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Original article

Repeatability of skin displacement and pressure during "inhibitory" vastus lateralis muscle taping

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Abstract

The use of taping to modify pain and muscle activity has become common practice among musculoskeletal physiotherapists. The aim of this study was to evaluate the repeatability of two variables, skin displacement and pressure, produced by a standardized taping procedure designed to inhibit the vastus lateralis (VL) muscle in patellofemoral pain. Measurements were recorded in 10 healthy volunteers. The effects of the taping procedure were assessed on the two lower limbs of each individual, and on measurements taken on the same limb in five subjects on two different days. On two-way analysis of variance no significant variable or interaction effect ($P<0.05$) was found. The coefficient (limit) of repeatability demonstrated that 95% of the differences measured for skin displacement and pressure were less than 6% and 94% of their respective means. The absolute pressures found were without exception very small and not repeatable. The results demonstrated that the VL "inhibitory" taping procedure used produced a reproducible effect for skin displacement. The validity of this taping technique is discussed.

Keywords: Taping; Skin displacement; Pressure; Repeatability

1. Introduction

Despite debate about the efficacy of the procedures, a number of muscle taping techniques have been developed in attempts to alter pain (McConnell, 2002; O'Leary et al., 2002) or muscle activity (Morin et al., 1997; Tobin and Robinson, 2000; Cools et al., 2002; Alexander et al., 2003). The use of rigid tape applied directly on the skin at right angles to the muscle fibres of an underlying muscle was developed initially in the context of patellofemoral pain by McConnell (1992) and termed "inhibitory" taping.

Tobin and Robinson (2000) examined the effects of taping the vastus lateralis (VL) muscle and demonstrated a decrease in the EMG activity of the VL in normal subjects during a step down task. A number of studies have also examined the effects of taping the upper trapezius muscles; Morin et al. (1997) produced a decrease in the activity of the upper trapezius during an isometric muscle contraction, while Brown (2001) demonstrated a decrease in upper trapezius:lower trapezius EMG ratio during shoulder abduction. However, using the same taping technique, Cools et al. (2002) were unable to replicate an inhibitory effect on the upper trapezius muscle.

Descriptions of the methods of tape application are subjective and variable. The application of tape needed to be "firm" (Cools et al., 2002; O'Leary et al., 2002), "snug" (Morin et al., 1997) or "under tension" (Alexander et al., 2003). Tobin and Robinson (2000) produced a "furrow" in the skin, McConnell (1996) created "a tuck or a fold in the skin" and O'Leary et al. (2002) described causing "a pitted, orange peel like appearance" of the skin. However, these studies described the tension of the

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tape as producing a desired end effect on the skin without attempts to measure or objectively quantify. Other studies failed to give any description of the actual taping procedure but only stated that the person taping was trained in "McConnell taping techniques" (Wilson et al., 2003; Pfeiffer et al., 2004). Comparisons between such studies are therefore questionable.

Therefore, studies of the effects of taping are of little consequence if the taping procedure itself cannot be replicated, and a repeatable mechanical effect produced.

To date, the consistency and repeatability of taping techniques have not been established. The extent of skin displacement and the compressive pressure produced by taping have both been suggested as possible mechanisms of muscle inhibition (Morin et al., 1997; Tobin and Robinson, 2000). However, these parameters have not been quantified in previous studies. The aim of this study was to assess the repeatability of VL "inhibitory" taping in a clinical situation using a standardized technique.

2. Methodology

2.1. Subjects

Ten healthy subjects (3 male and 7 female) aged 19–34 years (mean 26.4) participated in the study. Informed written consent was received from each participant prior to the commencement of the study, which was approved by University College Dublin Human Research Ethics Committee. Subjects with previous injury or pathology of the knee, quadriceps muscles, skin or connective tissues of the region were excluded. The mean height of the subjects was 167 cm, mean body mass 65 kg and mean calculated body mass index 23.0 kg/m^2. The mean skin fold thickness (48 ± 15.2 mm) was obtained from caliper measurements at four sites: biceps, triceps, subscapular and suprailiac and was within normal limits (Durnin and Womersley, 1974). Two reference lines were drawn longitudinally on each thigh: (1) an anterior line joined the anterior superior iliac spine (ASIS) to the midpoint of the superior border of the patella, and (2) a lateral line joined the greater trochanter to the lateral femoral epicondyle. The midpoint was marked on each line. The area was shaved and wiped with alcohol. The subject was positioned on the side with a pillow between the knees, which were flexed to an angle of 30°.

2.2. Taping procedure

Two lengths of flexible hypoallergenic tape, 5 cm in width (Fixomull-Beiersdorf, Milton Keynes, UK) were applied superior and inferior to the previously marked midpoints of the anterior and lateral reference lines extending past both lines by 2 cm. Three strips of 3.8 cm zinc oxide tape (Leukotape-Beiersdorf, Milton Keynes, UK) were laid on top of the hypoallergenic tape from the anterior line extending over the lateral line without any tension being applied. Lines were drawn on the zinc oxide tape as they crossed over the reference lines on the skin of the thigh. The tape was carefully removed and reapplied starting anteriorly over the hypoallergenic tape. Tension was applied to the zinc oxide tape laterally and posteriorly with one hand. The lateral thigh tissues were collected with the other hand while applying a downward pressure with the thumb over the VL between the reference lines causing a furrow in the skin. The tension applied on the tape was standardized to cause a "skin roll" in front of the thumb with the same height as the width (~20 mm) of the researchers thumb. A total of three zinc oxide tape strips were applied, starting with the most superior tape, followed by the middle, and finishing with the distal tape, each overlapping the other by one-third of the tape width.

2.3. Measurement of pressure

The downward pressure produced between the tape and the skin was measured using a force-sensing resistor (FSR) (Interlink electronics, Camarillo, CA, USA) with a variability of 5.8% (McCarthy Persson, unpublished data) (Fig. 1). The calibrated FSR was inserted underneath the zinc oxide tape, between two slips of paper at the middle of the application between the anterior attachment and the skin furrow formed. The FSR displayed an initial plasticity in response to a static load. Pressure recordings were therefore taken after 10 min, the time taken for the sensor to give a stable reading.

2.4. Measurement of skin displacement

The distance between the new position of the reference line on the zinc oxide tape and the original line on the skin was measured after 10 min using a

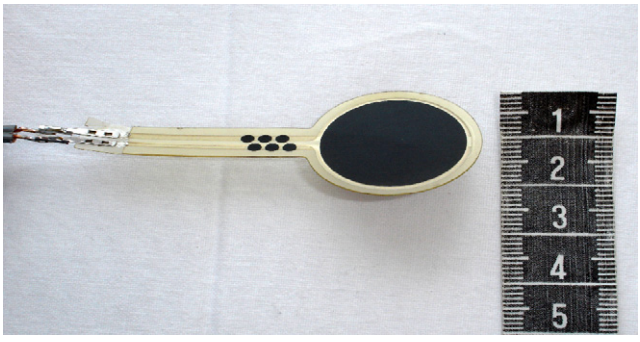

Fig. 1. The force-sensing resistor (FSR) (Interlink electronics, Camarillo, CA, USA) used for the study of pressure (thickness 0.2 mm, area 4.15 cm^2).