Changes in Landing Mechanics Between 6 and 12 Months Following ACL Reconstruction When Using a Functional Knee Brace.

Robin M. Queen, PhD¹, Robert J. Butler, DPT, PhD², Abigail L. Carpenter, MS³, Boyi Dai, PhD³, William E. Garrett, MD, PhD¹.
¹Duke University, Durham, NC, USA, ²University of Wyoming, Laramie, WY, USA.

Disclosures:

Introduction: Anterior Cruciate Ligament (ACL) injuries are one of the most common sports injuries in adolescents, often leading to reconstruction surgery(1). An estimated 200,000 ACL reconstructions are performed annually in the United States with a cost of approximately $20,000 per reconstruction(2). The goal of the surgery is to return individuals to their prior level of function and an extensive rehabilitation process is expected using a number of therapeutic interventions to maximize joint function. Rehabilitation following ACL reconstruction is critical for patients to return to their previous level of functioning(3). One of the common interventions utilized during the rehabilitation process to encourage normal joint function is knee bracing. Knee bracing has been recently observed to alter landing mechanics in patients six months following ACL reconstruction, however, to date no studies have examined whether these changes in landing mechanics are altered over time. As a result the purpose of this study was to examine the changes in landing mechanics that occur between 6 months and 12 months following ACL reconstruction when patients utilize a functional knee brace.

Methods: Fifteen adolescent patients who planned to return to athletic competition following ACL reconstruction (15.9 ±1.3yrs; 1.69 ±.09m; 68.4 ±17.0kg) participated in the study. Patients were excluded if they had any complication following the ACL reconstruction. All participants received a custom fit brace that had a 10 degree stop and increasing resistance in the 25 degrees of extension before the stop by four months after surgery (FourcePoint, DonJoy Orthopaedics LLC, Vista, CA). Patients completed a standard physical therapy regimen and were released by the treating surgeon by 6 months following ACL reconstruction.

Three-dimensional lower extremity kinematics and kinetics were assessed using an eight camera motion capture system sampling at 120 Hz (Motion Analysis Corp; Santa Rosa, CA) and two force plates (AMTI, Watertown, MA) sampling at 1200 Hz. Kinematic and kinetic data were collected bilaterally during seven stop-jump tasks during both a braced and non-braced condition. All patients were assessed at 6 and 12 months following ACL reconstruction. Visual 3D (C-Motion, Bethesda, Maryland, USA) was used to process the kinetic and kinematic data and calculate the joint angles and moments of interest. Ground reaction forces (GRFs) were normalized to body weight, while joint moments were normalized to body weight and height. For this study, data were analyzed during the first landing in the stop-jump task. The dependent variables were obtained using custom software developed in Matlab R2010a (MathWorks Inc., Natick, MA) The variables of interest were the sagittal plane hip, knee and ankle angles at initial contact and peak values as well as the peak moments and GRFs during the landing phase of the jump.

The surgical limb alone was analyzed using a series of 2x2 within-subject repeated measure ANOVAs to examine the differences between the time points (6 months, 12 months) and the brace conditions (braced, non-braced) (p <0.05).

Results: Main effects for time were observed at the ankle, knee and hip. Participants at 12 months landed with less ankle plantarflexion at initial contact compared to 6 months (2.5 ±11.6, 6.5 ±12.4, respectively, p = .005). Knee flexion, at initial contact, increased between 6 and 12 months (19.3 ±7.5, 21.6 ±7.9, respectively, p =0.045) (Figure 1). Interestingly, both the peak knee extension moment (p >0.05) and the peak hip extension moment (p =0.003) increased at 12 months when compared to 6 months. In contrast to the peak knee extension moment, the knee extension moment at initial contact significantly increased at 12 months compared to 6 months (p =0.033). No statistically significant interactions or main effects for brace were observed for any of the variables of interest.

Discussion: The results of this study suggest that patients who have undergone ACL reconstruction land differently at 6 months and 12 months following surgery. Specifically, patients land with more knee flexion and less plantarflexion at initial contact 12 months following surgery when compared to 6 months following ACL reconstruction. These changes in kinematics were associated with increased extension moments at the hip and knee. Interestingly, the changes in landing mechanics did not elicit any change in the peak vertical ground reaction force. These findings would suggest that on the surgical side there are changes in adaptations that occur with a greater load being placed at the knee and hip, which is associated with less plantarflexion at the ankle joint. This change in lower extremity mechanics may contribute to the high secondary injury rates (>20%) as well as affecting long term joint health. This study is one of the first to examine adaptations in landing mechanics that occur following ACL reconstruction in patients who are asked to wear a functional knee brace during return to sport. Surprisingly, no changes in landing mechanics were found that were associated with wearing the functional knee brace. These results could indicate that a
movement adaptation has already occurred or possible that the brace was not used enough between 6 and 12 months following ACL reconstruction to see differences based on brace wear. Additional research is warranted to better understand whether ACL reconstruction patients are compliant with wearing a functional knee brace during return to sport. In addition future work in this area should examine functional movement adapt in ACL reconstruction patients over time.

Significance: The results of this study suggest that after ACL reconstruction higher demands are being placed on the hip and knee, potentially resulting in decreased ankle range of motion during a stop-jump task. Although over time landing mechanics changed, the use of a knee brace did not appear to alter landing mechanics in this study. These changes in landing mechanics could be important to consider when outlining strategies to maximize long term functional outcomes and return to athletic participation following ACL reconstruction.

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Figure 1: Knee and Ankle Angles at contact at 6 and 12 months following ACL reconstruction
