

# AN ASSOCIATION BETWEEN PREOPERATIVE GAIT PATTERNS AND POSTOPERATIVE TOTAL KNEE IMPLANT MIGRATION

D. Wilson<sup>1,2</sup>, J.L. Astephen<sup>1,2</sup>, M. Dunbar<sup>1,3</sup>, K.J. Deluzio<sup>1,4</sup>

<sup>1</sup>School of Biomedical Engineering, Dalhousie University, Halifax, Canada

<sup>2</sup>Department of Human Biology, University of Cape Town, Cape Town, South Africa

<sup>3</sup>Department of Surgery, Dalhousie University, Halifax, Canada

<sup>4</sup>Department of Mechanical and Materials Engineering, Queen's University, Kingston, Canada

## INTRODUCTION

Total knee arthroplasty (TKA) is the current gold standard treatment for severe osteoarthritis of the knee. However, early aseptic loosening of the implant commonly leads to costly, invasive revision surgery (CJRR). Associations between preoperative biomechanical patterns and postoperative TKA surgery success have been identified (Hilding et al., 1995), but the relationship between preoperative kinematic and kinetic patterns and the amount and direction of postoperative implant migration have not been explored. The purpose of this study was to investigate the association between preoperative biomechanical patterns and the postoperative migration of both cemented and uncemented total knee arthroplasty measured with Radiostereometric analysis (RSA).

## METHODS AND PROCEDURES

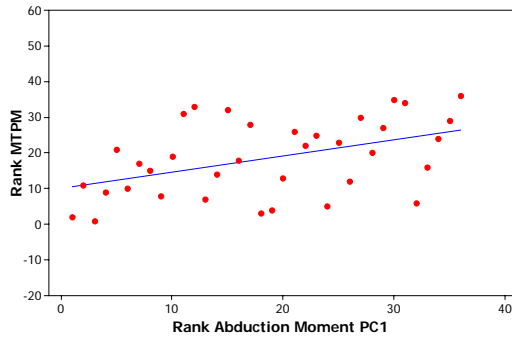
Forty-three patients with primary osteoarthritis of the knee underwent gait analysis trials in the week prior to total knee joint replacement surgery. Three-dimensional net external knee joint moments and angles were calculated. Principal component analysis (PCA) was applied to each of the joint angles and joint moments separately to extract major patterns of variation within the waveforms. A set of principal component scores for each subject were calculated by projecting original waveforms onto the principal components.

The subjects were randomized to receive the uncemented Nexgen TM monoblock (n = 22; mean age = 66 years; mean BMI = 32) or the cemented cobalt chrome, modular posterior-stabilized knees (n=21; mean age=65 years; mean BMI=33). Four experienced surgeons followed a standardized surgical technique (PCL resection, patella resurfacing, RSA bead placement in polyethylene and tibia) and post-operative protocol (CPM as tolerated, no drains, WBAT). Within four days of surgery and at six months post-operatively, patients had bi-planar knee RSA x-rays taken. RSA analysis was performed with MB-RSA (MEDIS, Leiden). RSA results at six months were reported as maximum total point motion, and six degrees of freedom translations and rotations. Due to the non-parametric distribution of the data, Spearman's rank correlations were used to examine the relationship between the first three principle component (PC) scores for each gait variable and the RSA metrics (P<0.05).

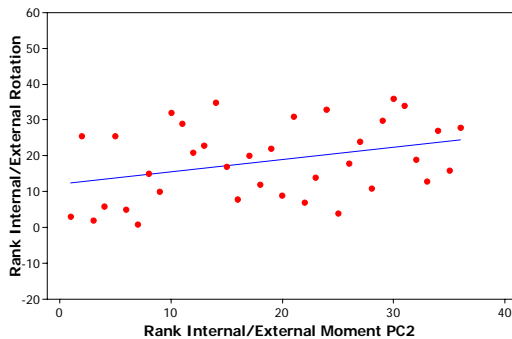
## RESULTS

There was a moderate, significant correlation between maximum total point motion (MTPM) and the first principal component (PC) of the knee adduction moment, which represented the overall magnitude of moment during the stance phase of the gait cycle (r = 0.459, P = 0.005). Higher preoperative knee adduction moment magnitudes were associated with greater MTPM postoperatively (Figure 1).

Internal rotation of the tibial implant with respect to the tibia was correlated with the second PC of the net resultant rotation moment at the knee, which represented the magnitude of the moment at load acceptance ( $r = 0.341$ ,  $P = 0.042$ ) (Figure 2).



**Figure 1:** Scatter plot of the rank of maximum total point motion (MTPM) vs. the rank of the first principle component (PC) of the knee adduction moment.



**Figure 2:** Scatter plot of the rank of the internal/external rotation of the tibial component vs. the rank of the second principle component of the internal rotation of the knee.

## DISCUSSION

The knee adduction moment is the biomechanical variable most associated with knee osteoarthritis both pre and postoperatively, and has been identified as predictive of high tibial osteotomy surgery outcome (Prodromos et al., 1985). In the

current study, the overall magnitude of the knee adduction moment during stance was shown to relate to postoperative TKR migration, and therefore may be an important factor in patient-specific implant selection. Greater resultant internal rotation moments of the tibia relative to the femur at load acceptance, preoperatively, were associated with higher tibial component internal rotations postoperatively (Figure 2). This has important clinical implications because in the longitudinal RSA study on the same subject group, internal rotation of the tibial component was associated with continuous migration.

## SUMMARY

The amount of postoperative migration of the tibial component of total knee arthroplasty was found to be associated with preoperative gait patterns, particularly to the magnitude of the knee adduction moment and the knee internal rotation moment. These results suggest that surgical success may be dependent on the preoperative mechanical environment of the knee joint.

## REFERENCES

- Hilding MB et al. (1995) *Acta Orthop Scand*, 66(4):317-20.  
 Prodromos, CC et al. (1985) *J Bone Joint Surg Am*. 67(8): 1188-1194.

## ACKNOWLEDGEMENTS

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