Sensorimotor Deficits Associated with Chronic Ankle Instability

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Abstract

Kim, Kyung-Min, Sensorimotor Deficits Associated with Chronic Ankle Instability, Exercise Science, 23(4): 287-296, 2014. Chronic ankle instability (CAI) is a common debilitating condition in sports medicine that contributes to dysfunction and disabilities. A significant portion of patients with ankle sprains develops CAI, resulting in recurrent injuries and an increased likelihood to develop a degenerative disease like ankle osteoarthritis. CAI may be due to either mechanical or functional insufficiencies, or both. The mechanical contributing factors are pathologic joint laxity, arthrokinematic restrictions, synovial inflammation and impingements, and degenerative changes. The functional insufficiencies include impairments in proprioception, alpha motoneuron pool excitability, reflex actions, strength, postural control, walking and running mechanics, and jumping and landing mechanics, which indicate alterations in the sensorimotor system. It may be intuitive that mechanical disruptions of the lateral ligaments in the ankle joint following an ankle sprain cause changes in joint mechanics, leading to the joint instability, but it is not clear how sensorimotor deficits arise from mechanical injury to the ankle. Recent evidence showed that deficits in postural control and alpha motoneuron recruitment might be more influential, however, each of the sensorimotor deficits play a role in CAI. Thus, the purpose of this review is to discuss the relevant literature surrounding chronic ankle instability with an emphasis on deficits in postural control and alpha motoneuron pool excitability, and to provide insight into rehabilitation for CAI patients suffering from sensorimotor dysfunction.

Key words: muscle activation, balance, ankle sprain
I. Introduction

Ankle sprains have been frequently reported as the most common sports injury in interscholastic and intercollegiate athletes (Fernandez et al., 2007; Fong et al., 2007; Hootman et al., 2007; Yard et al., 2008). These injuries accounted for 15% of all injuries in the 15 collegiate sports studied and are commonly found in athletes participating in basketball, soccer, football, and women’s volleyball and gymnastics (Hootman et al., 2007). Despite the high frequency of this injury, 55% of patients with ankle sprains did not seek professional medical care (McKay et al., 2001) indicating a general perception of an ankle sprain as an innocuous injury. There exists, however, ample evidence that an ankle sprain is not a simple injury, and leads to a significant proportion (30-74%) of patients that report prolonged symptoms, self-reported disability, limited physical activity, and recurrent injury for months to years following the injury (Verhagen et al., 1995; Gerber et al., 1998; Braun, 1999; Konradsen et al., 2002; Anandacoomarasamy & Barnsley, 2005; van Rijn et al., 2008). These debilitating sequelae following ankle sprains have been termed as chronic ankle instability (CAI) (Hertel, 2002). It has been characterized by repetitive bouts of the ankle giving way and feeling of ankle joint instability during ankle activities that present for a minimum of one year post-initial sprain (Delahunt et al., 2010). It has been documented that 30% of patients suffering an initial ankle sprain are predisposed to develop CAI (Itay et al., 1982). CAI has been found to be associated with lower quality of life and an increased likelihood to develop ankle osteoarthritis (Anandacoomarasamy & Barnsley, 2005; Valderrabano et al., 2006; Sugimoto et al., 2009).

The development of CAI after initial ankle sprain has been extensively examined in the literature over the past few decades in an effort to understand the etiology of CAI and to develop effective treatment strategies, but there has been a large discrepancy in results from studies investigating CAI (Hertel, 2008; Hiller et al., 2011). A comprehensive review article by Delahunt et al. (2010) pointed out the inconsistent findings across studies assessing sensorimotor deficits in relation to CAI, which were largely attributed to high variability of inclusion criteria to determine whether the subjects have the condition of CAI. This inconsistent criteria may be derived from the lack of a universally agreed upon definition of ankle instability. Particularly, functional instability is typically determined with self-reported ankle symptoms although the definition of mechanical instability is universally accepted as a result of pathologic ligamentous laxity (Hubbard & Hertel, 2006; Hiller et al., 2011). In addition, the terminology describing the condition being investigated varies greatly such as functional instability, functional ankle instability, chronic instability, CAI, chronic lateral instability, chronic ankle sprain, multiple ankle sprains, and recurrent ankle sprain. It is suggested that CAI appears to be the most encompassing term and the most commonly used to describe patients who complain of on-going symptoms after ankle sprains (Delahunt et al., 2010; Gribble et al., 2014).

CAI can be quantified with the incidence rate of ankle joint “giving way” and “feelings of instability”. The giving way refers to “the regular occurrence of uncontrolled ankle joint inversion episodes that do not necessarily result in an ankle sprain” while the feelings of instability refer to “the situation whereby the ankle joint feels vulnerable during daily and sporting activities” (Delahunt et al., 2010). The use of ankle instability questionnaires like the Ankle Instability Instrument (Docherty et al., 2006) and Cumberland Ankle Instability Tool (Hiller et al., 2006) provides an objective way to quantify the perceived ankle instability. Individuals with CAI report limited ankle function, which can be quantified with a validated, reliable, and responsive ankle instrument like the Foot and Ankle Ability Measure (Eechaute et al., 2007; Carcia et al., 2008). Since CAI results from an initial ankle sprain regardless of its severity (Itay et al., 1982), it is requisite that individuals with CAI have a history of at least one ankle sprain. The initial ankle sprain should be older than one year to ensure that the ankle instability is considered as a chronic problem (Delahunt et al., 2010). Furthermore, the time frame elapsed since the most recent ankle sprain should be considered because subjects in an early stage of healing may be undergoing the acute responses of the most recent injury. Practically, anyone suffering a sprain within