been a short-term study to examine the effect of KT on plantar fascia clinical outcomes. The results suggest that there were greater clinical improvements in

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Table 1
Characteristics of the sample and per KT and SKT group.

	Experimental group (KT) $n = 49$		Sham group (SKT) $n = 24$		Total group $n = 73$	
	Mean (SD)	CI 95%	Mean (SD)	CI 95%	Mean (SD)	CI 95%
Age in years	29.5 (5.3)	28.0–31.05	27.62 (7.1)	24.60–30.64	28.9 (6.0)	27.50–30.30
Weight in kg	69.3 (9.5)	66.5–72.04	73.20 (7.9)	69.89–76.52	70.6 (9.1)	68.45–72.72
Height in cm	172.7 (7.2)	170.6–174.78	176.0 (5.6)	1.74–1.78	174.0 (7.3)	172.3–1.75
Running hours/week	11.12 (1.9)	10.58–11.66	13.20 (2.5)	12.06–14.18	11.78 (2.29)	11.24–12.31
FPI	7.7 (1.4)	7.13–8.28	7.77 (1.7)	7.27–8.27	7.75 (1.61)	7.38–8.13

the KT group compared to usual clinical care[13], however the study was limited by the absence of a comparative control group. Even in a higher quality study (using a double blind randomised experimental method) of hindfoot KT, the results suggest there was no immediate or lasting (24 h) effect on pronated foot posture.[14] These foot and ankle studies suggest the clinical and biomechanical mechanism of KT is not well understood. This may be due to a lack of high quality clinical KT studies recently highlighted in a meta-analysis, the review concluded that KT may act as a placebo effect[11] and that further biomechanical and clinical studies are needed. To our knowledge no studies have examined the effect of KT on plantar pressures. The aim of this study was to address the lack of biomechanical studies and determine the short-term effect of KT on foot posture and the walking foot pressures in amateur runners with pronated foot type.

2. Methods

The study was a double-blind, two-arm experimental study. At screening, participants were randomised into two groups to receive either KT or sham KT. This biomechanical study was designed to examine the short-term effect of KT, no follow-up was undertaken. This study aimed to recruit a minimum of 20 participants into each group, which is the recommended sample size for preliminary 2-arm studies where precision plateaus after 20 participants.[15]

A convenience sample of amateur runners was approached, who were physically active candidates for entry into the fire department. The potential recruits were asked to attend a screening appointment to examine the post-run foot posture. A group of 116 runners were screened, of which 73 met the inclusion criteria: a pronated foot type (as defined by the Foot Posture Index [FPI][16] confirmed on the right limb), the participant characteristics of the sample are shown in Table 1.

Other inclusion criteria were (i) regular participation in running (continuous running >45 min, a minimum of three times per week, or to practice sports more than 10 h/week); (ii) FPI defined pronated foot type defined as a score of 6–12; (ii) no foot or ankle injury within the previous 6 months; (iv) no foot or ankle pain at the time of the study; (v) age between 18 and 40 years; and (vi) able to provide informed, written consent. Exclusion criteria were: (i) degenerative bone and joint diseases (diagnosed from medical history); (ii) lower limb surgery; (iii) recent knee-ankle injuries or serious foot injury that could have left morphological alterations; (iv) obvious leg length discrepancy; (v) loss of balance measured with Romberg's test; (vi) painful cutaneous conditions such as callus or plantar warts and (vii) oedema on foot-ankle articulation that may make difficult or mask any necessary details for collecting the FPI. All procedures were approved by the Medical Research Ethics Committee of Faculty of Health Science, University of Malaga (ID: 07/2011) and in accordance with the Declaration of Helsinki.

At the screening session, all participants ran continuously for 45 min on a 9 km long circuit, at a paced speed (5 min per kilometre) using a smart phone application (average speed 12 km/h, standard deviation of 4.57–5.02). After the exercise, two assessors measured the FPI (GGN) and plantar pressures (JAV). Both the FPI and plantar pressures were analysed from the right foot only, to avoid selection bias and breaching assumptions of statistical independence in bilateral limb studies.[17] Participants were randomised into the two groups KT and sham KT using a manual method of flipping a coin. After screening, participants who met the inclusion criteria ($n = 73$) were invited back on a separate day to assess the effect of KT upon FPI and walking pressures.

The Foot Posture Index was assessed by a podiatrist (GGN) with an established high intra-rater reliability of FPI scoring (Intraclass correlation coefficient [ICC] = 0.91–0.98),[14] who was blinded to the purposes of the study and the participant's identity. The FPI is a six-item clinical assessment tool used to evaluate foot posture,[16] with an acceptable validity[18] and good intra-rater reliability (ICC = 0.893–0.958).[19] The FPI evaluates the multi-segmental nature of foot posture in all three planes, and does not require the use of specialised equipment. Each item of the FPI is scored between −2 and +2, to give a total between −12 (highly supinated) and +12 (highly pronated). Items include: talar head palpation, curves above and below the lateral malleoli, calcaneal angle, talonavicular bulge, medial longitudinal arch, and forefoot to hindfoot alignment.

Plantar pressure was assessed, using Biofoot (IBV, Valencia, Spain); an instrumented in-shoe insole system over a period of 6 s.[20] This mobile system is commonly used in Spain as a reliable means to capture and analyse walking in-shoe plantar pressures in healthy pain free and foot pain groups (coefficient of variation between two sessions was around 7%, range: 4.6–9%) [20]. The insoles contain 64 piezoelectric pressure sensors (sampling rate of 100 Hz) of 0.5 mm thickness and 5 mm diameter calibrated according to the manufacturer's instructions. The participants were encouraged to acclimatise to the insoles, which were placed in the participants own training shoe for both screening and intervention sessions.

Pressure measurements were taken while walking along a 20 m line, in a single direction and at a self selected walking speed. This procedure was followed for both walking trials. All the participants were asked to walk normally, the measurements began during the middle of the walkway without informing the participants to encourage natural gait. Six steps were recorded and repeated three times, in order to obtain an average. In order to record and analyse data, specific software, Biofoot/IBV 6.0 (IBV, Valencia, Spain) was used to divide the foot into 3 regions: hindfoot, midfoot, forefoot (Fig. 1). The data were gathered and stored in a computer using digital telemetry.

The anti-pronation KT was applied by a specialised sports physiotherapist (MBA) (un-blinded) with more than 8 years of experience (see Fig. 2). Kinesiotaping was applied according to procedures recommended by Pijnappel et al.[21] and using Low-Dye Taping criteria of correction.[22] Standard 5 cm Black Irisana©tape was used for both groups. The taping had two parts: (i) the hindfoot: a single strip, 25 cm in length, was applied from the fibula (lateral malleolus), around the calcaneus, with 75% stretch, to the middle third of the medial tibia. (ii) The midfoot was applied from the base of the 5th metatarsal bone, cross the talo-navicular joint and surrounding the midfoot, and ascending to reach the internal aspect