

ACL Injury Prediction in Footballers Using Landing Error Scoring System (LESS)

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Abstract

Background: The use of clinical field assessment tools is popular in sports rehabilitation settings. The purpose of these tools is not only prediction of injury but also to assist in development of injury prevention programs. Landing Error Scoring System (LESS) is a clinical tool that evaluates biomechanical performance during a jump-landing task with particular focus on aspects related to an increased risk for ACL injury.

Objective: Of this study was to find the most common faulty biomechanics in football players.

Method: This is an evaluation-based study which predicts the risk of ACL injuries in 30 football players based on their jump landing mechanics. This evaluation was carried out with the help of software Kinovea that helps in analysis of joint kinematics. The data captured with the help of off-the-shelf cameras in frontal and sagittal planes and analysed. The frequency of common errors was identified.

Result: It was found out that 20% of the players had poor landing mechanics having maximum errors, 20% had moderate errors, while 13% had good score and 47% had excellent landing mechanics. The most common error was knee valgus at initial contact, stance width wider and knee valgus displacement.

Conclusion: LESS is beneficial in identification of faulty biomechanics. LESS when used along with Kinovea helps analyse common jump landing errors. Knee valgus along with internal rotation of tibia was found to be the common error which predisposes footballers to ACL injury.

Keywords: *Jump-landing, LESS, ACL injury, prevention program, Kinovea.*

Introduction

Injury to the anterior cruciate ligament (ACL) is one of the frequently encountered injuries occurring in sports today. These injuries not only take a significant financial and emotional toll on the athletes due to surgical and rehabilitation expenses, but it also decreases their sporting career due to early onset of knee osteoarthritis¹. According to studies done in India, Soccer was found to be the most common sport associated with knee injuries accounting for 30.6% of the injuries followed by kabaddi (20.9%). Also, competitive injuries were found to be significantly more than practice/training injuries. According to many studies, the most common injuries noted were ACL tears followed by meniscus injuries and the most common combination of injuries were an ACL

tear with medial meniscus tear. These statistics support an important area of research that aims to develop screening mechanisms to identify those individuals who may be at greater risk of injury. A variety of ACL injury prevention programs have been developed in the recent past which focused primarily on plyometric activities, balance and proprioception, as well as core, knee and hip muscle strengthening exercises. The basis for these programs comes from lower extremity pathomechanics related to the sport that are known to put them at risk for ACL injury. Specifically, poor jump landing mechanics have been linked to multiple lower extremity injuries. For effective injury prevention, presence of predisposing risk factors for injury should be established for effective prevention. Most risk factors for ACL injury such as gender, hormonal changes, notch

width and static postural alignment are non-modifiable through preventive efforts. Abnormal lower extremity biomechanics, however, is modifiable and specific preventive treatment can be given for correction. Specifically, 3- dimensional knee loading, including knee-extension moment, proximal anterior tibial shear force, knee valgus-varus moment and knee internal-external-rotation moment, often is implicated in ACL injury and imposes the greatest strain on the ACL.

The use of clinical assessment tools is popular in sports medicine settings. The purpose of these tools is not only prediction of injury but also to develop injury prevention programs. Landing Error Scoring System (LESS) is a clinical tool that evaluates biomechanical performance during a jump-landing task with particular focus on aspects related to an increased risk for ACL injury. LESS is a reliable and valid tool which requires videographic analysis of each joint of the lower limb at initial contact of the landing after the jump. The LESS has been proven to be reliable at identifying athletes with high-risk biomechanics by using a 17-criterion list that assesses the subject's biomechanics with the use of sophisticated videography (Padua et al. 2009). A higher LESS score indicates a higher number of errors during jump landing and hence poorer neuromuscular technique during landing. Clinically, the use of the LESS has great potential; however, validation studies have only been conducted in the laboratory environment. This restricts its usage widely among clinicians as it may not be feasible in terms of cost.

Keeping the above background as the basis for our study, there is a need to promote screening of faulty biomechanics for prevention of ACL injuries using a clinician friendly method. In our study, the motion analysis was performed mainly using computational tools instead of traditional sensors and special hardware. Our study was conducted using KINOVEA software which is a sophisticated and reliable software. This software helps in measuring joint angles by easily pausing and rewinding the videos; thereby making the process convenient, easily applicable and cost-effective⁶.

Material/Methodology and plan of Study: Thirty professional male footballers were selected as subjects for the study based on the following inclusion criteria of minimum 1-5 years of experience in the age group of 19-35 years. Female football players, players with

any injury and players with inadequate experience were excluded from the study as the study focussed on healthy professional young male football players with experience. The football players were asked to perform 3 trials of a standardized jump landing task during each test session on a ground. The test requires the participant to stand on a 30-cm-high box placed at a distance of half the body height away from a landing area, which was marked by a line on the ground. Participants were instructed to jump forward so that both limbs leave the box simultaneously, to land just past the line and to jump from maximal height immediately after landing. They were instructed to practice until they were comfortable with the task and then perform it. During task instruction, emphasis was placed on subjects jumping as high as they could once they landed from the box. Subjects were not provided with any feedback or coaching on their landing technique unless they were performing the task incorrectly. Reflective markers were placed on the subjects' skin over the lateral aspect of the thigh and antero-medial aspect of the proximal tibia and foot (on the shoes). Each test jump was recorded from both frontal and lateral views using off the shelf cameras. The videos were replayed at a later date and the LESS scored during replay using pause and rewind controls. To simplify the scoring process, the rater focussed on a designated "test leg," typically defined as the dominant leg. The LESS scoring sheet was used in conjunction with KINOVEA software which is a reliable tool for measuring joint kinematics^{8,11}.



a. Knee valgus displacement



b. Stance width: wide



c. Knee valgus at initial contact

Results

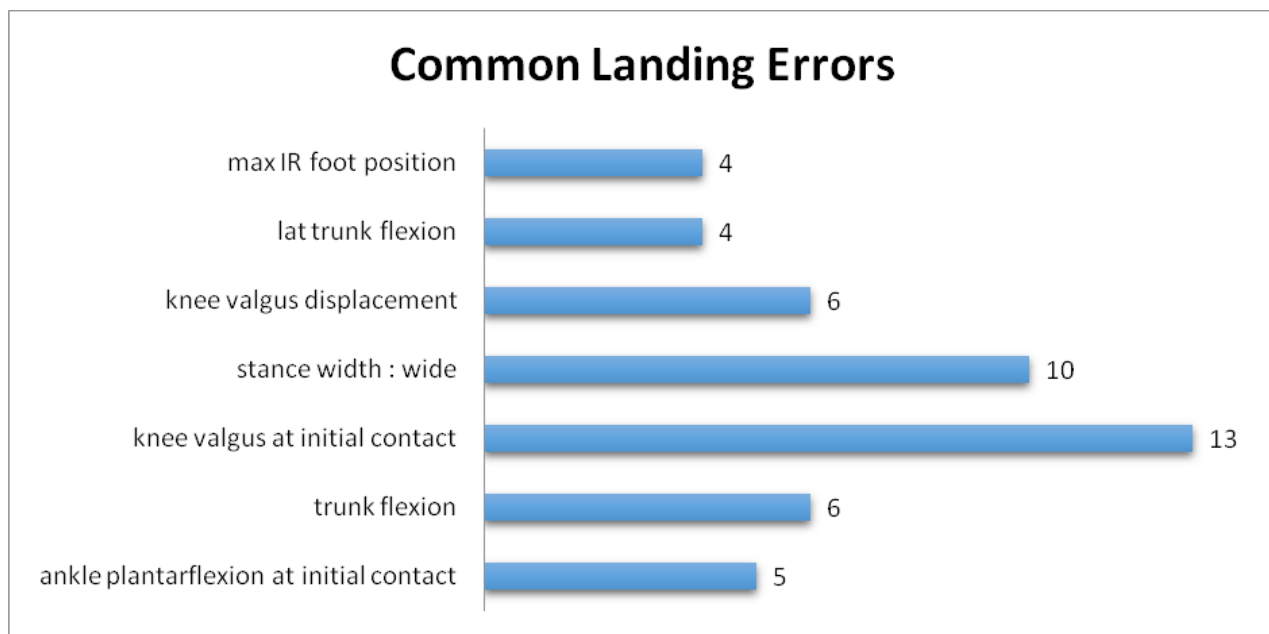
It was found out from the study that LESS helped in assessing the faulty biomechanics in the athletes. The most common faulty biomechanics were knee valgus angle at initial contact and stance width wide. Total scores indicate that 20% had poor landing mechanism with maximum errors, 13% had moderate errors, while 20% had good landing mechanics and 47% had excellent biomechanics while landing.

Descriptive Statistic:

N = 30	Mean	Standard Deviation
Age	24.07	3.9
Years of experience	4.5	2.14



Inference: It can be inferred that 47% of the players are at the least risk for an injury, 20% are at moderate risk and 20% of the people are at a high risk of injury.



Inference: Knee valgus at initial contact, wide stance width at landing, knee valgus displacement and increase trunk flexion were the common landing errors.

Discussion

It has been widely accepted that the mechanism of ACL injuries is multiplanar in nature. Many studies have demonstrated that isolated sagittal plane loading did not increase the risk of ACL injury. Addition of knee valgus moment combined with either decreased knee or decreased hip flexion, or decreased hip internal rotation velocity results in greater ACL injury risk. As the biomechanical risk factors for ACL injury are multiplanar in nature, clinical assessment tools too should reflect this fact. Landing error scoring system (LESS) is one such tool that assesses the otherwise 2-dimensional jump landing in a 3-dimensional procedure. To assist in this regard and as a replacement of laboratory settings, Kinovea proves to be a substantial tool.

Subjects with poor (high) LESS scores demonstrated different lower extremity kinematics across multiple biomechanical factors and in multiple planes of motion. In our study, based on the total scores 20% footballers demonstrated maximum faulty mechanics which amounts to greater risk of ACL injury. Although 47% footballers demonstrated excellent landing mechanics, 20% showed a moderate faulty mechanics. The total scores of all the 17 components in all the 30 participants were analysed and it was found that 14 players had a score < 4 excellent biomechanics, 4 players had a score >4 to ≤5 good biomechanics, 6 players had a score >5 to ≤6 moderate biomechanics and finally 6 players had poor biomechanics with a score of >6.

Many authors have established reliability of LESS and inference has been drawn on its ability to detect faulty biomechanics⁸. It was found in certain studies that the LESS successfully distinguished between groups on a range of jump-landing biomechanics that have previously been shown to be related to ACL loading and injury mechanisms. There were significant differences in sagittal, frontal and transverse plane biomechanics and in vertical ground-reaction force, between subjects with poor (LESS score >6) and excellent (LESS scores ≤4) jump landing technique¹¹. Our study concluded that LESS can be used for effective screening of footballers and counteract ACL injury with early prevention programs. The range of total LESS scores for our participants fell between 0 and 9 rather than the full possible 0-to-17 range and may have reduced our capacity to detect an association with injury risk. It could be attributed to a small sample size. It is possible that LESS score varies more widely in groups that are

undergoing rapid neuromuscular development, such as younger athletes, or the military population upon which the LESS was developed. In our study, it was found out that the mean age of the football players was 24.07 with a Standard deviation of 3.903. this could be one of the limitations of this study.

Another significant finding of our study was the recurrent faulty biomechanical patterns. Knee valgus angle at initial contact (13) i.e. knees not over mid foot, stance width wider at landing (10), i.e. stance width wider than shoulder, knee valgus displacement (6), i.e. medial knee movement at maximum flexion and increase trunk flexion (6) were the common errors observed. These findings of our study are in accordance with other studies; however, increase in knee flexion at initial contact were the commonest findings in other studies⁷. Isolated increase in knee valgus displacement and at initial contact are reported to place less load on the ACL but when combined with tibial internal or external rotation magnifies the loading greatly. Tibial internal rotation was observed with wider stance width at landing. Tibial internal rotation and knee valgus motion have been identified as common mechanisms, especially for noncontact injuries, which occur when strain is applied to the ACL in multiple anatomic planes. Increase in trunk flexion leads to changes at hip angles and asymmetric landing thereby predisposing one limb to ACL injury.

The main highlight of our study was that it was conducted using the Kinovea software. It is a free software application for the analysis, comparison and evaluation of joint movements in sports and rehabilitation settings. The main advantage of Kinovea is easy to use and the analysis can be done without using physical sensors. It has been found out to be a competent tool to aid easy clinical application of LESS⁶.

Conclusion

It was concluded that LESS is an effective tool to identify faulty biomechanics. Kinovea was also found to be an efficient tool to measure LESS. The most common faulty biomechanics was knee valgus angle at initial contact, stance width wider and knee valgus displacement. This information can help physiotherapists/coaches for injury prevention, correction of faulty biomechanics and application of correct techniques.

Conflict of Interest: There is no conflict of interest

Source of Funding: Self

Ethical Clearance: The study was undertaken after due clearance from the institutional ethics committee. Informed consents were taken from the subjects before data collection.

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