# KNEE BRACE MIGRATION: DETERMINING THE RELATIVE KINEMATICS OF THE LEG AND BRACE DURING CYCLING

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## INTRODUCTION:

Among the published subjective analyses of functional knee braces, a common complaint among participants is distal brace migration. As the primary function of the brace is to displace loading on the knee by constraining its motion and accepting some of the applied force during activity, it is crucial that the kinematics of the brace match, as closely as possible, the kinematics of the normal knee. Without this congruency between leg and brace kinematics, the protective effects of the brace on the ACL are deemed to be substandard, as the axes of rotation of brace and knee are not aligned (Regalbuto et al., 1989). As such, the purpose of this investigation was to determine the extent of relative motion that occurs between the leg and brace during cycling and establish how this motion changes over time.

## MATERIALS AND METHODS:

A group of five healthy male participants (age 22-27 years) were recruited for inclusion in the study. After informed consent was obtained, each participant's right leg was measured and fitted with the Bauerfeind Softec Genu brace (Bauerfeind USA, Inc.) according to the manufacturer's specifications. The anatomical reference system and triads used to define motion were defined according to methods described by Lamontagne et al. (2001). Further to this protocol, two additional non-collinear triads were placed on the proximal and distal aspects of the brace with respect to the hinge. Participants were asked to cycle for 15 minutes at 60 RPM with a frictional resistance of 2 Kp applied to the flywheel. During this period, 3D videographic data were collected for 10 seconds during the first minute, as well as following the $5^{th}$, $10^{th}$ and $15^{th}$ minute marks. For each subject the kinematics of the leg and brace were determined independently during one cycle revolution. Relative motion of each segment was calculated using methods previously described by Grood and Suntay (1983). The resulting 3D kinematics of the leg and brace were averaged across subjects, plotted against each other, and the root mean square (RMS) error between the leg and brace for each angular orientation was calculated.

## RESULTS:

Computation of the RMS error revealed that there was essentially no increase in relative brace-leg movement over the duration of testing for any of the three kinematic parameters examined. There was, however, a consistent difference between the kinematics of the leg and brace, which persisted over the 15-minute testing period. The difference between leg and brace kinematics was greatest when the angle of the leg in any single plane reached its maximum value, which corresponded to maximum flexion at the knee.

## DISCUSSION:

The finding of greatest dissimilarity between leg and brace kinematics occurring at maximum flexion is congruent with the findings of Regalbuto et al. (1989) who established that increased forces and moments at the hinge, indicating mismatch between the brace and leg, were largest during flexion of more than 60 degrees. Differences found between kinematics of the leg and brace, in terms of flexion/extension, were most likely the result of slight movement of the brace along the longitudinal axis of the leg due to bunching of the fabric of the brace behind the knee. Differences in angles of abduction/adduction were perhaps caused by the rigidity of the lateral supports of the brace and, hence, their ability to resist bending along their length. The leg, however, was free to abduct and adduct about the knee within the limits afforded by the elastic material of the brace. Lastly, it is believed that disparities between the kinematics of the leg and brace in terms of internal/external rotation are caused by motion of the leg about its longitudinal axis within the brace.

## CONCLUSION:

Although it was found that there was not an increase in relative movement between the brace and leg over time, there was a disparity between the kinematics of the two, which was consistent throughout the entire testing period. This difference between the leg and brace kinematics is believed to cause an offset of the optimal placement of the brace hinge with respect to the knee axis of rotation, which may decrease the ability of the brace to adequately control tibial translation and, consequently, ACL tension.

## REFERENCES:

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