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Original article

Increased treatment durations lead to greater improvements in non-weight bearing dorsiflexion range of motion for asymptomatic individuals immediately following an anteroposterior grade IV mobilisation of the talus

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ABSTRACT

Manual therapy aims to minimise pain and restore joint mobility and function. Joint mobilisations are integral to these techniques, with anteroposterior (AP) talocrural joint mobilisations purported to increase dorsiflexion range of motion (DF-ROM). This study aimed to determine whether different treatment durations of single grade IV anteroposterior talocrural joint mobilisations elicit statistically significant differences in DF-ROM. Sixteen asymptomatic male football players (age = 27.1 ± 5.3 years) participated in the study. Non-weight bearing (NWB) and weight bearing (WB) DF-ROM was measured before and after 4 randomised treatment conditions: control treatment, 30 s, 1 min, 2 min. NWB DF-ROM was measured using a universal goniometer, and WB DF-ROM using the weight-bearing lunge test. A within-subjects design was employed so that all participants received each of the treatment conditions. A 4 × 4 balanced Latin square design and 1 week interval between sessions reduced any residual effects. Two-way repeated measures ANOVA revealed a significant improvement in DF-ROM following all AP mobilisation treatments ($p < 0.001$). The within subjects contrasts showed that increases in treatment duration was associated with statistically significant improvements in DF-ROM (NWB DF-ROM control = 0.01%, 30 s = 14.2%, 1 min = 21.6%, 2 min = 32.8%; WB DF-ROM control = 0.01%, 30 s = 5.0%, 1 min = 7.6%, 2 min = 10.9%; $p < 0.05$). However, WB DF-ROM improvements were below the minimal detectable change scores needed to conclude that improvements were not a consequence of measurement error. This research shows that single session mobilisations can elicit NWB DF-ROM improvements in asymptomatic individuals in the absence of pain, whilst increases in treatment duration confer greater improvements in NWB DF-ROM within this population.

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1. Introduction

Joint mobilisations are a set of techniques used to treat patients with joint hypomobility through the restoration of arthrokinematic movements that occur between joint surfaces (Green et al., 2001). These techniques are proposed by Maitland et al. (2001) and consist of the application of passive, oscillatory rhythmical forces (Venturini et al., 2007). The core tenet of the Maitland technique is a conceptual framework of clinical reasoning, which forms the basis for the selection of the specific grade, oscillatory frequency, treatment duration and volume (Banks and Hengeveld, 2010). This technique is founded on a grading system that varies from I to IV, with the latter grades being performed into resistance in order to restore joint range of motion (ROM) through the elongation of articular and periarticular tissue (Green et al., 2001).

Restrictions in ankle dorsiflexion (DF) can lead to limitations in gait and other functional activities (Chizewski and Chiu, 2012; Collins et al., 2004). Limited DF has been shown to increase the risk of ankle sprains in both healthy and symptomatic populations (De Noronha et al., 2006; Pope et al., 1998; Willems et al., 2005). Deficits in DF-ROM are often related to an anterior talar displacement and restricted talar glide (Hubbard and Hertel, 2006). Restrictions in the noncontractile tissues surrounding the ankle may inhibit the posterior talar glide decreasing ROM (Hertel, 2002). Static stretching techniques may not be sufficient

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to address these arthrokinematic restrictions, justifying the use of talocrural joint mobilisations (Denegar et al., 2002). A Maitland anteroposterior (AP) glide of the talus within the mortise has been shown to lead to improvements in DF-ROM (Landrum et al., 2008; Van der Wees et al., 2006). Various treatment doses have been utilised by researchers in an attempt to study the effects of AP mobilisations of the talus on DF-ROM. Where needed the results of these studies have been converted using the research of Bennell et al. (1998), where about 3.6° of DF-ROM occurs for every 1 cm in distance away from the wall during the weight bearing lunge test (Hoch and McKeon, 2011a, 2011b). Hoch and McKeon, 2011a concluded that significant increases in DF-ROM were detected in the order of 1.5–2° following two, 2 min applications of grade III mobilisations in individuals with self-reported chronic ankle instability (CAI). In a smaller cohort study by Hoch et al. (2012) increases in DF-ROM of 1.4 cm, or 5° were recorded. However, the treatment dose had been increased to four, 2 min grade III mobilisations. Furthermore, subjects were treated 6 times over a 2 week period and also utilised grade II tractions of the talus as an additional treatment protocol. An early randomised controlled trial by Green et al. (2001) investigated the effects of three, 1 min mid-grade mobilisations concluding a statistically significant improvement of 4.3°. In a methodologically similar study Yeo and Wright (2011) concluded an average increase of 3.5°. Research has also shown that significant increases in DF-ROM can be gained from low dose AP mobilisation treatments. Venturini et al. (2007) concluded that a treatment prescription of two, 30 s bouts elicited a 2° improvement in DF-ROM, whilst Landrum et al. (2008) recorded an increase of 4.4° following a single 30 s mobilisation. These studies highlight how minimal treatment doses can produce clinically significant outcomes. However, research has shown that grade IV mobilisations produce greater mean force (Silvernail et al., 2011) and increased plastic deformation of connective tissue (Bonutti et al., 1994; Moutzouri et al., 2008; Ulrich et al., 2010) than grade III techniques. This is of particular importance when improvements in ROM are sought within asymptomatic individuals. Indeed, many researchers have demonstrated ROM improvements at various joints following accessory mobilisation treatments in asymptomatic individuals (MacRae et al., 2012; Manske et al., 2010; McCollam and Benson, 1993; Thomson et al., 2009). Specifically, Venturini et al. (2007) and De Souza et al. (2008) revealed a statistically significant increase in DF-ROM following higher grade joint mobilisations in asymptomatic populations with no history of ankle injury. The use of asymptomatic individuals also limits confounding variables associated with clinical conditions, such as pain associated treatment limitations that may influence its application and subsequent response (George et al., 2002). The objective of the present study was to investigate whether varying treatment durations of a grade IV AP talus mobilisation produce differences in ankle DF-ROM within an asymptomatic population. It was hypothesised that greater improvement would occur with greater duration of treatment.

2. Methodology

2.1. Subjects

A total of 16 male football players (mean ± SD age = 27.1 ± 5.3 yr) volunteered to participate in this randomised cross-over study. Subjects were excluded if they exhibited any ankle pathology, or any history of ankle injury in the past 6 months. Written consent was gained from all participants and data was anonymised then securely stored. Ethical approval was obtained from London Metropolitan University's Research Ethics Review Panel.

2.2. Testing procedures

All participants completed the same testing procedure and received either a control treatment where no mobilisation was performed (treatment 1), a mobilisation treatment of 30 s (treatment 2), 1 min (treatment 3) or 2 mins (treatment 4). A period of 1 week was given between treatment sessions, and the use of a balanced 4 × 4 Latin square was utilised to limit potential carry-over effects. Participants were randomly assigned, using a random numbers table, to one of the four testing groups and received the different treatment conditions in the order prescribed. To reduce any inter-tester reliability issues, all mobilisation treatments were conducted by the same therapist who was experienced in peripheral mobilisation techniques. ROM testing was conducted by an independent examiner who was blinded to the treatment duration that the participant had received. Study participants were all initially familiarised with the procedures.

2.3. Measurement of dorsiflexion range of motion of the ankle

Prior to treatment, weight bearing (WB) and non-weight bearing (NWB) DF-ROM were measured. NWB ROM was assessed using a 30 cm universal goniometer (MSD Europe BVBA) following the procedure proposed by Jonson and Gross (1997). During the procedure the participant would lay prone on the plinth with the knee in extension. The subject was instructed to dorsiflex the foot actively to a maximal position. This method demonstrates an intra-class correlation coefficient of 0.98, indicating high reliability (Venturini et al., 2007). The weight-bearing lunge test was used to measure weight bearing ROM, utilising the knee-to-wall principle described by Hoch and McKeon (2011b). Subjects positioned the test foot so that heel line and big toe were aligned with the tape measure. A controlled lunge was then performed such that the knee flexed as the participant attempted to touch it to a vertical line marked on the wall with adhesive tape. Foot alignment was maintained on the tape measure secured to the floor, whilst the tester watched for knee contact with the wall and monitored the heel to ensure contact with the floor. The maximum distance that the participant could achieve the knee-wall contact whilst maintaining heel-floor contact was recorded. This method demonstrates an excellent intra-class correlation coefficient of 0.97–0.99 (Chisholm et al., 2012). For all measurements of DF-ROM only a single measurement was taken ensuring that there was no cumulative effect upon ROM from repeated assessment. Following the initial DF measurements participants received the joint mobilisation intervention based on their group assignment. Immediately after the treatment NWB and WB DF-ROM measurements were again taken utilising the same protocol. Participants were blinded from their test scores to ensure that results would not be artificially augmented.

2.4. Joint mobilisation intervention

The joint mobilisation was performed with the participant in supine with their foot comfortably positioned over the end of the plinth. The ankle was placed at 20° to plantar flexion in order to achieve a loose-packed position of the talocrural joint (Magee, 2014; Mulligan, 2011). In this position, the talus was held slightly anterior to the mortise, allowing greater pressure application during the mobilisation, the force of which was transmitted to the posterior periarticular tissues (Wright et al., 2000). The stabilising hand was placed proximal to the malleoli to stabilise the distal leg, whilst the mobilising hand cupped the anterior talus using the 1st web space. The talus was then glided posteriorly with downward force applied by the mobilising hand (AP) (Houglum, 2010). The

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