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Full Length Article

Movement adjustments in preparation for single-leg jumps in individuals with functional ankle instability

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ABSTRACT

There is some evidence showing that people with functional ankle instability (FAI) can present changes in postural control during the landing phase of a jump. These studies also show preliminary results indicating possible changes during phases prior to landing. Therefore, the objective of this study was to investigate whether movement adjustments prior to a jump are different between people with and without FAI. Sixty participants with (n = 30) and without (n = 30) FAI participated in this study. The main outcome measures were the variability of range of motion in ankle inversion/eversion and dorsiflexion/plantarflexion; and variability of center of pressure for the directions anterior-posterior and medio-lateral during the pre-jump period for drop jump, vertical jump and during single-leg stance. The group with instability showed more variability of center of pressure in anterior-posterior direction (p = 0.04) and variability of range of motion in ankle dorsiflexion/plantar flexion (p = 0.04) compared to control in the single-leg stance test. For the within-group comparisons, the group with instability showed more variability of center of pressure in anterior-posterior direction in the drop jump higher than single-leg stance and vertical jump. The same pattern was seen for the control group. Thus, this study suggests that people with FAI have greater ankle range of motion variability and center of pressure variability in the anterior-posterior axis when compared to healthy individuals during single-leg stance. For those same two variables, preparation for a drop jump causes more postural instability when compared to the preparation for a vertical jump and to single-leg stance.

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1. Introduction

The ankle joint is subjected to constant stress during sports practice, and because of its anatomical design, it is highly prone to injury (Fong, Hong, Chan, Yung, & Chan, 2007; Gerber, Williams, Scoville, Arciero, & Taylor, 1998). Between 2002 and 2006, more than 3 million ankle sprains were reported in emergency departments throughout the USA (Waterman, Owens, Davey, Zacchilli, & Belmont, 2010). After-effects are a common concern following these sprains, with patients

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reporting sequelae that can last up to three years (Gerber et al., 1998; van Rijn et al., 2008). Due to these sequelae, there is often a decrease in physical activities and an increase in the risk of recurrent sprains, which can lead to chronic ankle instability (Hertel, 2002; Hubbard-Turner & Turner, 2015).

Although there are different theories on ankle instability, many researchers have investigated the role of functional deficits in people with chronic ankle instability, naming this particular condition functional ankle instability (FAI) (Hertel, 2002). It is important to identify the changes in function that are usually present after an ankle sprain as this can guide treatment and procedures intended to prevent new sprains (de Noronha, França, Haupenthal, & Nunes, 2013; Hiller, Refshauge, Herbert, & Kilbreath, 2008). Some of these possible changes related to FAI have been previously reported, particularly those related to sensorimotor control (McKeon & Hertel, 2008; Munn, Sullivan, & Schneiders, 2010).

A meta-analysis presented by Munn et al. (2010) showed evidence that sensorimotor control is impaired in people with FAI, particularly for the variables joint position sense and postural control. The studies on postural control used three different measurements: Star Excursion Balance Test, single-leg stance test, and time to recover balance in single-leg stance after a jump.

Studies often use the jump in their measurements (Brown, Ross, Mynark, & Guskiewicz, 2004; de Noronha, Refshauge, Crosbie, & Kilbreath, 2008; Ross & Guskiewicz, 2004, 2006; Ross, Guskiewicz, & Yu, 2005; Wikstrom, Tillman, & Borsa, 2005) because it is a complex activity, regularly seen in sports and highly related to ankle sprains. The results of these studies show that people with FAI can present changes during the landing phase of a jump (Brown et al., 2004; de Noronha, Refshauge, & Crosbie et al., 2008; Ross & Guskiewicz, 2004, 2006; Ross et al., 2005; Wikstrom et al., 2005), with preliminary results indicating possible changes during phases prior to landing (Delahunt, Monaghan, & Caulfield, 2006; de Noronha, Refshauge, & Crosbie et al., 2008).

de Noronha, Refshauge, and Crosbie et al. (2008) investigated the variability in inversion range of motion (ROM) during the preparation phase prior to a single-legged drop jump in people with FAI, showing that people with FAI had increased range of motion (ROM) of ankle inversion when compared with healthy controls. Such findings present the possibility that people with FAI will be affected while preparing for a challenging task. However, as single-leg stance tests have shown to be different in people with FAI, the question remains: are the changes presented by de Noronha, Refshauge, and Crosbie et al. (2008) due to a preparation for a jump or are those changes the same as those seen during the single-leg stance tests, as reported by Munn et al. (2010)? Therefore, the aim of this study was to investigate whether movement adjustments prior to a jump are different between those with and without FAI. In addition, we compared the movement adjustments happening prior to a jump to those happening during an one-legged stance test.

2. Methods

2.1. Design

This was a cross-sectional study investigation of whether there were differences in the variability for inversion/eversion (I/E) and dorsiflexion/plantar flexion (D/P) in two different conditions between people with and without FAI. We also compared the variability for the center of pressure (COP) in the anterior-posterior (AP) and medio-lateral (ML) directions immediately prior to a jump.

2.2. Participants

Sixty participants from the academic community of Santa Catarina State University, aged between 16 and 35 years, with and without FAI agreed to participate in the study. To be eligible for the FAI group, participants needed to have a history of at least two lateral ankle sprains in the same ankle, with the latest sprain between 12 and 2 months previous to study enrollment and a score of less than 23 in the *Cumberland Ankle Instability Tool – Português* (CAIT-P) (de Noronha, Refshauge, Kilbreath, & Figueiredo, 2008; Gribble et al., 2013). The FAI could be unilateral or bilateral. For the control group, participants could not have a history of ankle sprain and should have a score over 27 in the CAIT-P. Exclusion criteria for both groups were history of surgery and/or fracture in the lower limbs or any vestibular, neurological or musculoskeletal disease that could interfere with or was a contraindication to the procedures of the study. A lateral ankle sprain was defined as an inversion movement beyond the physiological joint limit followed by at least one of the following symptoms: persistent pain for more than one day, edema for more than one day, hematoma for more than one day, inability to participate in routine physical activity for more than one day (Fong, Chan, Mok, Yung, & Chan, 2009; Hiller et al., 2008). Participants from each group were paired according to age (range of 2 years), height (range of 3 cm), and mass (range of 3 kg) (Table 1). The study was approved by the Human Research Ethics Committee of Santa Catarina State University (registration number 03967912.6.0000.0118), and consent was granted by all participants.

2.3. Procedures

Initially a researcher, not involved in the data collection, verified the inclusion/exclusion criteria for the participants to define group allocation; ensuring the researchers involved in data collection were blinded to the CAIT-P score. Data

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