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DOUBLE-BLIND RANDOMIZED CLINICAL TRIAL

The immediate effect of talocrural joint manipulation on functional performance of 15–40 years old athletes with chronic ankle instability: A double-blind randomized clinical trial

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ABSTRACT

Objective: To evaluate the immediate effect of talocrural joint manipulation (TCJM) on functional performance of athletes with chronic ankle instability (CAI).
Participants: Forty athletes (18males, 22females) with CAI divided into TCJM group (n = 20) and sham manipulation group (n = 20).
Intervention: TCJM was performed as a quick thrust on the involved talus, in the posterior direction. Sham manipulation was maintaining the same position, without any thrust.
Main outcome measures: Functional performance of athletes was assessed with single leg hop; speed and Y balance tests, before and after the interventions.
Results: All functional tests evaluated in this study improved significantly after TCJM (p-value<0.05). These findings were not seen in the control group. Between-group comparisons also showed significant changes for all the measurements after the interventions ($p < 0.05$).
Conclusions: TCJM can significantly increase the functional performance of athletes with CIA and can be an effective supplementary treatment for these subjects. However, this was a pre-post study and future studies with long-term follow-ups may provide more reliable results about the long-term effectiveness of this type of treatment.

1. Introduction

Musculoskeletal injuries are very common among athletes. This fact can place a huge financial burden on individuals and societies annually with respect to diagnosis and treatment of these injuries and sportspeople's absence from sporting activities. Second to the knee, the most common site of injury during sport activities is the ankle; furthermore, lateral ankle sprain (LAS) is the most widespread type of ankle injury(Fong et al., 2007). Thus far, it has been estimated that 23,000 athletes incur LAS daily in the United States(Kannus and Renström, 1991). Epidemiologic studies have revealed that ankle injuries constitute 10–30% of all the sports injuries, potentially reaching up to 40% in some specific sports such as soccer, volleyball, and handball. In general, competitive sports, which include evasive maneuvers, are faced with the highest incidences of ankle injuries(McGuine and Keene, 2006).

LAS usually occurs via hyper-supination of rear foot ensuing initial contacts or landings. In this position, the talocrural joint (TCJ) would be in excessive inversion, internal rotation, and plantar flexion, placing an extreme tension on the lateral ligaments of the ankle(Milgrom et al., 1991). While the TCJ is strongly reinforced by a fan-shaped deltoid ligament on the medial side, it is rather highly vulnerable laterally, where it is supported by the moderately weak anterior talofibular, posterior talofibular, and calcaneofibular ligaments. Anterior talofibular and calcaneofibular ligaments are, respectively, the most injured parts during LAS, up to the point that isolated anterior talofibular ligament ruptures comprise 66% of all ligamentous ruptures during ankle injuries(Hertel, 2002).

According to previous studies, females, young individuals, and athletes participating in indoor and court sports are more susceptible to LAS(Doherty et al., 2014). However, a recurrence rate of 70% has turned the previous experience of LAS to be considered as the most important risk factor and predictor of future LAS

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Nomenclature

TCJM	talocrural joint manipulation
CAI	chronic ankle instability
LAS	lateral ankle sprain
DF-ROM	dorsiflexion range of motion

occurrences(Smith and Reischl, 1986; Ekstrand and Tropp, 1990; Milgrom et al., 1991; Bahr and Bahr, 1997; McKay et al., 2001).

Repetitive ankle sprains can lead to osteoarthritis and articular degeneration in the TCJ (Harrington, 1979; Gross and Marti, 1999), and, if not treated, may become chronic. According to the literature, 72.6% of patients with LAS suffer from symptoms anywhere from 6 to 18 months after the injury(Braun, 1999). These symptoms include pain, swelling, weakness, and feeling of "giving way" that are more notable during activities (Yeung et al., 1994). It has been estimated that 55% of subjects sustaining LAS do not refer to a health care provider for treatment(Smith and Reischl, 1986; Ekstrand and Tropp, 1990; Milgrom et al., 1991; Bahr and Bahr, 1997). These statistics imply the high prevalence of chronicity and repetition and persistence of LAS symptoms, which is known as chronic ankle instability (CAI)(Hertel, 2002).

Numerous contributory factors have been identified for CAI including ligamentous laxity (Karlsson et al., 1991; Lentell et al., 1995), proprioceptive impairment (Ryan, 1994; Lentell et al., 1995), joint instability (Clanton, 1989), and muscle weakness (Clanton, 1989). Generally, the pathomechanics of CAI can be attributed to two major causes: mechanical instability due to laxity and functional instability due to proprioceptive and neuromuscular insufficiencies. But then again, CAI usually occurs as a result of combined functional and mechanical instabilities(Hertel, 2002). Aside from its causes, CAI can lead to athletes' frequent absences from sporting activities as well as long-standing disability, to an extent that lateral ligament injury has been reported to be the most widespread cause of sports time lost(Garrick, 1977).

Up to now, various methods of physical therapy have been applied to tackle CAI, including supportive braces (Feger et al., 2014), kinesio taping (Simon et al., 2014), strengthening exercises (Hall and Docherty, 2015), balance training (Hale et al., 2014), and manual therapies (Hoch and McKeon, 2011). One of the most common implications following CAI is the hypo-mobility of the ankle joint, particularly in dorsiflexion (DF) (Tabrizi et al., 2000). This reduction in DF range of motion (ROM) can be attributed to tight gastrocnemius and soleus muscles; more importantly, accessory movements of TCJ may decrease due to an anteriorly positioned "talus" bone(Hubbard et al., 2007). One of the best therapeutic measures to address this issue is TCJ manipulation (TCJM) to reposition the talus.

To the best of our knowledge, as yet, no study has evaluated the effect of TCJ manipulation on the functional performance of athletes with CAI by functional tests. In this study, we aimed to use functional tests as straightforward evaluative tests obviating the need for laboratory equipment such as force platform and isokinetic system.

2. Methods and materials

2.1. Subjects

Forty athletes with CAI (18 males and 22 females), who were recruited by convenience random sampling, had referred to physiotherapy clinics of Shiraz, Iran, between October 2013 and January 2014. Sample size was calculated by using Power SSC, on the basis of a previous pertinent study ($\alpha = 0.05$, $\beta = 0.02$, 95% CI, $d = 2$, $SD = 1.9$) (Green et al., 2001). The participants were semi-elite soccer ($n = 11$), volleyball ($n = 16$), and basketball ($n = 9$) players and martial arts athletes ($n = 4$) who had been exercising at least 3 times per week. The written informed consents were obtained, and the subjects were divided into two groups of treatment ($n = 20$) and control ($n = 20$) by random number table. Ethical code was obtained from local medical ethical committee.

The athletes aged between 15 and 40 were included in the study, provided that they had at least one experience of acute ankle sprain (grade I or II) in the previous six weeks or multiple episodes of giving way in ankle joint in the previous 12 months prior to their participation in this study. The subjects also had to complete the "24-m running test" without pain, and their injured leg had to have at least 80% of the strength of their healthy leg. An expert orthopedist confirmed the definite diagnosis of grade I or II ankle sprains. The patients were excluded if they had any history of neurological diseases, rheumatoid diseases, postural disorders, fractures in lower limbs, flat foot, and sacroiliac joint impairments. In order to avoid probable bias, we included subjects who were suffering from CAI in their dominant leg.

2.2. Interventions

The participants were randomly allocated into two groups; the intervention group received TCJM, and the control group received sham manipulation. An educated physical therapist assessed the participants' demographic properties and their baseline values for functional tests, including single leg hop test, speed test, and Y-balance test which is a simplified version of star excursion balance test. These functional tests are well-established assessments in this field(Ageberg et al., 1998; Gribble et al., 2012).

For the purpose of manipulation in the intervention group, the subjects were sat on a bed, with flexed hip and knee and a wedge under the foot in order for them to stay in a resting position. Another experienced physical therapist, who was not cognizant of the results, performed the interventions. The therapist put his hands on each other and then on the cubital edge of the patient's talus. By extending the elbows, the therapist delivered a quick thrust in the posterior direction (see Fig. 1). The same position was

Fig. 1. Talocrural joint manipulation.