“Quantification of functional brace forces for posterior cruciate ligament injuries on the knee joint: an in vivo investigation.”

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METHODS

In vivo three-dimensional knee kinematics of six adult, male, healthy volunteer subjects in different functional activities wearing the dynamic force Rebound PCL brace and a static force PCL brace.

RESULTS

The Rebound PCL brace applies significantly larger forces at higher knee flexion angles, where the posterior cruciate ligament (PCL) is maximally loaded in vivo, compared to a static PCL brace.
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Abstract

PURPOSE

Counteracting posterior translation of the tibia with an anterior force on the posterior proximal tibia has been demonstrated clinically to improve posterior knee laxity following posterior cruciate ligament (PCL) injury. This study quantified forces applied to the posterior proximal tibia by two knee braces designed for treatment of PCL injuries.

METHODS

The forces applied by two knee braces to the posterior proximal tibia and in vivo three-dimensional knee kinematics of six adult, male, healthy volunteer subjects (mean ± standard deviation: height, 182.5 ± 5.2 cm; body mass, 83.2 ± 9.3 kg; body mass index, 24.9 ± 1.5 kg/m²; age, 25.8 ± 2.9 years) were measured using a custom pressure mapping technique and traditional surface marker motion capture techniques, while subjects performed three functional activities. The activities included seated unloaded knee flexion, squatting, and stair descent in a new generation dynamic force (DF) PCL brace and a static force (SF) PCL brace.

RESULTS

During unloaded flexion at the lowest force level setting, the force applied by the DF brace increased as a function of flexion angle (slope = 0.7 N/°; p < 0.001) compared to the SF brace effect. Force applied by the SF brace did not significantly change as a function of flexion angle (slope = 0.0 N/°; n.s.). By 45° of flexion, the average force applied by the DF brace (48.1 N) was significantly larger (p < 0.001) than the average force applied by the SF brace (25.0 N). The difference in force continued to increase as flexion angle increased. During stair descent, average force (mean ± standard deviation) at toe off was significantly higher (p = 0.013) for the DF brace (78.7 ± 21.6 N) than the SF brace (37.3 ± 7.2 N). Similar trends were observed for squatting and for the higher force level settings.

CONCLUSIONS

The DF brace applied forces to the posterior proximal tibia that dynamically increased with increased flexion angle. Additionally, the DF brace applied significantly larger forces at higher flexion angles compared to the SF brace where the PCL is known to experience larger in situ forces. Clinical studies are necessary to determine whether the loading characteristics of the DF brace, which more closely replicated the in situ loading profile of the native PCL, results in long-term improved posterior knee laxity following PCL injury. LEVEL OF EVIDENCE: II.

REFERENCE