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Landing Error Scoring System for Screening Risk Scores among Elite-Youth Soccer Players

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Abstract

Identifying the risk of anterior cruciate ligament injury is very important for the careers of elite players. When identifying risk factors, effective, easy, valid, reliable methods applicable to a large number of participants should be used. The purpose of this study was to compare the landing pattern of elite-youth soccer players using the landing error scoring system (LESS) which is a valid and reliable qualitative screening method. 95 volunteer elite-youth soccer players (U19, U17, U16 & U15) between the ages of 14 and 18 participated in this study. Jump-landings were recorded by two camcorders from sagittal and frontal planes. These records were replayed and scored by a trained rater on LESS score sheets. There were statistically significant differences in LESS scores among the soccer age groups ($p = 0.00$). Post-hoc analysis demonstrated significant differences between U19 and U17 ($p = 0.00$), U17 and U15 ($p = 0.00$) and U16 and U15 ($p = 0.01$) soccer players. The best LESS score was found in U17 players and U15 players had the weakest score. The higher LESS score of the U15 players may be related to the neuromuscular control ability however, more evidence is needed to confirm the potential influence of age categories on LESS scores.

Keywords: Injury risk, Soccer, Jump landing

1. Introduction

Anterior cruciate ligament (ACL) injury is one of the most common injury to the lower extremity (Agel & Klossner, 2014) and in the literature, for many sports, the landing maneuver has been defined as an important mechanism in non-contact ACL injuries (Arendt et al., 1999). Yu et al. (2002) reported that most of the ACL injuries occurs through non-contact situations. The injury is thought to occur when the quadriceps muscle contracts eccentrically to resist flexion (Colby et al., 2000). It is assumed that the internal forces

produced by the leg muscles can be defined as the mechanism of these injuries (Colby et al., 2000). In addition, there are other different biomechanical factors in the literature related to ACL injury occurrence (Salci et al., 2004; Nedergaard et al., 2020; Zahradnik et al., 2020; Della Villa et al., 2020).

A laboratory-based motion analysis system results are the most valuable variables in defining the effects of landing on these injuries, even such studies have to require specific laboratory facilities with low participants. There is also several screening tools to identify the individuals with high-risk movement patterns (Cortes & Onate, 2013; Myer et al., 2011; Padua et al., 2009). One of the popular visual screening methods is named as "Landing Error Scoring System" (LESS) which has higher applicability and enables achieving higher sample sizes in ACL injury studies (Padua et al., 2009).

Injury prevention one of the most important factor for elite athletes for continuing their high-level careers. Besides the high medical costs, long-term morbidity is an important problem for all athletes. For soccer, in particular, the risk of ACL injury is higher than for other team sports (Marshall et al., 2007), and researchers continue to explore this issue at different levels of soccer and age groups. Since neuromuscular control skills in the jump-landing movement may differ in athletes of different age groups, these differences should be determined and appropriate protective training programs should be recommended according to the differences in age groups. Therefore, the aim of this study was to compare the landing pattern of elite-youth soccer players using the LESS.

2. Method

2.1 Participants

95 volunteer elite-youth soccer players between the ages of 14 and 18 participated in this study. U19 players (n = 30; mean age 17.50±0.51 years; body mass 70.10±6.40 kg; height 179.57±5.92 cm; experience 5.23±1.22 years), U17 players (n = 24; mean age 16.00±0.00 years; body mass 66.33±6.94 kg; height 177.17±5.78 cm; experience 5.63±1.58 years), U16 players (n = 18; mean age 15.00±0.00 years; body mass 66.61±6.35 kg; height 178.33±5.78 cm; experience 4.39±1.58 years), and U15 players (n = 23; mean age 14.00±0.00 years; body mass 62.35±3.66 kg; height 170.70±3.90 cm; experience 4.04±1.22 years). Players were excluded from testing if they had reported any knee injury in the past eight months. Before the test session subjects completed informed consents in accordance with the local university's ethical procedures.

2.2 Procedures

All testing measurements were performed on the soccer field. Players performed landing to the ground three times. With the verbal command, they land from the 30cm high platform to the target area which was set at a distance of 50% of their height. After the landing, they jumped vertically as high as possible immediately. Three trial opportunities were given before the test. In all tests and trials, players were not given any feedback about their landings.

Video recordings were made with 2 cameras (Sharp Viewcam, Osaka, Japan) as Padua had

placed before (Padua et al., 2009). Then, the videos were stored in a PC where LESS scores were detected by trained observers. Evaluation was done according to pre-defined movement errors. There are 17 items to be scored in the LESS (Padua et al., 2009). A higher score shows a greater number of movement errors, and lower scores mean better landing maneuvers.

2.3 Statistical Analysis

One-way analysis of variance (ANOVA) was performed comparing LESS scores among age groups. A Tukey post-hoc test was performed to test for group differences. Intraclass correlation coefficient (ICC) was calculated. Intrarater reliability (ICC 2,1) was determined by the same rater reassessed the 25 randomly selected LESS data from 95 players. The second evaluation was performed 2 weeks apart to reduce the likelihood of rater remembering the initial assessment. Interrater agreement (ICC 2,*k*) was evaluated by a second-rater. 25 randomly selected players reevaluated by second-rater. Pearson product-moment correlation analysis was used to examine the relationship between LESS score and experience. The level of significance was set at $p < 0.05$ for all tests.

3. Results

The overall LESS score for all 95 players was 3.97±2.74 with a range between 0 and 11. Intraclass correlation coefficient (ICC 2,*k*) was 0.81 for interrater reliability. Intrarater reliability (ICC 2,1) was 0.92. Interrater and intrarater reliability indicated strong and almost perfect agreement respectively. There were statistically significant differences in LESS scores among the soccer age groups ($F_{3,91} = 9.966$, $P = 0.00$). The post-hoc analysis demonstrated significant differences between several age groups (Table 1). As expected, there were also significant differences in experience years among the soccer age groups ($F_{3,91} = 6.455$, $P = 0.00$). Multiple comparisons revealed that U19 (5.23±1.22 years) players had statistically longer experience than U15 (4.04±1.22) ($p = 0.014$) and also U17 (5.62±1.58 years) players had statistically higher experience than U15 (4.04±1.22) and U16 (4.39±1.57 years) soccer players, respectively ($p = 0.001$; $p = 0.027$). Pearson product-moment correlation analysis was not showed any significant relationship between LESS score and experience of U19 ($r = -0.02$), U17 ($r = 0.04$), U16 ($r = -0.25$) and U15 ($r = 0.06$) soccer players ($p > 0.05$).

Table 1. Comparison of LESS scores of elite-youth soccer players

Variable (Mean±SD LESS scores)	p-value for post-hoc comparisons	95% CI
U19 players (4.87±2.30) vs U17 players (2.04±2.07)	0.000*	1.09 to 4.55
U19 players (4.87±2.30) vs U16 players (3.17±2.41)	0.092	-0.18 to 3.58
U19 players (4.87±2.30) vs U15 players (5.43±2.86)	0.831	-2.32 to 1.18
U17 players (2.04±2.07) vs U16 players (3.17±2.41)	0.445	-3.09 to 0.84
U17 players (2.04±2.07) vs U15 players (5.43±2.86)	0.000*	-5.23 to -1.55
U16 players (3.17±2.41) vs U15 players (5.43±2.86)	0.019*	-4.25 to -0.28

Note. * Significant at the 0.05 level.

4. Discussion

The anterior cruciate ligament (ACL) is one of the most commonly injured ligaments in the knee joint. Though there is lot of study on ACL injury, there is several studies on an easy and effective testing methods for individuals at higher risk of ACL injury. The current study aimed to compare the landing pattern of elite-youth soccer players using the LESS which is a valid and reliable screening method. Results of the present study indicated that there is a significant difference among elite-youth players in the total LESS scores.

LESS score results put participants into 4 quartiles, poor (> 6), moderate (> 5 to ≤ 6), good (> 4 to ≤ 5), and excellent (≤ 4) (Padua et al., 2009). Padua et al. (2009) also reported that LESS scores of 5 or over the 5 elite-youth soccer players had a greater ACL injury risk than the players who had LESS scores below 5. Therefore, the total mean 3.97 LESS score of the present study could put all the players in low-risk movement patterns which potentially decrease the risk of lower extremity injury. The present average LESS scores are consistent with the study of Padua et al. (2009) who reported 4.43±1.71 LESS scores for uninjured elite-youth soccer players. However, they included both gender and it should not be forgotten the LESS score is affected by age and gender (Padua et al., 2009). There are studies suggesting that female athletes' LESS scores are higher (Beutler et al., 2009; Kuenze et al., 2018; Wesley et al., 2015). Given this factor, perhaps even closer scores would have been possible if there were no females in Padua's (2009) mixed group.

In the present study, the best LESS score was found in U17 players and then U16, U19 and U15 players followed respectively. Furthermore, multiple comparisons revealed significant differences between the ages of U17 and U19. In addition, there is a significant difference between U15 and U16. To our knowledge, this is the first study that compares the elite-youth soccer groups. Therefore, it will not be easy to establish a cause-and-effect relationship. Considering the years of experience from the characteristics of the players, the highest experience year belongs to the U17 age group and then U19, U16, and U15, respectively.

Although the differences that arise at this point are within the general expectation, the group with the most successful LESS score has the highest year of experience. However, no significant relationship was found in the correlational analysis between LESS score and experience.

LESS scores of U19 players actually similar to those of Smith et al. (2012). The male athletes (18.48±2.47 yrs) in this study achieved a LESS score of 5.53±2.08. In addition, the LESS scores of Tara et al. (2020) are very similar to our study. In this study conducted with young soccer players (19.7±1.30 yrs), a LESS score of 4.79±1.50 was obtained. These results could be perceived as the effect of maturation. Meanwhile, the higher LESS score of the U15 players may be related to the neuromuscular control ability (maturation process). It was previously stated that the age factor may be related to LESS score (Padua et al., 2009; Hanzlíková et al., 2021). DiStefano et al. (2018) showed that elite football and basketball players between the ages of 8 and 14 achieved LESS scores between 5.24 and 5.89. This study evaluating both genders together seems to be close to the LESS values we obtained (5.43±2.85) in present U15 players. In addition to Padua's age effect probability, Smith et al. (2012) reported a similar comment saying that young athletes' LESS scores could be in a wider range because of their rapid neuromuscular development. Therefore, more evidence is needed to confirm the potential influence of age categories on LESS scores.

Players who have high-risk movement profiles or high LESS scores should be strongly recommended injury prevention neuromuscular training programs beside the usual training programs to decrease the probability of ACL injury. Studies conducted on injury prevention programs concluded that plyometric, core, and balance exercises significantly increase the LESS score in soccer players (Padua et al., 2012; Pryor et al., 2017).

5. Conclusions

Elite-youth soccer players demonstrated significant differences among each other. U17 players achieved the best LESS scores, while U15 players achieved the weakest LESS scores. In addition, it was concluded that the reason for poor LESS scores of younger players may be related to their maturation process. The researchers who developed this test battery have identified this tool as an easy, inexpensive, and quite acceptable predictive instrument for the finding out of landing maneuver errors of especially soccer players. Therefore, LESS is a good instrument, especially if researchers want to work with a large number of participants. By using this tool, young athletes who have high-risk movement profiles can be identified and these risks can be reduced with preventive programs. Especially in football, which has a higher risk of ACL injury compared to other team sports (Marshall et al., 2007), it can be ensured that the effect of age can be examined in more detail with future LESS studies.

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