Ankle joint position sense in male Taekwondo athletes after wobble board training

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Abstract

There is evidence of an improvement in sportive performance in the athletes after completing a wobble board training program. The aim of this study was to determine whether a six-week wobble board training increased the awareness of joint position sense on ankle joint proprioception in male taekwondo athletes.

Material/Methods:
Eighteen male taekwondo athletes took part in this study. Participants were randomly divided into experimental and control groups. For experimental group (n=10) the average age, height, weight and experience time of the subjects were 19.50±2.07 years, 175.80±7.27 cm, 64.80±4.71 kg and 6.30±1.49 years, respectively. For control group (n=8) it was 19.88±2.30 years, 173.75±5.06 cm, 67.50±5.55 kg and 7.13±2.56 years, respectively. Experimental group took wobble board training three times a week for the period of six weeks. To assess ankle joint position sense (JPS), passive angle reproduction test was performed by the Biodex System 3 Dynamometer (Biodex Medical Systems, Shirley, NY, USA). Passive angle reproduction test was conducted on dominant and non-dominant ankle at 5° and 25° of plantar flexion angles. Measurements were taken twice, before and after training.

Results:
There was no significant difference in dominant ankle at 5° between JPS measurements before and after training in experimental group (t=1.920, p=0.087). JPS increased significantly in dominant ankle at 25° (t=3.060, p=0.014), non-dominant ankle at 5° (t=2.939, p=0.016) and 25° (t=3.213, p=0.011) in experimental group.

Conclusions:
The WBT of taekwondo athletes had improved JPS, especially in non-dominant ankle. The proprioception training with wobble board may provide an advantage in using dominant leg during performing taekwondo sport moves and in decreasing the number of ankle injuries in male taekwondo athletes.

Key words: ankle • proprioception • taekwondo • training • wobble board

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Background

The term of proprioception was first described by Sherrington (1906) as a result of sensory information achieved by the central neural system through mechanoreceptors located in the ligaments, joint capsule, tendons, muscles, and skin [1]. The proprioceptive mechanism is required for correct function of the joints in sports, activities of daily life and some occupational tasks. Proprioception contributes to the motor programming of neuromuscular control during movements and at the same time contributes to muscle reflex for
Turn Kicking (Dollyo Chagi / Round Kick) – The practitioner raises his knee, turns hips, pivots on the non-kicking foot, and snaps the kick horizontally into the target at an 80 to 90 degree angle.

Turn Kicking (Mom-Dollyo Chagi / Bandae Dollyo Chagi) – The body is turned round and the foot is directed upward and pushes the back leg straight toward the target, hitting it with the heel while watching over the shoulder. The foot is stretched up aiming at the opponent’s face.

Taekwondo Foot Techniques – Ap chagi / Front kick, Dollyo chagi / Round kick, Yeop chagi / Side kick, Dwi chagi / Back kick, Neur chagi / Axe kick, Mon-dollyo chagi / Turning kick.

Ankle Joint Position – In the passive reproduction test the system moved the subjects foot from the neutral posture noted as 0° to the target angle (first 5° and then 23° of plantar flexion).

Ankles are the joints of the leg at which the leg is attached to the foot, and are one of the most vulnerable areas of the body to injury. Ankle proprioception is the sensory feedback that contributes to postural equilibrium, muscle sense, joint stability. Proprioceptors are located in the skin, muscles, tendons, ligaments, and joint capsules [6]. The lack of proprioceptive feedback caused by injuries may lead to excessive or unsuitable loading of a joint [7]. It is one of the factors that lead to progressive degeneration of the joint and continued deficits in joint dynamics, balance, and coordination [8].

Proprioception test

Ankles were randomly divided into experimental and control groups. For experimental group (n=10) the average age, height, weight and experience time of the subjects were 19.50±2.07 years, 173.75±5.06 cm, 67.30±5.53 kg and 6.30±1.49 years, respectively. For control group (n=8) it was 19.88±2.30 years, 173.75±5.06 cm, 67.30±5.53 kg and 7.13±2.56 years, respectively. Participants were excluded if they had a lower extremity injury; vestibular problems and visual problems. Exclusions were assessed by questioning the participants. Subjects were instructed to refrain from any exercise before test.

Wobble board training

The experimental group took WBT program in addition to standard taekwondo training. The control group entirely performed standard taekwondo training. The WBT was
adapted from previous studies [19–23] and performed on wobble board (Table 1). The experimental group was trained 20 minutes, 3 times per week for the period of 6 weeks. On each training day, subjects performed a 5 minute warm up before WBT. Training was performed with open eyes and closed eyes on dominant and non-dominant leg. Subjects were requested to perform dorsiflexion/plantar flexion and inversion/eversion exercises while their knee joints were at 45 degrees flexion.

Statistical analysis

The Shapiro-Wilk test for normality was performed. Data from passive reproduction test were examined with a t-test for independent samples to determine significant differences among the experimental and control groups. T-test for dependent samples was used to determine significant differences among measurements, before and after training. A significance level of 0.05 was set for the study. Analyses were conducted using SPSS 16.0.

RESULTS

Subjects’ demographic characteristics are presented in Table 2.

Taekwondo athletes’ passive reproduction test means ±SD before (pre-test) and after training (post-test) in dominant and non-dominant legs are shown in Table 3 and 4. In the passive reproduction test measurements for dominant leg significant differences were not found between experimental and control groups in pre-test (t=1.113; p>0.05) and post-test (t=–0.369; p>0.05) at 5°. Significant differences were not identified between experimental and control groups in pre-test (t=–0.655; p>0.05) and post-test (t=–0.884; p>0.05) for dominant leg at 25°. Passive reproduction test measurements for non-dominant leg significant differences were not found between experimental and control groups in pre-test (t=0.998; p>0.05) at 5°. A significant difference was identified between experimental and control groups in post-test (t=–2.440; p<0.05) for non-dominant leg at 5°. Passive reproduction test measurements for non-dominant leg were no different for experimental group and control group in pre-test (t=0.260; p>0.05) and post-test (t=–0.642; p>0.05) at 25°.

In experimental group for dominant ankle at 5°, a non-significant difference was found in the ankle JPS between pre-test and post-test measurements (t=1.920,
After a 6 week WBT, passive reproduction test performance increased at 5° for non-dominant leg (t=2.959; p<0.05) and at 25° for dominant (t=3.060; p<0.05) and non-dominant leg (t=3.213; p<0.05). On the other hand, no significant difference was found in the ankle position sense measurements after a period of 6 weeks between pre-test and post-test (t=0.659; p>0.05 for dominant leg and t=–1.124; p>0.05 for non-dominant leg at 5°, t=2.320; p>0.05 for dominant leg and t=1.793; p>0.05 for non-dominant leg at 25°.

**Discussion**

During six week WBT performed by the taekwondo athletes there was an improvements were observed in JPS for dominant and especially non-dominant ankles. Proprioception may also have changed with short-term acute exercise and the risk of ankle injury may further worsen due to temporary changes in neuromuscular control [24].

JPS is a component of proprioception and is often measured to assess proprioception [25]. During the test of proprioception, joint and muscle receptors are theoretically stimulated and an unspoilt motor control system is required [3]. To measure proprioception different instruments may be used, like goniometer, isokinetic dynamometer, motion analysis systems and other unique measuring systems [26].

In ankle rehabilitation wobble boards, ankle discs and balance boards played an important role [27,28]. In general the wobble board is used in rehabilitation of functional instability of the an ankle, to assist the re-education of the proprioceptive system. It has been designed to restore the normal neuromuscular feedback and improve mechanoreceptor function [29].

In the study the experimental group included 10 taekwondo athletes. Subjects’ ankle positions sense significantly increased from before- to after training (Table 3). Lephart et al. [3] declared the positive impact of training as regular observable on proprioception sense. It improves the neuro-sensory and motor roads and reduces the risk of injury [3]. Some studies have well documented effectiveness of WBT on the improvement of markers of proprioception in individuals with no history of ankle instability [30,31].

When the ankle JPS after training program, was measured, it was noted that experimental group of taekwondo athletes had higher ankle JPS performance than control group, which is statistically significant especially at non-dominant ankle JPS non-dominant 5° and 25°. In taekwondo training the dominant leg is used more effectively and the taekwondo athletes apply to many of taekwondo foot technique on the dominant leg during both training and competition.

At the end of comparing the experimental and control groups’ ankle JPS measures have been calculated after proprioception training program; the reason why no significant difference was found in dominant ankle joint position scores is probably due to the fact that in athletes’ use their bodies unilaterally. Waddington et al. [31] investigated effect of WBT on rugby players. They took part in

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<th>Table 3. Taekwondo athletes’ passive reproduction test (absolute error at 5°) means ±SD in second.</th>
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* Different from pre-test (p<0.05); ** Different from experimental group in post-test (p<0.05).

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<th>Table 4. Taekwondo athletes’ passive reproduction test (absolute error at 25°) means ±SD in second.</th>
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* Different from pre-test (p<0.05).
WBT over five weeks. At the end of training, they found significant developments in both ankle and knee JPS.

**Conclusions**

Our study indicated that training with a wobble board may enable subjects to become more accurate in their foot positioning. The WBT focused on improving the athletes’ body control and preparing the neuromuscular system for taekwondo specific movements. Compared with the control group that continued standard training, the WBT group had significantly improvement. The study findings may provide evidence supporting the effects of regular wobble board exercise on proprioception. Using proprioception training with wobble board may have an advantage in using dominant leg during performing techniques concerning taekwondo sport and in decreasing the number of ankle injuries in male taekwondo athletes.

**References:**

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