INTRODUCTION
Valgus unloader knee braces (VUB) are designed to decrease medial compartment knee loading and are effective at improving the clinical status of patients with knee osteoarthritis (OA) [1]. Whether medial compartment unloading is a consistent result of VUB or whether other kinematic and kinetic alterations occur while the VUB is worn during gait requires further exploration. The purpose of this study was to examine the effect of 6 months of brace wear on knee kinematics and kinetics during walking in patients with moderate medial compartment knee OA.

METHODS
Twenty-eight participants (5 female) with medial compartment knee OA were recruited. An orthopaedic surgeon prescribed a custom fitted VUB (Breg Fusion™, Carlsbad, CA, USA). All braces were fitted by a single, experienced physiotherapist. Testing was completed at baseline and after 6 months of monitored brace wear. 3-D lower limb motion data were collected at 100 Hz using two Optotrak 3020™ camera banks (NDI, Waterloo, ON, Canada) based on standard procedures [2]. Ground reaction forces were collected at 2000 Hz using a single AMTI force plate (Watertown, MA, USA) embedded in the 6-meter walkway, and aligned to the global coordinates of the motion capture system. Two conditions were randomized; walking with the brace on and with the brace off. Prior to each condition, at least 3 walking trials were completed for protocol familiarization. Five walking trials at a self-selected speed were collected and used for analysis for both conditions.

Marker positional data were low-pass filtered (4th order Butterworth, Fc=8 Hz). Three dimensional knee angles were calculated using the Joint Coordinate System and three-dimensional knee moments were calculated using inverse dynamics [2]. Knee moments are presented as external moments. Gait speed was calculated. For each variable, ensemble average waveforms from five walking trials were calculated for each participant over each condition (brace on and off) and time period (baseline and 6 months).

Principal component analysis was performed for knee angles and moments in all three planes to identify principal waveform patterns. Three principal patterns, capturing over 85% of the variance in the amplitude and temporal waveform characteristics, were retained for each angle and moment waveform. The angle and moment ensemble waveforms were scored against the principal patterns to generate PC-scores.

Results
Mean age of the group was 59+/−9 years and mean body mass index was 32.1+/−5.0 kg/m². No change in gait speed (1.22 to 1.24 m/s) was seen between brace and time conditions.

Significant brace effects (p<0.05) were found for the 3 transverse and 3 frontal plane angle PC-scores (magnitudes and difference operators). Brace wear resulted in a decrease in internal rotation magnitude and total angular displacement. Brace wear resulted in greater knee abduction at heel strike and greater knee adduction during mid/late stance. There was one significant brace effect for sagittal plane angle PC-scores, indicating an earlier flexion angle during swing.

There was a significant (p<0.05) interaction effect for one sagittal plane moment PC-score. Post hoc analysis revealed at baseline, with the brace there was a decreased knee extension moment during late stance (45-60% gait cycle).

DISCUSSION AND CONCLUSIONS
The frontal knee (adduction) moment, a surrogate measure for medial compartment loading, was not altered with the VUB, which was consistent with some previous findings [3], while contradicting others [4]. With VUB, there was greater abduction angle in late swing and at heel strike but this was not present during mid to late stance. This finding perhaps helps to explain the lack of change in the knee adduction moment. The decrease in the knee internal rotation magnitude and total excursion with brace suggests a potential stabilizing mechanism similar to functional knee braces. The effects were not altered over time except for a reduced late stance knee extension moment which was present at baseline but not after six months of brace wear. These results show that three-dimensional knee joint kinematics were altered with VUB wear, but these effects are immediate and not changed with time. These findings provide information on the mechanisms by which VUB alter the knee joint mechanical environment.

REFERENCES

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