Contribution of Functional Knee Bracing to Joint Stability and ACL Function

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Disclosure

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Introduction

- **Contact sports and those requiring rapid cutting motions, such as football, soccer, ice hockey, and skiing, have an especially high incidence of knee injuries.**
- **Although some athletes playing these sports utilize functional knee braces designed to provide additional stability to the knee while preserving full range of motion, the effect of functional knee bracing is still controversial.**

Objective

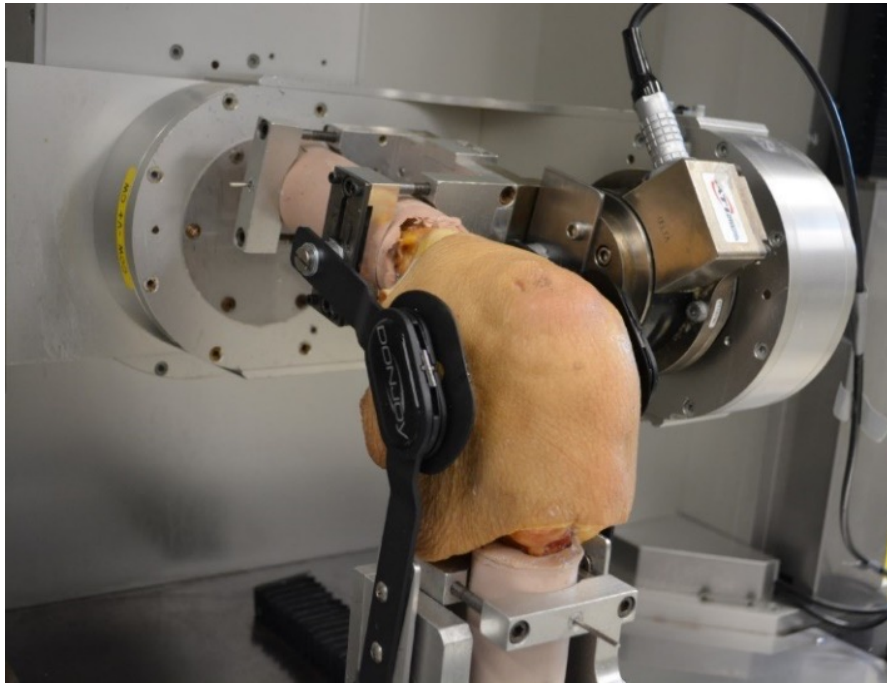
The objective of this study is to determine the effect of functional knee bracing on knee kinematics and in-situ forces in the ACL in response to rotatory and translational loads.

Methods

- A 6 degrees of freedom robotic testing system was used to apply external loads to 8 fresh-frozen human cadaveric knees (mean age, 66.4 years).
- Two loads were continuously applied from full extension to 60° flexion: (1) 5-Nm internal tibial + 5-Nm valgus torque (simulated pivot shift) and (2) 134-N anterior tibial load (simulated anterior drawer).
- Kinematic data and in-situ forces in the ACL were acquired for two states: (1) native and (2) braced.

Methods

- **To simulate a functional knee brace, a hinged brace was modified for use within the constraints of the robotic testing system and rigidly attached to the clamps holding the femur and tibia.**
- **This attachment methodology replicated an "ideal" functional knee brace since a rigid connection between the brace and the leg would be the optimal function of a knee brace does now allow any relative motion between the brace and tibia/femur.**



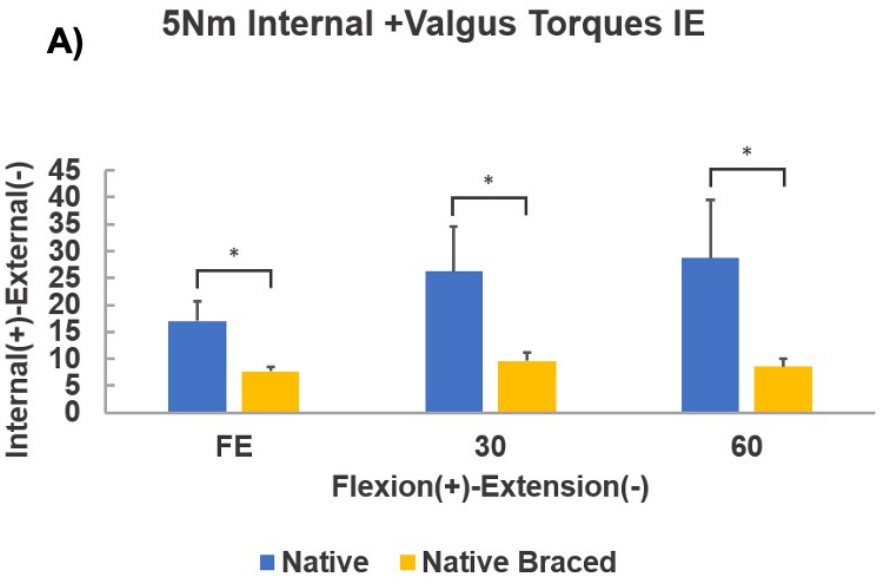
Medial oblique views of the modified functional knee brace rigidly connected to the robotic clamps simulating the “ideal” knee brace.

Methods

- **The in-situ forces in the ACL in response to each external load were determined utilizing the principle of superposition after removal of the ACL.**
- **Wilcoxon sign-ranked tests were performed at full extension, 30° , and 60° of flexion comparing the native state with the braced state. Significance was set at $p < 0.05$.**

Results

- **In response to the combined internal and valgus torques, functional knee bracing significantly reduced internal rotation at every flexion angle by up to 70.4% of rotation and valgus rotation at 60° of flexion by 49.7% ($p < 0.05$).**
- **Furthermore, functional knee bracing significantly reduced the in-situ force in the ACL in response to the combined internal and valgus torques at full extension and 30° of flexion by 75.4% and 62.2%, respectively ($p < 0.05$).**
- **Functional bracing had no clinically significant effect on knee kinematics or in-situ force in the ACL in response to the anterior load.**



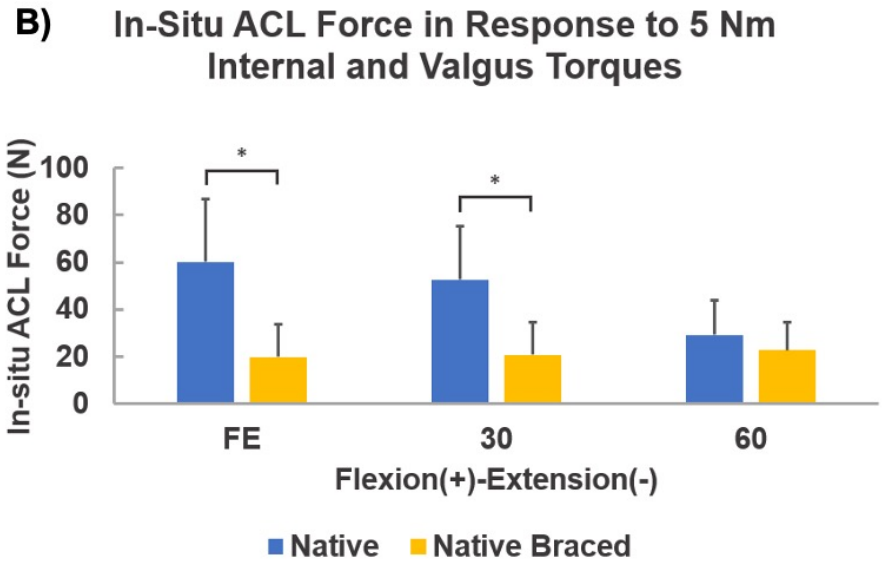


Figure 1: A) Internal rotation in response to combined 5-Nm internal and valgus torques at each knee state at full extension, 30°, and 60° of flexion at the native and braced states. B) In-situ force in the ACL in response to combined 5-Nm internal and valgus torques at full extension, 30°, and 60° of flexion at the native and braced states. Significance is set to $p < 0.05$ and denoted by *.

Discussion

- **The data obtained from our study show that the functional knee brace can improve rotational stability in native knees during full extension through 60° flexion but did not protect the knee during application of an anterior load.**
- **Functional bracing also significantly reduced the in-situ force of the ACL in response to combined internal and valgus torques that simulate a pivot shift which is a common mechanism for ACL injury.**

Discussion

- **The results of this study demonstrate that an "ideal" functional knee brace improved rotatory instability and reduced the force in the ACL in response to a simulated pivot shift at early flexion angles.**
- **Therefore, functional knee bracing provides rotatory protection to the ACL in response to a pivot shift.**