The Influence of a Functional Knee Brace and Exercise on Lower Extremity Kinematics During Jogging

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Introduction

Functional knee braces (FKB) are often used during ACL rehabilitation to assist in providing a functionally stable knee during locomotion. Previous research has demonstrated that, in part, this may be due to decreases in knee joint torques that are shifted to the hip and possibly the ankle. It may be that these alterations in torque are a product of altered lower extremity kinematics. However, there has been only limited research to document the changes in lower extremity kinematics, associated with the use of an FKB, during locomotor activities. Additionally, it has been shown that exercise, and the associated fatigue, has the potential to alter lower extremity locomotor kinematics. Typically, those who use FKB's do so during forms of exercise that produces fatigue. Thus, it is logical to speculate about interactions between the effects of FKB use and exercise that may uniquely influence lower extremity kinematics. Thus, the purpose of this project was to examine the effect of an FKB on lower extremity kinematics during jogging across multiple time points in an exercise session that reflect varied levels of fatigue.

Statement of Clinical Significance

Functional knee braces are widely used in the prevention, maintenance and rehabilitation of ACL injuries and have been shown to have a protective effect on the anterior cruciate ligament immediately after donning the brace. An expanded understanding of the means by which FKB's provide such protection, as well as factors such as fatigue that may influence this protective function, may enhance the ability of clinicians to optimize their use.

Methodology

Sixteen subjects with no history of lower limb pathologies within the two years prior to this study participated in the investigation. Eight subjects were in each group: unbraced ((UB), 4 males; 4 females, age 25.75 ± 5.87 yrs) and braced ((B), 8 males, age 27.25 ± 8.36 yrs). Each subject in the B group was fitted, according to manufacturers' guidelines, with a FKB. Both the B and UB groups performed a one-hour exercise protocol, which was divided into three 20-minute increments. Prior to the protocol and following each 20-minute increment a multi-trial jogging gait analysis was performed to help determine the affects of the brace and exercise on the individuals gait pattern. A total of six multi-trial gait analyses (six time points) were performed. Gait data was collected using a six camera, 3-D HIRES video system, a gait analysis software package and two force platforms.

Results

These results show kinematic differences while wearing the FKB during jogging. The mean knee, ankle and hip joint angle for both the B and the UB groups at mid-stance, across time points (TP) 2-5, are illustrated in Figures 1, 2 and 3 respectively. Figures 1 and 3 show evidence of diminished knee and hip flexion, that would appear to be due to the FKB, and that remained suppressed and relatively constant across the later stages of the one hour testing period. Figures 4, 5 and 6 illustrate the average knee angles in the sagittal, frontal and transverse planes respectively. The red line for the graphs 4-6 is the average curve for the subjects in the B group prior to brace fitting, the blue line is the average curve for the B group immediately after brace application and the green line is the average curve for the B group following one hour of exercise.

Figure 1: Knee Joint Angle at TP 2-5

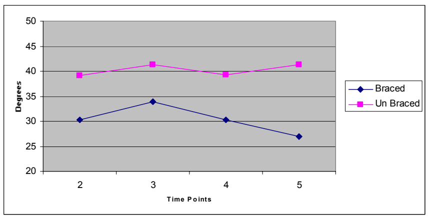


Figure 2: Ankle Joint Angle at TP 2-5

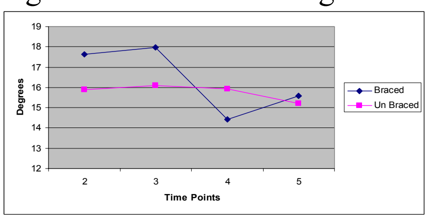


Figure 3: Hip Joint Angle at TP 2-5

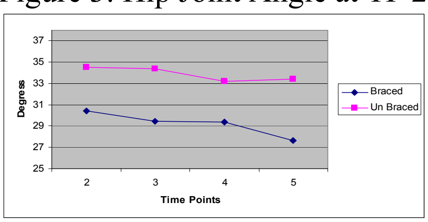


Figure 4: Knee Flexion/Extension

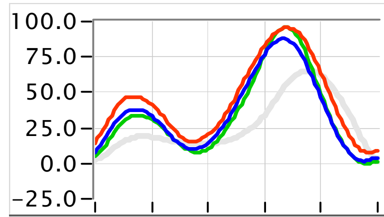


Figure 5: Knee Varus/Valgus

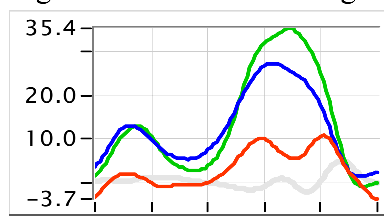
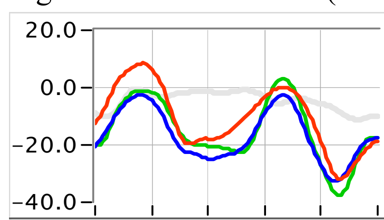


Figure 6: Tibial Torsion (Int/Ext)



Discussion

Previous studies have demonstrated a pattern of knee extensor torque adaptation, associated with FKB use, indicative of reduced stress on the ACL. This may be the result of a reduction in the external flexion moment, due to decreased stance phase knee flexion, as evidenced in Figure 4. Initially, during the exercise session, there appeared to be a trend towards normalization of knee flexion (Figure 1). However, as the duration of the session progressed, less stance phase knee flexion was observed. This may reflect an attempt to minimize the demand on the quadriceps, through a decrease in the external flexion moment, as the quadriceps became increasingly fatigued. Corresponding patterns of adaptation were seen at the hip and the knee, as well is in both frontal and transverse plane movements. Collectively, these data may provide a partial explanation of the means by which an FKB assists in protecting the ACL during locomotor activities.

References

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