DYNAMIC LOWER LIMB ALIGNMENT AND KNEE JOINT LOAD DURING GAIT IN PATIENTS WITH KNEE OSTEOARTHRITIS

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INTRODUCTION

Factors suggested to be associated with the development and progression of osteoarthritis (OA) of the knee include lower limb malalignment and high dynamic knee joint loads. Due to the high, repetitive knee joint loads associated with walking, gait analysis has become an important tool in the evaluation of OA in patients. The peak external knee joint adduction moment (EKAM) has been the most commonly reported variable in the gait literature for patients with OA of the knee due to its hypothesized association with medial compartment knee joint load during walking [1]. The EKAM is calculated as the product of the frontal plane lever arm (FPLA) and the frontal plane ground reaction force (GRF). While numerous studies have reported GRF data, no previous studies have reported data pertaining to the FPLA in patients with OA. Since the FPLA can be thought of as a dynamic measure of alignment, it would be beneficial to understand how lower limb alignment contributes to knee joint load during gait. The purpose of the present study was to examine the inter- and intra-limb relationships between the peak EKAM, peak FPLA, and peak frontal plane GRF during gait in patients with knee OA.

METHODS

Prior to medial opening wedge high tibial osteotomy, gait analyses were performed on 125 patients (98 males, 27 females; mean age = 46.8 +/- 10.5 yrs.) with knee joint OA primarily affecting the medial compartment. Patients walked across the laboratory at a self-selected velocity while three-dimensional kinetic and kinematic data were collected bilaterally. These data were combined to calculate the EKAM and the FPLA – defined as the perpendicular distance from the GRF to the knee joint centre of rotation (Figure 1). Inter-limb comparisons (operative vs. non-operative) were made among the peak values during stance for the following dependent variables: EKAM, FPLA, and frontal plane GRF. Pearson product moment correlations were computed to assess the magnitude of the intra-limb relationships between variables. Lastly, intra-limb comparisons were made regarding the time during stance (% stance) where the peak value of each variable occurred.

RESULTS AND DISCUSSION

Compared to non-operative limbs, the peak EKAM and peak FPLA magnitudes were significantly greater in the operative limbs (Table 1). In contrast, peak frontal plane GRF magnitudes were significantly larger in the non-operative limbs. The peak EKAM was more highly correlated with the peak FPLA (r=0.77) than the peak frontal plane GRF (r=0.18). Within limbs, the positions during the gait cycle where the peak values occurred were significantly different among all variables (Table 1).

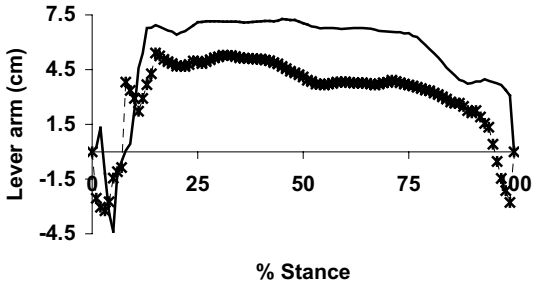

Figure 1: Frontal plane lever arm values for a single patient during stance. Solid line indicates operative limb while dashed line indicates non-operative limb.

These results indicate that although the peak magnitude of the frontal plane GRF was greater in non-operative limbs, the peak magnitude of the EKAM was larger in operative limbs mainly due to an increased lever arm length. The increased dependency of the EKAM on the lever arm magnitude was further highlighted by a higher correlation with the FPLA than with the frontal plane GRF.

CONCLUSIONS

Results from this study support the claim that knees affected with OA experience higher dynamic medial compartment knee joint loads during walking. However, this is the first study to report data pertaining to the FPLA during stance in this patient population. Given the hypothesized association between lower limb alignment and OA development and progression [2] and the finding of a high association between EKAM and FPLA peak magnitudes, the FPLA appears to be an important biomechanical measure of dynamic lower limb alignment in the study of knee joint OA.

REFERENCES

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2. Cooke D, et al. *Osteoarthritis Cartilage* **5**, 39-47, 1997.

Table 1: Mean (SD) peak magnitudes and gait cycle positions where peak values occurred.

	Non-operative Limb		Operative Limb	
	Peak	**Time of Peak (% stance)**	**Peak**	**Time of Peak (% stance)**
Force	1.09 (0.07) BW	59.2 (20.5)	1.06 (0.06) BW	56.2 (19.9)
Lever arm	3.19 (1.08) %ht	33.5 (16.1)	3.70 (1.21) %ht	33.4 (17.0)
Moment	2.52 (0.79) % BW*ht	41.2 (18.3)	2.94 (0.90) % BW*ht	41.7 (17.6)