INTRODUCTION

Acute anterior cruciate ligament (ACL) rupture is one of the most commonly seen injuries in sports. The majority of ACL injuries occurred with non-contact mechanisms. Literature indicates that small knee flexion angle in landing tasks is likely to be a risk factor for non-contact ACL injuries. A knee extension constraint brace was recently developed as a training tool for prevention of non-contact ACL injuries. The purpose of this study was to determine the immediate effects of the new knee brace on lower extremity motion patterns in a stop-jump task in which non-contact ACL injuries frequently occur.

METHODS

A total of 40 male and 40 female college aged recreational athletes without known lower extremity disorders were recruited as subjects. Each subject was asked to perform five trials of the stop-jump task under each of the three brace conditions: (1) no brace, (2) with a non-constraint brace, and (3) with the constraint brace. The order of brace conditions was randomized. The non-constraint knee brace had the same appearance as the constraint knee brace.

Three-dimensional (3-D) coordinates of 15 reflective markers on the pelvis and lower extremities, and ground reaction forces were collected using six cameras and two force plates. The 3-D coordinates of critical lower extremity landmarks were estimated from the coordinates of reflective markers. Knee joint angles were determined as Euler angles. Approach and takeoff velocities were estimated from the horizontal velocity of the mid hip at initial foot contact with the ground and the vertical velocity of the mid hip at the takeoff. Ground reaction forces were normalized to subjects’ body weight.

One-way ANOVAs with repeated measures were performed to compare knee flexion angles at initial foot contact with the ground and peak posterior ground reaction force, peak impact posterior and vertical ground reaction forces, and approach and takeoff velocities among three brace conditions. A 0.05 Type I error rate was used as indication of statistical significance.

RESULTS AND DISCUSSION

Subjects significantly increased their knee flexion angle at landing of the stop jump task with the knee extension constraint brace (p = 0.00) (Figure 1). Subjects also significantly increased their knee flexion angle at the peak posterior ground reaction force with the knee extension constraint brace (p = 0.00) (Figure 2). The non-constraint brace did not show significant effect on the knee flexion angles at initial foot contact with the ground and at the peak posterior ground reaction force.

Subjects significantly decreased the impact peak posterior ground reaction force during the landing of the stop jump task with knee braces (p = 0.00) (Figure 3). Knee braces
did not show significant effect on the peak vertical ground reaction force during the landing of the stop-jump task. Knee braces did not show significant effects on approach and takeoff velocities.

The results of this study suggest that knee extension constraint brace can increase knee flexion angles and decrease impact peak posterior ground reaction force during landing of the stop-jump task. The effect of the knee extension constraint brace on knee flexion angle is a constraint effect while the effect on peak impact posterior ground reaction force is a brace effect.

Increasing knee flexion angle at the peak impact posterior ground reaction force and decreasing posterior ground reaction force during landing should assist in reducing peak ACL loading and thus the risk of non-contact ACL injuries. The knee extension constraint brace may be a useful training tool in future ACL injury prevention programs. Future studies are needed to investigate the training effects of the knee extension constraint brace.

CONCLUSIONS

The constraint to knee extension significantly increased knee flexion angle while the brace significantly decreased peak impact posterior ground reaction force during the landing of the stop-jump task.

REFERENCES


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Figure 1. Knee flexion angles at initial foot contact with the ground.

Figure 2. Knee flexion angles at peak impact posterior ground reaction force.

Figure 3. Peak impact posterior ground reaction force.