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The Relationship between Trunk Function and Injury among Junior High School Soccer Players

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Abstract. [Purpose] The purpose of this study was to examine the relationship between trunk stability and injury among young soccer players. [Subjects and Methods] The subjects were 19 male soccer players in junior high school. The presence of injury was noted, and trunk stability was measured by using the bench test and sideways bench test, which were modified from "The 11+" exercises. [Results] There was no significant difference in endurance time in the bench test or sideways bench test between the injury group (n=9) and non-injury group (n=10). Comparison within each group revealed no significant difference in endurance time between the right and left sideways bench tests in the non-injury group; however, the time in the left sideways bench test was significantly longer than that in the right in the injury group. [Conclusion] This study suggests that there is a relationship between asymmetric trunk stability and injury. Further research investigating the relationship between asymmetric trunk function and balance skills is necessary.

Key words: Trunk stability, Growth period, Injury prevention

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INTRODUCTION

Adolescents experience accelerated physical development called a growth spurt or a period of rapid growth. During this period, bones grow faster than soft tissues, such as muscles and tendons. As a result, flexibility of the muscles, tendons, and capsules tends to decrease. When repetitive mechanical stress, such as that caused by an extensive sports activity, is placed on such vulnerable parts of the body, a young sports player can suffer injuries, which is common in this rapid growth period. We have argued the importance of evaluation of muscle tightness and prevention of the decrease in flexibility in teenage athletes[1–3)]. However, there are few reports on trunk function in young athletes even though it is widely known that trunk training is important for the prevention of sports injuries. Therefore, the aim of this study was to examine the relationship between trunk stability and injury among young soccer players.

SUBJECTS AND METHODS

The subjects were 19 male junior high school students belonging to a soccer team in Gunma Prefecture in January of 2012 (second graders, n=10; first graders, n=9) (Table 1). All the subjects were right-leg dominant (the leg that kicks the ball). The investigation and measurements below were performed before practice by 3 physical therapists. The purpose of this study was explained to the school instructors, parents, and subjects, and informed consent was obtained.

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Investigation and measurement method

The survey concerned with injury was conducted by means of an interview. All subjects were questioned concerning whether they had pain and its location.

Trunk stability was assessed with the bench test (static) and the sideways bench test (rise and lower hip), which were modified from exercises of "The 11+"[4)]-an injury-prevention program for soccer players developed by the Fèdèration International de Football Association (FIFA) Medical Assessment Research Center (F-MARC), which is a subsystem of FIFA. Subjects were instructed to hold the postures indicated in "The 11+" (Table 2), and endurance time was recorded. The tests ended either when the subject assumed to fulfill one of the stop standards (Table 2), which was validated among the 3 physical therapists before the research, or when the measurement time reached 60 s. During the tests, each subject was examined by several physical therapists.

Analysis method

Subjects were divided into 2 groups according to the presence of pain: the injury group and the non-injury group. Assessments of differences in endurance time between the 2 groups of subjects were performed with the t-test, with the significance level set at 0.05. In addition, endurance times in the right and left sideways bench tests were compared within each group. Statistical analysis was conducted by using SPSS version 20 for Windows.

RESULTS

The number of students in the injury group was 9 (47%), while that in the non-injury group was 10 (53%). There

Table 1. Overview of participants

	Number	Height (cm)	Weight (kg)	BMI	Dominant leg (number)
Second graders	10	161.8±5.2	50.3±7.7	19.1±2.2	Rt 10, Lt 0
First graders	9	157.0±8.2	45.3±8.9	18.2±1.7	Rt 9, Lt 0
Total	19	159.5±7.0	47.9±8.4	18.7±2.0	Rt 19, Lt 0

BMI: body mass index; Rt, right; Lt, left

Table 2. Measurement position of the bench test and sideways bench test (adapted from 4)

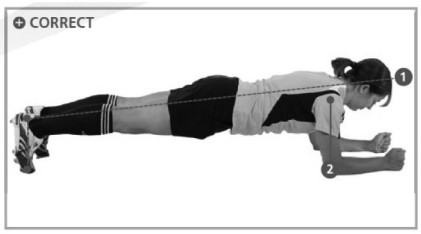
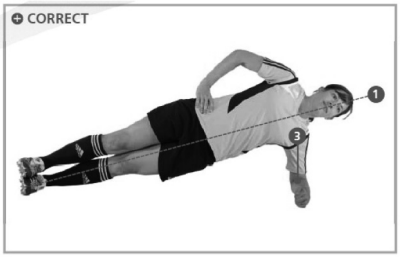
	Bench	Sideways bench
Start position	Prone position, supporting yourself on your forearms and feet. Your elbows should be directly under your shoulders.	Side lying with both lower extremities straight and supporting yourself on your forearm. Your elbow should be directly under your shoulder.
Measurement position	Lift your trunk, pelvis and lower extremities until your body is in a straight line from head to foot. 	Raise your pelvis and lower extremities until your body forms a straight line from the uppermost shoulder to the uppermost foot. 
Stop standard	1. Head, shoulder, trunk, and knee are not in a straight line. 2. Elbows are not directly under shoulders. 3. Pelvic tilt right or left (not parallel to ground).	1. Frontal plane, upper shoulder, hip and upper extremity are not in a straight line. 2. Elbow is not directly under shoulder. 3. When viewed from above, shoulder, elbow, hip, and bilateral knees are not in a straight line. 4. Axis of neck and trunk is not in a straight line. 5. Shoulders, pelvis, or lower extremities tilt forward or backward. 6. Lower extremities do nott maintain position.
End standard	60 s	60 s

Table 3. Relationship between injury and endurance time

	Non-injury group (n=10)	Injury group (n=9)	Total (n=19)
Bench test (s)	53.9±10.5	55.6±11.6	54.7±10.7
Right sideways bench test (s)	54.4±14.5	55.9± 6.5 *	55.1±11.2 *
Left sideways bench test (s)	50.8±14.9	46.7±12.2 *	48.8±13.5 *

* $p<0.05$

were 11 injury cases in the injury group; most occurred in the lower extremities (8 cases), followed by the low back (2 cases), and the upper extremity (1 case). There was no significant difference in endurance time in the bench test or sideways bench test between the injury group and the non-injury group. Comparison within each group revealed no significant difference in endurance time between the right and left sideways bench tests in the non-injury group; however, the time for the left sideways bench test was significantly longer than that in the right sideways bench test in the injury group ($p<0.05$).

The overall average endurance time for the bench test was 54.7±10.7 s, while that for the left sideways bench test was 55.1±11.2 s, and that for the right sideways bench test was 48.8±13.5 s. The endurance time of the left sideways bench test was significantly longer than that for the right sideways bench test ($p<0.05$) (Table 3).

DISCUSSION

"The 11+" is an injury-prevention program for soccer players aimed at decreasing the risk of lower extremity injuries[4]. This program consists of 3 parts: (1) running exercise for 8 min; (2) muscle-strengthening, plyometrics, and balance exercises for 10 min; and (3) running exercise for 2 min, which should be performed as a warm-up. It was reported that female soccer teams in Norway that implemented "The 11+" at least twice a week for 8 months showed a significant reduction in the number of injuries[5], which could show its effectiveness scientifically.

In this research, we assessed trunk stability among young soccer players by using the bench test and sideways bench test, which were modified from "The 11+" exercises, and examined the relationship between trunk function and injury. Although there was no significant difference in endurance time in both the bench test and sideways bench test between the injury and non-injury groups, the injury group showed a significant difference in endurance time between the right and left sideways bench tests. Several investigators have indicated that physical imbalance might cause sports injuries. For example, Knapik and colleagues[6] reported that a soccer athlete who has more than a 15% difference in muscle strength between his/her right and left lower extremities is 2.6 times more likely to experience a sports injury. Moreover, Watson AW[7] suggested that a lack of symmetry in the upper extremities can cause low back pain. Even though they studied the effects of asymmetrical extremities on causing injury, their results are quite similar to our own. Trunk muscles are considered to play an important role in producing power and in controlling and transferring power from the extremities as an axis of the body[8, 9]. Davies[10]noted that confident balance during all activities and in all situations can only be achieved by improving selective trunk activity, particularly that of the abdominal muscles, and pointed out the importance of trunk function. Based on our results, imbalanced trunk function might deteriorate balance skills, which might be one of the causes of injury. This suggests there is a relationship between asymmetric trunk stability and injury. Further research investigating the relationship between asymmetric trunk function and balance skills is necessary.

In terms of overall average, endurance time in the left sideways bench test was significantly longer than that in the right. This result might be because all subjects were right-leg dominant, and thus used their right legs more often than the left ones while playing soccer. Some researchers who have investigated trunk muscle activity during single-leg standing have suggested its involvement in maintaining posture[11, 12]. Therefore, the left sideways bench test, which is performed on the same side as the support leg when kicking, showed longer endurance time.

In this research, only the trunk stability exercises were modified and used for evaluation, even though "The 11+" includes other exercises, such as plyometric and balance exercises. Therefore, it is necessary to examine junior high school soccer players' abilities by using these other exercises. In addition, concerning the prevention of injury, it also is necessary to investigate the effectiveness of trunk training.

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