TOTAL KNEE MOMENT VS ADDUCTION MOMENT:
SENSITIVITY TO DIFFERENCES BETWEEN OSTEOARTHRITIC AND CONTROL SUBJECTS

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INTRODUCTION
Currently, differences between the gait of osteoarthritic (OA) and Control subjects are most often quantified using knee adduction moment. This gait feature has a well-established relationship with osteoarthritis (OA) severity [3]. However, it has been suggested that total knee moment may be more relevant to knee osteoarthritis. Boyer et al [1] reported that the most sensitive measure for differentiating treatment effects for knee OA was the total peak knee moment than the knee adduction moment peak. Another recent study [2] reported that a combination of flexion and adduction moments better represented medial contact force than adduction moment alone. Total knee moment offers the advantage of being independent of the anatomical reference frames, and is therefore potentially less sensitive to inaccuracies in defining the joint axes.

This work compares the sensitivity of total and knee adduction moments to differences in the gait between subjects with moderate knee OA and asymptomatic Controls.

METHODS
Gait data from forty-two subjects with radiographically confirmed mild to moderate medial compartment osteoarthritis were compared to forty-four asymptomatic control subjects. This data was collected using an Optotrak 3D motion analysis system (Northern Digital Inc., Waterloo, ON, Canada) and an AMTI force platform (Advanced Mechanical Technology Inc., Watertown, MA, USA). Joint moments were calculated using a standard inverse dynamics approach in MATLAB (The MathWorks, Natick, MA, USA). The coordinate system was fixed in the distal (tibia) segment; using the approach described in Newell et al [4]. Moments were normalized by body mass, and then PCA was applied to each moment waveform, following the approach described by Deluzio and Astephen [5]. To compare the relative sensitivity of the various gait parameters to differences between OA and control subjects, the effect size was calculated (Cohen’s d, [6]). Effect size is a ratio of the difference between two groups to their pooled variance, which allows for comparison that is independent of units and magnitude.

RESULTS
The mean total knee moment waveforms for control and OA subjects (Figure 1) illustrate the similarity of the first peaks and the larger difference in first peaks of the adduction moment. The peak total moment during gait was not significantly different between the OA subjects and controls (p=0.53). The effect size between OA and Control subjects was 0.14 for peak total moment. In contrast, the effect size of the difference between the peaks of the knee adduction moment was 0.55, as shown in Figure 2. This effect size is comparable to that of the first Principal Component (PC1) of the total moment waveform (0.58). However, both effect sizes were smaller than the difference detected by PC1 of the adduction moment (0.71).

DISCUSSION & CONCLUSIONS
The total knee moment is an appealing indicator for osteoarthritis because it is not confounded by reference frame selection. However, in this study the peak total knee moment was not sensitive to differences in gait between OA subjects and controls. Applying PCA to the total moment significantly improves its sensitivity to group differences, but was still not as sensitive as the first principal component of knee adduction moment.

REFERENCES

ACKNOWLEDGEMENTS
This research was supported by NSERC.