

Effect of Injury Prevention Training Program on Kinematics of Drop Jump Tasks: Evaluation with Landing Error Scoring System and Three-Dimensional Kinematic Analysis

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Summary:

The ACL injury prevention program we designed could effectively correct the risky motion pattern associated with increased risk for ACL injury.

Abstract:

Introduction

The Landing Error Scoring System (LESS) has been shown to be a reliable clinical screening tool that was developed to identify individuals at increased risk for noncontact anterior cruciate ligament (ACL) injury through evaluation of landing biomechanics during the drop vertical jump (DVJ) test. In the present study, we developed an ACL injury prevention training program and applied the program to the subjects. Kinematic characteristics during DVJ were assessed by LESS scoring and three dimensional motion analysis system before and after the training intervention. The purpose of this study was to examine whether the training intervention can correct (alter) the kinematics of jump-landing task using the two evaluation systems.

Methods

Study subjects

Ten female healthy volunteers participated in the study (average age; 20.6 years). The injury prevention training program consisted of turn jump, plyometric exercise, and strengthening training (approximately 20 minutes for one set of exercise) was conducted 3 days a week for a period of 6 weeks. Kinematic analysis using LESS and motion analysis system was performed before and after completion of the whole training program.

Jump-landing task according to the LESS protocol

All subjects performed 3 test DVJ trials according to the LESS protocol described by Padua et al.

Analysis of video images for LESS scoring

Frontal and sagittal view video data were acquired using standard HD video camcorders (HDR-CX560, Sony, Tokyo, Japan) that were positioned according to the LESS protocol.

Three-dimensional motion analysis using Point Cluster Technique

Simultaneously, three-dimensional kinematics data were collected using an 8-camera motion analysis system (Vicon motion system, Oxford, UK) with ground reaction forces recorded using a force plate. In order to accurately analyze the sequential change in tibio-femoral spatial relationship at the knee, the Point Cluster Technique (PCT) was utilized. Testing procedure included attachment of multiple reflective markers and use of the special program to analyze the three-dimensional motion for extension/flexion, varus/valgus rotation, internal/external rotation of the tibia with respect to the femur.

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Results

LESS score at the post-training trial (4.8) was significantly smaller than that for the Pre-training trial (6.2) ($P < 0.05$) (figure1). Regarding the motion analysis results, the peak knee valgus angle at the post-training trial (5.0°) was significantly smaller than that at the pre-training trial (8.2°) ($P < 0.05$); however, peak knee flexion and tibial rotation angles were not significantly different between pre- and post-training trials.

As regards the correlation between the LESS and motion analysis results, significant correlation was found between peak knee valgus angle and LESS score at the pre-training trial ($R=0.83$, $P < 0.05$) and the post-training trial ($R=0.95$, $P < 0.05$). All subjects experienced internal tibial rotation after toe contact. In addition, there was a moderate correlation between the peak internal tibial rotation angle and the LESS score at both the pre-training and post-training trials ($R=0.64$ and 0.43 respectively).

Conclusion

The results of the present study showed that The ACL injury prevention program successfully decreased knee valgus angle and LESS score. Therefore, the potential effectiveness of the training intervention was confirmed.