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Lower-leg Kinesio tape reduces rate of loading in participants with medial tibial stress syndrome

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ABSTRACT

Context: Medial tibial stress syndrome (MTSS) is an overuse injury occurring among the physically active. Linked to increased strain on the medial tendons of the ankle, studies emphasize controlling medial foot loading in the management of this condition. Kinesio taping (KT) has gained popularity for treating musculoskeletal pathologies; however, its effect on MTSS remains uninvestigated. This study aimed to determine if healthy participants and patients with current or previous history of MTSS differ in the rate of loading, and if KT affects plantar pressures in these participants.

Methods: Twenty healthy participants and 20 participants with current or previous history of MTSS were recruited and walked across a plantar pressure mat prior to KT application, immediately after application, and after 24-h of continued use. Time-to-peak force was measured in 6 foot areas and compared across groups and conditions.

Results: ANOVA revealed a significant interaction between group, condition, and foot area ($F = 1.990$, $p = 0.033$). MTSS participants presented with lower medial midfoot time-to-peak force before tape application (95%CI: 0.014–0.160%, $p = 0.021$) that significantly increased following tape application ($p < 0.05$).

Conclusions: These results suggest that KT decreases the rate of medial loading in MTSS patients. Future research might assess mechanisms by which this effect is achieved.

1. Introduction

Medial tibial stress syndrome (MTSS) contributes to 13–17% of all running injuries (Plisky, Rauh, Heiderscheit, Underwood, & Tank, 2007; Yates & White, 2004) and up to 35% of all cases of exercise-related leg pain (Moen, Tol, Weir, Steunebrink, & De Winter, 2009). Incidence rates for MTSS have been reported between 4 and 35 percent for military recruits and runners (Andrish, Bergfeld, & Walheim, 1974; Bennett, Reinking, Pleumer, Pentel, Seaton, & Killian, 2001; Yagi, Muneta, & Sekiya, 2013; Yates & White, 2004). This condition is characterized by pain along the posteromedial aspect of the distal two-thirds of the tibia that occurs prior to, during, or after activity (Moen et al., 2009). Patients with MTSS have an increased risk of developing a stress fracture in the area, and recent sports medicine research has emphasized the importance of prevention among physically active populations (Moen et al., 2009; Winters, Eskes, Weir, Moen, Backx, & Bakker, 2013).

Various risk factors for MTSS have been identified including type, duration or frequency of activity; improper footwear; and running surface (Willems, Witvrouw, De Cock, & De Clercq, 2007; Yates & White, 2004). While these extrinsic factors may be altered to reduce the risk of MTSS, a number of intrinsic risk factors are also present that may be more difficult to modify. These include an increased navicular drop (where the medial longitudinal arch of the foot between is observed to flatten during weight-bearing), increased pronation during the loading response of the gait cycle (Bandholm, Boysen, Haugaard, Zebis, & Bencke, 2008; Bennett et al., 2001; Delacerda, 1980; Moen et al., 2009; Sommer & Valentyne, 1995; Yates & White, 2004), biomechanical alterations in running gait (Tweed, Campbell, & Avil, 2008), higher body mass index (Plisky et al., 2007), lean calf girth (Burne et al., 2004), and increased plantar flexion range-of-motion (Hubbard, Carpenter, & Cordova, 2009). Among these, the greatest amount of evidence

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exists supporting the presence of an increased navicular drop and increased foot pronation during gait as observed in large prospective studies in military recruits (Moen et al., 2009; Yates & White, 2004), recreational athletes and runners (Busseuil, Freychat, Guedj, & Lacour, 1998; Tweed et al., 2008; Willems et al., 2007), dancers (Sommer & Valentyne, 1995), collegiate athletes (Hubbard et al., 2009; Reinking, 2006), and high school athletes (Bennett et al., 2001); where participants with increased pronation were approximately twice as likely to develop medial tibial stress syndrome. This increase in pronation has been hypothesized to increase the eccentric load on the deep plantar flexors and invertors leading to increased strain applied to the medial aspect of the tibia (Beck, 1998).

Altered kinematics potentially related to excessive pronation during gait may be quantified using a plantar pressure mat (Hafer, Lenhoff, Song, Jordan, Hannan, & Hillstrom, 2013; Lord, Reynolds, & Hughes, 1986; Morrison et al., 2010). While typical force plates measure only forces and moments about the center of pressure, mats and insoles with small force transducers are able to provide increasing information regarding the distribution of forces and pressures in varying areas of the foot. Previous studies have demonstrated significant increases in medial plantar forces pressures in participants with exercise-induced leg pain, although its relative contribution to MTSS specifically has not been assessed (Sharma, Golby, Greeves, & Spears, 2011; Willems, De Clercq, Delbaere, Vanderstraeten, De Cock, & Witvrouw, 2006). Sharma et al. (2011) reported 70% of military recruits who developed MTSS had higher rearfoot peak plantar forces and pressures, while only 14% of healthy controls had similar plantar pressure measurements. Although not explicitly measured, it has also been hypothesized that increases in peak medial plantar pressures may be tied to an increase in the rate of loading and altered biomechanical patterns (Menz & Morris, 2006).

In order to relieve symptoms related to MTSS, the use of various modalities have been used to treat symptoms, while multiple rehabilitation strategies have been implemented to reduce the intrinsic risk factors leading to this condition. Several modalities, such as the use of non-steroidal anti-inflammatories and ice (Andrish et al., 1974), massage (Johnston et al., 2006), and therapeutic laser and ultrasound (Nissen, Astvad, & Madsen, 1994) have been used with limited effectiveness. Reports have suggested prevention and treatment of MTSS should be achieved by altering mechanics using techniques such as taping, orthotics use, and strengthening (Moen et al., 2009; Rome, Handoll, & Ashford, 2005). These interventions and treatments may be effective if used in conjunction with each other; however, there were no significant findings to support their individual usage. The only treatment that has consistently proven to be effective is cessation from activity (Moen et al., 2009).

Recently, Kinesio taping (KT) has garnered interest among sports medicine clinicians for treating a variety of musculoskeletal pathologies. Developed in the 1970s, KT involves application of an elastic therapeutic tape intended primarily for the treatment of sport-related injuries (Kase, Wallis, & Kase, 2003). The tape is designed to mimic the properties of skin in its thickness and elasticity; while differing from traditional athletic tape in several ways, including tensile strength and flexibility, as well as the binding agents; which together allow the tape to be worn for several days at a time (Kase et al., 2003). Although some studies have investigated the effects of KT on pain, range-of-motion, strength, and proprioception, very few of these studies have investigated its use among injured populations. A recent meta-analysis of ten studies observed that KT may have a beneficial effect on strength, force sense error and active range of motion; however, no significant findings were found to support improvements in pain or joint position sense of the lower extremity (Williams, Whatman, Huma, & Sheerin, 2012). Studies that have investigated the effects of KT on injury have found varying results for pain in the foot (Tsai, Chang, & Lee, 2010), knee (Aytar, Ozunlu, Surenkok, Baltaci, Oztop, & Karatas, 2011; Campolo, Babu, Dmochowska, Scariah, & Varughese, 2013; Osorio et al., 2013) and in the shoulder (Kaya, Zinnuroglu, & Tugcu, 2011; Thelen, Dauber, & Stoneman, 2008), and no effect on balance among previously sprained ankles (Shields, Needle, Rose, Swanik, & Kaminski, 2013). A recent investigation reported an increase in joint stiffness in the foot and ankle with KT application, although it remains unclear how this would affect patients with joint injury (Fayson, Needle, & Kaminski, 2013).

As the use of KT becomes more widespread among sports medicine and orthopedic clinicians, further investigation is warranted how the tape affects joint mechanics and musculoskeletal pathologies (Williams et al., 2012). The purpose of this research is to examine the differences in rate of loading between healthy participants and those with MTSS and the effects of KT on the rate of loading across all participants with a history of MTSS. We hypothesize that differences in the rate of plantar loading will exist at baseline between healthy and MTSS patients; and that application of KT may reduce this rate of loading.

2. Methods

2.1. Study design

A repeated measures case-control study design with a non-injured comparison group was used to measure changes in time-to-peak force in participants before and after Kinesio tape application. Independent variables included group (MTSS vs. Healthy), tape application, and area of the foot (medial and lateral rearfoot, midfoot, and forefoot). Dependent variables included time-to-peak force.

2.2. Participants

Forty participants were recruited from a university community through posted and classroom announcements over several months. The sample included 20 healthy participants (10 M, 10 F, 173.2 ± 11.7 cm, 76.9 ± 14.4 kg, 20.2 ± 1.5 yrs.) and 20 participants with a previous or current history of MTSS (10 M, 10 F, 172.7 ± 10.4 cm, 74.3 ± 13.4 kg, 20.7 ± 2.0 yrs.). Institution-reviewed informed consent (UDIRB 247899-2) in line with current ethical practices in sports and exercise research was obtained from all participants.

Participants were separated into the two groups using a lower-leg injury questionnaire adapted from Hubbard et al.(2009), which determined inclusion criteria for the participants in the MTSS group. Participants with no previous history of MTSS and no lower limb injuries within the past 6 months were classified as healthy; while participants who had a current or previous history of MTSS that was diagnosed by a healthcare professional (physician, physical therapist, or athletic trainer), with no other lower limb injuries within the past 6 months were placed in the MTSS group. Participants with both current and previous history of MTSS were included as symptoms may often be transient while biomechanical risk factors may still be present (Rome et al., 2005). Of the 20 participants in the injured group, 8 reported a current diagnosis of MTSS, while 17 reported leg pain during running at the time of testing.

2.3. Procedures

Plantar pressures were measured using a 442 mm × 488 mm Tekscan® pressure mat system (Boston, MA). Prior to testing, the mat was calibrated for each individual's mass using F-Scan® System