The Relationship between the amounts of Core Stability and Lower Extremity Injuries in Male Karate-Ka Elites

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Abstract

Background and Aims: The purpose of this study was to investigate the relationship between the amount of core stability and lower extremity injuries in male karate-ka elites with functional test. Decreased core stability has been suggested to contribute to the etiology lower extremity injuries but all of researchers had used nonfunctional tests to assess the core stability.

Methodology: 30 male karate-ka elites with history of five day in week participating in karate sport exercise with history of lower injury in two past years participated in this research. Static and dynamic postural control, lumbopelvic stability and endurance of core stabilizer muscle was assessed for each athletes with bass stick, SEBT, step down test Battery of test that derived from core stability exercise (p < 0.05).

Results: Pearson correlation and Fisher Z tests indicated that core stability significantly was related to lower extremity injuries in male karate-ka elites (r= -0.655 , P=0.001). Strongest correlation was achieved from lumbopelvic stability and lower extremity injuries in male karate-ka elites (r= -0.712, P=0.001).

Conclusion: Core stability has an important role in lower extremity injuries and strengthening of core stabilizer muscle can use to prevent the lower extremity injuries in male karate-ka elites.

Key words: Core stability, Lower extremity injuries, Karate

Introduction

Physical activity and championship sport are accompanied with a lot of injuries. Since sport activities are usually done as a closed chain, to assess the location of damage, researchers often investigate the mechanic of joint and evaluate the upper and lower joints of the damage (Thomas and Nelson, 2005). Karate is one of the sports played in the closed chain and stability in any part of the kinetic chain such as central part of the body will lead to the appropriate or inappropriate distribution of pressure and forces entered on the rest of the kinetic parts (Ireland et al., 2003). However, the central part of the body includes abdominal muscles, muscles around the spinal and gluteus, diaphragm, and muscles of pelvic floor and pelvic girdle which help to stabilize the spine, pelvis, and kinetic chain and leads to the appropriate distribution of force through minimizing compressive, transitional, and shearing forces in the joints of the kinetic chain (Thomas and Nelson, 2005).

It is reported that lack of proper activity of muscles in this part leads to damages on Anterior Cruciate Ligament (ACL), Genu Valgum, and Tibial external rotation. Finally, such mechanisms cause other damages including friction syndrome of Tibialiliacusbar and patello-femoral pain (Maribo, 2006). Although the mechanical effects of legon upper parts have been extensively studied (Jacobs, 2007) so far stable relationships and effects of the upper parts with structure and pathology of lower limbs have not been fully investigated. In the study conducted in this regard, (Bazgirinejad, 2012) examined the relationship between central power and
dynamic balance in Alpine skiers. Researchers reported that to improve the balance which is one of the most important factors preventing sport injuries, more consideration of components of central power is necessary (Bazgirinezhad et al., 2013).

Because of the role of central stability in controlling the balance and ultimately the amount of damage on one hand and researches conducted on the central stability and injuries of the lower limbs on the other hand, central stability has rarely been evaluated in karate athletes and is necessary to be reviewed in these athletes. The reform, given the importance of central stability and its relation with injuries of lower limbs in elite karate athletes and using dynamic applied measurement methods in the closed chain, the researcher plans to measure the central stability and evaluate its relation with injuries of lower limbs. So, the main objective of the current study is to determine the relationship between the amount of central stability and injuries of lower limbs in male elite karate athletes and to answer whether or not there is a statistically significant relationship between central stability of the body and the incidence of injuries of lower limbs in elite karate athletes.

Materials and Methods

Out of all karate athletes membered in the national team and club teams participated in the super league, 30 athletes who have played at least eight years voluntarily participated in the study. The objective of the study and testing method were first described and written consent was taken from the subjects. During the study, the participants had no pain or injury in the areas of the lower limbs, trunk, and upper limbs and at least six months had been passed from the acute phase of their injuries. After selecting the subjects, a questionnaire on the experience of injury was distributed among the participants and some descriptions were provided. The subjects were required not to use any special medicine one day before the measurements and have no heavy sport activity.

Anthropometric measurements

The height of subjects was recorded without shoes and with full straight stature while they stood back toward the device (44440 wall model, Kaveh Company, Iran) and that their height was measured in centimeters. Their weight was also recorded in standing state with the least possible clothes on the scale in kg. To measure the length of feet, the distance between Anterior Superior Iliac Spine (ASIS) and External ankle was used.

Dynamic and static balance tests and the test of endurance of central stability were performed on the subjects to test dynamic and static balance and stability of pelvic balance. Before the test, the subjects were asked to do the test for 10 seconds in order to warm up and exercise and the test was started one minute after the exercise. In this test, it was tried to pay sufficient attention to all cases to increase the accuracy in the performance and reduce errors and they were fully explained to the subjects. Star excursion test was used to assess monitoring and dynamic balance (Lanning, 2006).

In this test, one should keep his balance on one foot without engaging supporting surface and imbalance while he achieves maximum distance in eight directions by other foot (Taunton, 2002). Stick bass test was applied to assess postural control and static balance in a way that the time that the subject could stand on the toe of the foot on a piece of timber with a width of one inch without touching the ground for 60 seconds was recorded in second (Maribo, 2006). To assess lumbar-pelvic stability, step-down test was used in a way that the person stands with one foot on the platform with a height of 8 inches (20.32cm), then, his non-support foot puts forward and down so that only his heel touches the ground, and eventually he makes his support knee quite smooth. All these processes are considered as a repetition and the number of person’s repetitions is recorded within 30 seconds and that the test is performed for both organs (Leetun, 2004). Planck status, Cobra status, supine bridge on the heels, supine bridge tests, and endurance test of abdominal muscles were used to determine the endurance of central stability (Cooper et al., 2006) in a way that the subject did every movement in terms of his ability for a while and the time was recorded for person in second.

Data collection

Damage questionnaire approved by experts was distributed among the participants and explanations were presented for them so as to correctly complete the questionnaires. Then, the obtained data are classified.

Statistical analysis

To analyze the collected data, descriptive and inferential statistics were used. The normality of data was assessed using Kolmogorov–Smirnov test. Pearson correlation test was used in SPSS Software with the significant level of 0.05 to investigate the relationship between data related to each hypothesis and the incidence of injuries of lower limb and Z Fisher test was used to obtain an overall correlation coefficient or the mean correlation coefficients.
Results

Descriptive statistics of the subjects are given in Table 1.

Table 1: Physiological attributes of the subjects before the onset of the study

<table>
<thead>
<tr>
<th>Variable</th>
<th>Age (year) ±4.82</th>
<th>Height (cm) ±18.16</th>
<th>Weight (kg) ±35.35</th>
<th>BMI ±2.82</th>
<th>Play experience (year) ±1.44</th>
<th>Duration of activity per week (hours) ±1.18</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25.5±4.82</td>
<td>175.5±18.16</td>
<td>80±35.35</td>
<td>13±2.82</td>
<td>11.5±1.44</td>
<td>4.7±1.18</td>
</tr>
</tbody>
</table>

The results indicated that there is a significant relationship between the endurance of central muscles and injuries of lower limb (P = 0.001, r = -0.661), yield strength of lumbar-pelvic girdle and injuries of lower limb (P = 0.001, r = -0.622), static postural control and injuries of lower limb (P = 0.001, r = -0.675), and the central stability of the trunk and injuries of lower limb (P = 0.001, r = -0.655) in male elite karate athletes (Table 2).

Table 2: Data related to the evaluation of the central stability of the samples (N=50).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Step-down test (Number) ±4.65</th>
<th>Star test (cm) ±33.1</th>
<th>Stick bass test (Seconds) ±18.3</th>
<th>Depth exercises (Seconds) ±101 ±152.2</th>
<th>Abdominal muscles (Seconds) ±458.34</th>
<th>Supine bridge on the heels (Seconds) ±32.02</th>
<th>Supine bridge (Seconds) ±61.32</th>
<th>Cobra test (Seconds) ±36.35</th>
<th>Planck test (Seconds) ±64.1±24.72</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>33.92±4.65</td>
<td>70.33±3.1</td>
<td>13.5±2.31</td>
<td>101±152.2</td>
<td>±458.34</td>
<td>80.52</td>
<td>137.88</td>
<td>±36.35</td>
<td>64.1±24.72</td>
</tr>
</tbody>
</table>

Discussion and Conclusion

In this study, the relationship between central stability and injuries in lower limb of male elite karate athletes was investigated. For this purpose, 30 karate athletes membered in the national team and club teams participated in the super league who have played at least eight years participated in the study and were evaluated.

The results showed that there is a significant negative relationship between central muscle strength and injuries in lower limb of male elite karate athletes. In general, on the role of central stability and its relation with injuries and performance of lower limb, researchers reported different results on the role of these muscles in the prevention of injuries of lower limb and improvement of the performance of lower limb. In the study by (Leejouk, 2004) researchers reported that there is a relationship between the strength of abductor and external rotator muscles of hip and central muscles and prevention of occurring injuries so that the strength of external rotator muscles of hip was introduced as the only and the most important predictor of the severity of injury. Despite the test, anterior stability has no enough validity in the mentioned study and trunk flexor muscle endurance test used in the present study is more appropriate (Ladeira, 2005).

However, unlike the report in the present study, Lederman et al (2006) reported that an abdominal muscle has no effective impact on central stability (Richardson, Hodges, and Hides, 2004). The difference in the obtained results may be due to the differences in the type of in strumpets and method used for assessing the central stability and selecting samples, as well as applying training methods and programs and the number of different training sessions because some of the measurement tools have not sufficient reliability when they are used on samples of athletes (Hodges, 2004; Jacobs, 2007).

Step-down test revealed that there is a significant negative relationship between the yield strength of lumbar-pelvic girdle and injuries of lower limb in male elite karate athletes. Jacobs et al (2007) evaluated the relationship between the performance of abductor muscles of hip and landing kinematics of lower limb and stated that increasing knee valgus during landing can increase the risk of acute knee injuries and according to the obtained information, expressed that the strength of abductor muscles of hip played an important role in neuromuscular control (Grue and Krauss, 2003). On the other hand, (Grue and Krauss, 2008) did not recognize the weakness of abductor muscle of hip effective in the creation of friction syndrome of TibialIliacusbar and introduced the increase of the strength of adductor muscles of hip as the factor creating friction syndrome of Tiba Illiacusbar compared to abductor muscles (Thomas and Nelson, 2005). The reason of getting different results probably relates to difference in the number of samples, measurement methods, and type of the studied injuries (Hollman, 2009).

Since the most important muscle in the creation of lumbar-pelvic control and conduction of step-down test is Gluteus Medius muscle (Tyler et al., 2006) the reason of the relationship between yield strength of lumbar-pelvic girdle and injuries of lower limb may be related to the weakness of this muscle and other abductor and gluteus muscles because the muscle has both feed forward and feedback in the performance of the lower limb. Any weakness in the hip muscles can cause abnormal movements in the hip and tibia bone and in addition, lead
to disorder in the patella-femoral mechanism, which creased normal forces in the knee joint, and make lower limb prone to the incidence of injuries (Leetun, 2004).

Weakness in the abdominal and central stabilization muscles can decrease the strength of hamstring and quadriceps muscles, delay on the onset of contraction in muscles of lower limb, and as a result increase in the likelihood of injuries. The most important muscles playing a role in this regard are abductor and external rotator muscles of hip (Cochrane, 2006; Kraemer, 2004). When these muscles are weak, they cannot prevent abnormal movements of hip joint and movements causing many injuries of lower limb including closing and excessive internal rotation of hip. Because of the nature of closed chain of movements in the lower limb and transferring movements into all joints of the lower limb, this issue can cause injuries in the lower limb (Kraemer, 2004; Plisky et al., 2006).

The results of star excursion test revealed that there is a significant negative relationship between dynamic postural control and injuries of lower limb in male elite karate athletes. In the study on the relationship between star excursion test and injuries of lower limb on 235 high school basketball players, reported that values obtained from star excursion test would be the predictors of injuries of lower limb (Plisky, 2006). Star test requires sufficient strength in hip and pelvic muscles (Pivetha et al., 2008) and neuromuscular coordination to create appropriate conditions for joint and sufficient muscle strength for muscles around joints during the test (Plisky, 2006). Although, the study subjects had no pain in the lower limb, upper limb, trunk, and neck during testing, individuals with more number of injuries probably had less strength and range of motion and more proprioception deficit compared to those who had fewer injuries. So, part of relationships between dynamic postural control and injuries of lower limb can be related to this issue.

The results showed that there is a significant negative relationship between static postural control and injuries of lower limb in male elite karate athletes. It is reported that after doing exercises, the balance muscles are strengthened and the improvement is associated with the progression of neuromuscular control (McKeon and Hertel, 2008). Also, reported that there is a relationship between chronic ankle instability and failure to postural control (Gregury, 2008). In addition to ability of central stabilization muscles for maintaining gravity in the support surface, the relationship between static postural control and injuries of lower limb may be related to the strength of Gluteus Medius muscles and other pelvic muscles too. The central stabilization muscles have task to keep the center of gravity on the support surface. If the system does not act properly, neuromuscular control and strength of lower limb muscles can be impaired (Kraemer, 2004; Gregory, 2008). Also, neuromuscular inhibit causes the silence of primary mover and pelvic loses its stability and as a result, movement chain disappears and the lower limb loses its correct alignment (McKeon, and Hertel, 2008).

It was observed that there is a significant negative relationship between the central stability of trunk and injuries of lower limb in male elite karate athletes. Given the value of $r^2$ ($r^2=0.429$), it can be said that variables of central stability of trunk are correlated with injuries of lower limb in male elite karate athletes about 42% and remaining 58% of injuries may be related to likely factors such as age, sex, race, and other factors related to the injuries. Given the 42% relationship and high correlation between the central stability of trunk and injuries of lower limb in male elite karate athletes, it is recommended that the importance of central stability in the prevention of injuries of lower limb in male elite karate athletes should be considered by athletes and coaches so that the incidence of injuries in lower limb can be prevented in this group of athletes.

In general, the results obtained from the study indicated that there is a relationship between the central stability and injuries of lower limb in male elite karate athletes and it is suggested that in addition to training specialized karate, karate athletes also consider exercises strengthening the central stability so that they will be more secure against the incidence of injuries of lower limb.

**Conflict of interest**

The authors declare no conflict of interest

**References**


