



ORIGINAL RESEARCH

The effect of Tai Chi exercises on postural stability and control in older patients with knee osteoarthritis



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KEYWORDS

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Different surfaces

Summary A few studies have examined the effect of Tai Chi on balance in elder patients with knee osteoarthritis (OA). The aim of this study was to determine the balance measures in elder patients with knee OA after Tai Chi exercises. For this purpose 14 females and 6 males with knee OA were chosen. Area and mean velocity of the center of pressure movements (CoP) were measured by force plate in standing positions (on foam and rigid surfaces). The measurements of area and mean velocity of CoP were performed before and after 60 min of Tai Chi sessions (twice a week for 8 weeks). The results showed that the area of CoP in standing position on rigid surface was significantly decreased ($P < 0.01$) after Tai Chi exercises. Furthermore, the mean velocity of CoP was significantly decreased after Tai Chi exercises on both rigid and foam surfaces ($P < 0.001$). Our study also indicated that changes in surfaces (rigid and foam) would cause significant differences regarding the area of CoP in standing positions. However, similar findings were not found regarding the mean velocity of CoP. Considering the

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effects of Tai Chi on mean velocity of CoP, it might be concluded that motor control and postural stability improvements have occurred. Therefore, based on these results, Tai Chi exercises could be recommended for elder patients with knee OA as part of their rehabilitation and physical therapy protocols.

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Introduction

Osteoarthritis (OA) is the most prevalent joint disease in elder people, and the most involved joints in this disease are knees, hips and fingers (Cooper and Arden, 2011). The signs and symptoms of OA are degeneration of joint surface, joint space narrowing, pain, stiffness, swelling and decrease in physical function (Scott and Kowalczyk, 2007). Furthermore, muscle weakness and functional limitations are frequently observed in knee and hip joints following OA (Emrani et al., 2006). Knee OA is the most common joint disease (Cooper and Arden, 2011); which is seen in people of different ages but it is more prevalent among older adults (Michael et al., 2010). Approximately 10% of adults over 60 years suffer from knee OA (Scott and Kowalczyk, 2007).

Normal postural control consists of integration of somatosensory, visual and vestibular systems (Abrahamova and Hlavacka, 2008). Since, knee OA is accompanied by pain, deterioration of proprioception and muscle weakness, postural instability is one common finding in these patients (Hassan et al., 2001). In addition, as the consequences of aging, proprioception and motor disturbances and hence postural imbalance and rate of falling might increase in this group of patients (Lelard et al., 2010). Accordingly, Hytonen and his colleagues had suggested, the sway velocity of elder people begins to increase after the age of 60 (Hytönen et al., 1993). Therefore, the information on postural stability is helpful for the assessment and also treatment of these patients. Reviewing the literature, there is almost no definite and comprehensive treatments for OA and, the core therapeutic strategies are based on symptomatic reliefs including analgesics, glucocorticoids, glucosamine, surgery and exercise therapy (Burks, 2005). Among these treatments, exercise therapy has shown to be effective in controlling the signs and symptoms of knee OA (Roddy et al., 2005).

Tai Chi is an ancient Chinese mind-body exercise that is comparable to aerobic exercise. Tai Chi includes relaxation, deep breathing and slow movements. Tai Chi has been suggested to bring on many physical and mental benefits (Lee et al., 2008). These benefits in turn could reduce pain and anxiety and lead to a feeling of calmness in chronic patients (Wang et al., 2004). Hence, Tai Chi might be suggested as a complimentary treatment in elderly patients with knee OA. Even though Tai Chi has evolved in the past two decades but there is almost no scientific evidence for effectiveness of this treatment in patients with knee OA (M. S. Lee et al., 2008).

There are few studies on the effect of Tai Chi on healthy subjects and patients with balance disorders; Lelard and his colleagues showed that Tai Chi exercise has no effect on mean velocity and area of CoP in old subjects (Lelard et al.,

2010). On the other hand, Li and his colleagues showed that Tai Chi exercises had positive effects on functional capacity and rate of falling in patients with Parkinson's diseases (Li et al., 2012). However, Wang and his colleagues (Wang et al., 2009) showed no positive effect of Tai Chi on balance; albeit, they had only used questionnaires for their evaluation. Furthermore, most of studies regarding the effectiveness of Tai Chi on postural stability had used Platforms with controversial positive (Voukelatos et al., 2007) and negative effects (Woo et al., 2007).

In the present study, we aimed to assess the effects of Tai Chi on the postural stability of patients with knee OA. Area and mean velocity of CoP were defined as the area covered by CoP displacements (cm²) and the mean velocity of CoP displacement (cm/s), respectively. These parameters were derived from ground reaction forces and recorded by the force platform. All the above mentioned parameters had been utilized in order to describe some features of the complicated movement pattern termed body sway and therefore, the postural stability. According to the previous studies (Raymakers et al., 2005), mean body sway velocity had been suggested as the best parameter to indicate the most consistent differences between age ranges, test situations and health conditions and also was the most reliable parameter (Lin et al., 2008). COP was measured bipedally with the subjects standing still. This method of measurement may be used as a reliable tool for investigating general postural stability under specific conditions (Ruhe et al., 2010). Furthermore, we used center of pressure (COP) parameters (area and mean velocity) in bipedal position for evaluating the balance in our subjects. In addition, we used different surfaces (foam and rigid) in order to consider the effect of somatosensory inputs on postural stability.

Methods

Subjects

14 women and 6 men with knee OA participated in this study. The Inclusion criteria were as following; age ≥ 60 years old, BMI ≤ 40 , and Visual Analog Scale for pain 3–7, radiographic Kellgren/Lawrence scale knee OA grade ≥ 2 , Mini Mental Examination > 24 , Berg Balance Scale > 41 , ability to stand for one minute on feet to achieve the parameters of force plate (Masui et al., 2006), patients had no history of seizure, dizziness, diabetes, knee fracture, Parkinsonism and other diseases that might cause disturbances in balance (Hassan et al., 2001). Also, the participants had no history of taking part in exercises such as yoga or Tai Chi, no history of physical therapy, knee surgery, or

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