The effect of active core exercise on fitness and foot pressure in Taekwondo club students

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Abstract. [Purpose] The effects of core training using slings and Togus on the improvement of posture control in Taekwondo club students, that is, balance ability, were investigated. To that end, changes in the Taekwondo players' balance ability resulting from active core training for eight weeks were examined through fitness and foot pressure. [Subjects] The present study was conducted with 13 male Taekwondo players of K University in Daegu, South Korea. Once the experiment process was explained, consent was obtained from those who participated voluntarily. [Methods] Air cushions (Germany), Jumpers (Germany), and Aero-Steps (Germany) were used as lumbar stabilization exercise tools. As a method of training proprioceptive senses by stimulating somatesthesia in standing postures, the subjects performed balance squats, supine pelvic lifts, and push-up plus exercise using slings while standing on an Aero-Step and performed hip extension parallel squats (Wall Gym Ball), and standing press-ups on a Togu using their own weight. The subjects performed four sets of these isometric exercises while maintaining an exercise time per set at 30 seconds in each session and repeated this session three times per week. [Result] Left grip strength significantly increased and number of sit-ups, which indicates muscle endurance, also significantly increased after the eight weeks exercise compared with before the exercise. The values measured during the sit and reach test, which indicate flexibility, also significantly increase after the eight weeks of exercise compared with before the exercise but only in the left foot. [Conclusion] The result of present study suggest that active core exercise using Slings and Togus can be applied as a very effective exercise program for enhancing balance, which is an important physical factor for Taekwondo club students.

Key words: Sling, Togu, Foot pressure

INTRODUCTION

In relation to fitness, although power, strength, muscle endurance, agility, and flexibility have been reported as very important fitness factors in Taekwondo games1–4), factors that directly affect athletic performance have not yet been established5, 6). For Taekwondo players, the importance of balance at landing during kicks or steps takes a part of fitness factors.

If vertical jump motions are made frequently in sport activities, the possibility of injuries developing in the jumper’s knees or anterior cruciate ligaments will increase because of excessive increases in stretching in the knee region and landing motions7–8). The rate of injuries due to kicks including high level jumps is actually exhibiting an increasing trend.

In general, the causes of occurrences of sport injuries are attributed to excessive training, incorrect training methods, issues related to physique, lack of flexibility, and imbalance of muscle strength9).

Proprioceptive senses play an important role in maintaining joint stability. It is known that although flexibility, muscle endurance, and muscle strength are needed to perform in high-level sports agilely and accurately, proprioceptive senses act as a very important factor for continuous and precise performance of sports techniques10).

Core stabilization exercises are known to strengthen the deep muscles of the human body such the local spinal muscle group, the abdominal muscle group, the hip muscles, and the pelvic muscles11). The trunk muscles such as the spinal, pelvic, and abdominal muscles are called the core muscles. These core muscles generate all the power and motility of the human body. In the case of Taekwondo players, strengthening these core muscles would improve spinal movement and stability, and greatly help to improve athletic performance.

Fitness factors such as the ability to turn quickly, quickness, agility, and balance are required in Taekwondo games because attacks and defensive maneuvers are made in response to the movements of opponents, and at least 90% of attacks are made with foot techniques. Therefore, in the present study, the effects of core training using slings and Togus on the improvement of postural control in Taekwondo
club students that is, balance ability, were investigated. To that end, changes in the Taekwondo club students' balance ability resulting from active core training for eight weeks were examined through fitness and foot pressure.

**SUBJECTS AND METHODS**

The present study was conducted with 13 male Taekwondo players of K University in Daegu, South Korea. The age (mean ± standard deviation), height, weight, and body fat percentage of subjects in the lumbar stabilization group were 20.10±1.60 years, 173.00±6.59 cm, 70.45±8.01 kg, and 10.67±3.23% respectively.

Once the experiment process was explained, consent was obtained from those who participated voluntarily. All the subjects understood the purpose of this study and provided written informed consent prior to participation in the study in accordance with the ethical standards of the Declaration of Helsinki. Regarding the measurement tools and methods, height, weight, body fat, and body mass index (BMI) among body components were measured using a body composition analyzer (Inbody 720, Biospace, Seoul, South Korea), in which bioelectrical impedance analysis was applied. The distribution of plantar pressure of the foot was measured using a GPS400 (Italy). The subjects were instructed to stand on the foot pressure measuring system with bare feet in a comfortable posture and look straight ahead without any movement. This was used to measure the distribution of plantar pressure of the foot for 20 sec. in a static, neutral posture.

Air cushions (Germany), Jumpers (Germany), and Aero-Steps (Germany) were used as lumbar stabilization exercise tools. As a method of training proprioceptive senses by stimulating somatesthesia in standing postures, the subjects performed balance squats, supine pelvic lifts, and push-up plus exercise using slings while standing on an Aero-Step and performed hip extension, parallel squats (wall gym ball), and standing press-ups on a Togu using their own weight. The subjects performed four sets of these isometric exercises while maintaining an exercise time per set of 30 per session, repeated three times per week. The data in the present study was processed using PASW Statistics for Windows Version 18.0 (SPSS Inc., Chicago, IL, USA) program to calculate and schematize the means (M) and standard deviations (SD) of individual items. Paired sample t-tests were conducted before and after the exercise program. The statistical significance level was set to 0.05.

**RESULTS**

The basic fitness parameters of the Taekwondo club students are shown in Table 1. Through active core training for eight weeks, left grip strength increased significantly from 39.00±7.99 kg to 43.33±5.39 kg (p<0.05). The number of sit-ups, which indicates muscle endurance, also significantly increased after the eight weeks of exercise (30.23±6.22 times/30 sec) compared with before the exercise program was undertaken (26.33±6.27 times/30 sec) (p<0.05). The distance in the sit and reach test, which indicates flexibility, also significantly increased after the eight weeks of exercise (13.81±6.35 cm) compared with before the exercise program was undertaken (8.87±7.99 cm) (p<0.05).

The changes in foot pressure are shown in Table 2. Foot pressure significantly increased after the eight weeks of exercise (34.46±4.41%) compared with before (33.65±4.55%), but only in the left foot (p<0.05).

**DISCUSSION**

There is currently great attention being paid to prevention of injuries related to Taekwondo, and many studies related to this are being actively conducted. The present study was designed to examine changes in the fitness and balance of Taekwondo players resulting from stability training undertaken by the Taekwondo players.

Since stability in sport situations is completely different from the stability on a stable surface, motions required become much easier to perform when the center of gravity of the body is effectively arranged to maintain the balance of a relatively heavy weight on a small and narrow base of support.

Aktuthota and Nadler advised that although diverse terms are used for lumbar stabilization exercises such as core strengthening, dynamic stabilization, trunk stabilization, muscular fusion, and neutral spine control, their purpose, which is to improve the functional stability around the abdomen and pelvis, is the same. They suggested that lumbar stabilization exercises should be effective when the roles of different muscles are well understood and exercise programs that fit the characteristics of these muscles are applied. Trunk stabilization exercises have been mainly used to restore the ability to control muscles and movements in low back pain patients, musculoskeletal system disease patients, and normal persons.

| Table 1. Changes in fitness between before and after exercises for eight weeks |
|-----------------------------|-----------------------------|
| Grip strength (kg)          | Before | After  |
| Left                        | 39.0±7.9 | 43.3±5.3*|
| Right                       | 39.0±7.9 | 43.3±5.3*|
| Sit-ups (times)             | 26.3±6.2 | 30.2±6.2*|
| Vertical jump (cm)          | 75.0±12.4 | 62.3±12.2|
| Sit and reach (cm)          | 8.8±7.9 | 13.1±6.3*|
| Balance (time)              | 16.7±16.9 | 27.8±22.0|
| Balance (time)              | 17.4±15.1 | 22.3±21.5|

|*: p<0.05|

| Table 2. Changes in foot pressure between before and after exercises for eight weeks |
|-----------------------------|-----------------------------|
| Left foot (%)               | 33.6±4.5 | 34.4±4.4*|
| Left foot weight (kg)       | 47.9±3.1 | 48.9±2.5|
| Right foot (%)              | 36.2±4.5 | 35.5±3.9|
| Left foot weight (kg)       | 51.8±3.2 | 50.6±2.5|

|*: p<0.05|
Whether the core has sufficient power or not, power will be lost at the hip muscles if the trunk is unstable because the level of core stability is insufficient, and so the body will supplement the power with power from other muscles, eventually leading to the loss of body balance. In a study on changes in loads on muscles and spinal stability made while healthy adults were performing seven core stabilization exercises, Kavcic et al. reported that abdominal curl, side bridging, and bridging exercises with leg lifts were very closely related to the activity of the muscles of the rectus abdominis.

Choi et al. reported that the muscle activity of individual abdominal muscles was significantly increased through lumbar stabilization exercises performed by 20 healthy adults in crawling positions in four different environments setups using slings.

Trunk stability exercises improve body balance and stability. In particular, these exercises activate the abdominal muscles and the multifidus muscles, which are small muscles on the spine, simultaneously and in harmony, thereby improving any imbalance of those muscles necessary to maintain posture.

In a study conducted by Kim et al., the rate of weight bearing increased more in their experimental group that performed exercise to improve lower trunk stability five times per week for three weeks than in their control group which received general exercise treatment intended to improve balance with weight loads or weight shift, gait, and muscle strength; the experimental group showed significant differences in the ability to control balance and gait ability, and exercise to improve lower trunk stability showed significant positive correlations with balance ability and gait ability.

In the present study, active core exercises using Togus were applied to Taekwondo players, and the effects were investigated. Fitness and foot pressure rates were improved, and this is considered attributable to the squat and upper- lower extremities, and trunk exercises performed on a Togu while holding a sling in order to strengthen the core muscles in the abdomen. This result can be considered to be consistent with the results of a previous study conducted by Oh et al., indicating that the core muscles generate all the power and mobility of the human body, as well as maintaining balance every time we move, and that the movements and stability of the trunk can be maximized by repeatedly stretching and strengthening the core muscles.

In the present study, the foot pressure distribution of the Taekwondo players was improved in balance through active core exercises using Togus, although the differences were not significant, which is similar to the case previous studies. Hodges and Richardson reported the importance of trunk muscles in performing upper and lower extremity movements while maintaining spinal stability in standing positions or sitting positions. In the present study, the core muscles of the Taekwondo players were strengthened by the eight weeks of exercise centering on trunk muscles, and measurement of the foot pressure in standing positions indicated that balance was significantly improved.

Dynamic balance had a positive impact throughout four weeks of core exercise in stoke patients, and Lee, Park, and Lee showed results indicating a positive effects compared with their control group after exercising for two weeks using an Aero-Step in subjects in their 20s from the general pubic Seo et al. reported that a significant effect appeared in terms of physical fitness of the elderly in an intervention using Swiss ball movement for 12 weeks in elderly women. The results of the present study were found to be consistent with this.

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