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Review article

A review of Tai Chi Chuan and parameters related to balance

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Abstract

Introduction: Previous systematic reviews of the literature on the effects of Tai Chi Chuan (TCC) on balance have focussed either on determining the quality of the research design or have provided just a general description of the studies. To the best of our knowledge none have approached this topic by conducting an analysis from the point of view of the factors which affect balance. It is important to present this perspective as it will help to guide future research in this field.
Methodology: Seven electronic data bases were searched for publications dated between 1996 and 2012. The inclusion criteria were; randomized controlled trials (RCT) written in English.
Results: From a total of 397 articles identified, 27 randomized controlled trials were eligible for the analysis.
Conclusions: Studies reviewed appear to confirm that TCC improves static and dynamic balance and in the functional factors which affect balance in persons of over 55 years of age. Only one study was identified on people affected with problems with the vestibular system. No studies on the influence of TCC on improvement in balance in individuals suffering from deteriorated brain function were identified.

Keywords: Elderly people; Vestibular system; Visual system; Proprioceptive system; Tai Chi Chuan; Balance

Introduction

For people over 65 years of age, falls represent a serious problem leading to both the loss in quality of life and to the expense to public health care systems resulting from treatment [1]. One of the main factors associated with falls in elderly people is the deterioration in balance control which occurs, due to the degeneration of the brain function, proprioceptive and motor systems – which is clearly manifested in their reduced walking speed and stride length [2].

Among the physical activity and sports programmes which are used to improve balance in the elderly, Tai Chi Chuan (TCC) has become the focus research internationally. TCC is a physical activity for health originating as we know it today, in the 17th Century in China. With time different schools or styles have been created, the most important being Chen, Yang, Wu, Hao and Sun. This activity consists in a kind of choreography performed with slow but continuous, circular and fluid movements, postural alignment and relaxed body, with trunk rotations around the hips and body weight changes from one leg to the other in different directions (forward–backwards, laterally or a combination), patterns that some authors naturally associate with an improvement in the balance of the participants [3]. TCC has been recommended in health programmes for its calm non-competitive nature, the fact that it does not need special equipment, because practice time and place can be very flexible and because people of all ages can participate [4].

Although review articles can be found in the literature on the effects of Tai Chi Chuan on balance [5–10], these have focused on providing systematic reviews to determine the quality of the research design used in the studies analyzed or have been limited to simple general descriptions of the studies. To our knowledge no study has approached this topic by analyzing these papers from the point of view of the factors which affect balance (static and dynamic balance, and physiological systems which influence it: vestibular, proprioceptive, visual and cerebral). This aspect is important in order to inform guidance for future research in this area.

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Methods

Search strategy and exclusion process

Seven electronic data bases were used: Medline-Pubmed, Scirus, Cochrane, Pascal, ScienceDirect, SportDiscuss, Science Citation Index and BIOSIS using as key words Tai Chi, Tai Chi Chuan, T′ai Chi, Taiji, Tai Ji Quan, balance and biomechanics. The search focussed on publications dated between 1996 and 2012 and excluded studies which were not published in English, were not randomized controlled trials, or were abstracts, posters, or summaries from congresses. From a total of 397 articles found, 27 randomized controlled trials were selected following the above mentioned criteria.

Data extraction and analysis

The articles found were classified in two domains: (a) studies which include balance as an additional factor in their research, and (b) original studies which analyzed balance from a functional point of view. In this second division the studies were differentiated according to whether they focussed on analyzing balance from a vestibular, proprioceptive or visual viewpoint.

Results

Twenty seven RCT were identified and analyzed with regard to balance (see Table 1).

These studies were carried out between 1996 and 2012 in different countries: USA (14), China (10), Australia (2) and France (1). The TCC styles used were: (a) Yang in simplified versions of 5, 8, 9, 10, 12 and 24 movements (18 studies) and only 1 used the traditional system of 108 movements, (b) Chen (1 study), (c) Sun (1 study) and (d) NG (1 study). The duration of the interventions oscillated between 3 weeks and 4 years. The mean for the frequency of the classes was 2–3 times per week and the duration of the session 1 h.

From these studies, 13 out of 19 which analyzed this item found that TCC caused significant improvements in static balance [3,11,12,18–20,22,24,25,30,31,33,35], 14 out of 16 in dynamic balance [3,4,13,14,19–21,23–26,29–31] 5 out of 7 in the proprioceptive system [3,21,29,31,34], 4 out of 5 in the vestibular system [21,27,28,31], 2 out of 3 in the visual system [27,31], none of them analyzed the influence of deteriorated brain function and only 4 studies [15–17,32] did not find significant improvements in any parameter.

Table 2 shows the diversity of instruments used to evaluate data on static and dynamic balance; and the proprioceptive, vestibular and visual systems:

The framework which includes studies related to balance can be classified in two sections:

(A) Studies which include balance as secondary outcome factor in their research

This section includes the studies in which general balance tests are administered together with the analysis of other parameters which affect health, without going into the sensory motor aspects of balance in depth. Among these studies Audette et al. [11], Barnett et al. [12], Li et al. [18], Qin et al. [22], Taylor-Piliae et al. [24]; Taylor-Piliae and Coull [25] and Yan [4] confirmed significant improvements, and only Hartman et al. [16] found none.

In the studies which consider balance in the elderly from a general point of view, some authors like Wong et al. [31] and Yan [4], feel that priority should be given to dynamic balance over static balance, because it implies greater difficulty to integrate the sensory motor information and requires better coordination of the body segments coinciding with the demands of the activities of daily living which the elderly have to perform (walking, going up and down stairs, etc.), and has a closer relation with falls. However, many authors [11,12,22] have concentrated their research on improvements in static balance ignoring these recommendations.

(A) Original studies which analyze balance from a functional point of view

This section includes the interventions which study this problem by analyzing in depth the sensory motor aspects of balance. Wong et al. [31] distinguish two types of basic strategies for recovering balance control: (a) proactive ones which are the body adjustments which happen before the destabilizing forces which are directly associated with walking; and (b) reactive strategies which are applied afterwards. Proprioceptive, visual and vestibular information is fundamental in both aspects and has become the focus of study in the different research projects which analyze the benefits of TCC for balance.

- *Proprioception* concerns the bodily awareness of the person in space, the position of their joints, their movement and their acceleration [36].

Five of the studies analyzed in this paper confirm that TCC produces an improvement in the proprioceptive system of its practitioners [3,21,29,31,34] while two did not find significant improvements [27,32]. The length of time that the subject has practised seems to be of great importance to achieve these improvements. In particular a long experience of 2–20 years [31] and 4 or more years [34] revealed a better reflex action in the lower limbs to compensate balance and a higher level of proprioception in the knee and ankle. However, Tsang et al. [27] found that although the practitioners with more than 1 year of practice improved their visual and vestibular systems they did not show improvement in their proprioceptive system, and Woo et al. [32] found that an intervention of 12 weeks (3 times per week) was still not sufficient to improve this aspect.

Among the studies on proprioception and fall prevention, special mention should be given to the results obtained with regard to improvements in proprioception and strength in the ankle joint in people who practised TCC. It has been found that the negative changes which appear with ageing and foment falls in the elderly, include the lack of muscle strength in the ankle joint and the lesser use of the somatosensorial information