RELATIONSHIP BETWEEN THE SAGITTAL AND FRONTAL KNEE MOMENTS IN HEALTHY OBESE ADULTS WITH DIFFERENT BODY MASS DISTRIBUTION PATTERNS.

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INTRODUCTION

Osteoarthritis (OA) is a leading cause of disability amongst US adults (Felson, 1998) and obesity has been identified as an important modifiable risk factor, contributing to both the development (Gelber, 1999) and progression of knee OA (Spector, 1994). Though many researchers believe that obesity may be affecting the pathogenesis of knee OA by increasing the mechanical loading of the articular cartilage, there have been very few studies analyzing obese gait and quantifying knee kinetics in both the frontal and sagittal plane (DeVita, 2003). Obesity is highly associated with increased odds ratio for combined tibiofemoral and patellofemoral knee OA (Cicuttini, 1997). External knee adduction moments are considered a reliable estimate of loading at the medial compartment of the knee joint, whereas sagittal moments contribute to the overall loading across the knee, as well as the loading through the patellofemoral joint. While investigators have speculated that high frontal moments would require stabilization by high knee extensor moments (Schnitzer, 1993), to date, the extent to which the magnitudes of these moments are synchronized has not been documented. Coloring the relationship between mechanical loading and OA is the fact that only 16% of obese adults develop knee OA (Doherty, 2001) with is a greater prevalence in obese women (Eaton, 2004). This suggests that the unexplored differences in the body mass distribution patterns amongst men and women might be contributing to altered gait mechanics, subsequently affecting knee joint loading. The purpose of the study was to analyze the relationship between sagittal and frontal moments in obese adults with varying body mass distribution and comparing them with their normal weight peers as this might help to provide some insights into the loading mechanics of this at risk population.

METHODS

Sixty subjects, twenty normal weight controls, twenty subjects with a lower obese pattern and twenty subjects with a central obesity pattern, between the ages of 35-55 years and with no knee, lower limb, neuromuscular or medical problems participated in the study. Obesity was defined as having a body mass index greater than or equal to 30.0 Kg/m^2 (BMI of controls < 25.0 Kg/m^2). Women with waist: hip ratio of 0.85 or less and men with a ratio of 0.95 or less were identified to have lower obesity patterns. Standard kinetic and kinematic data was collected using an Optotrak motion analysis system and Kistler force plate as the subjects walked along a 10 m walkway at their self selected speed. Three non-collinear markers were used to track the right lower limb, pelvis and trunk. Kinematic data were collected at 60 Hz and filtered at 6 Hz. Frontal plane data were analyzed using Visual 3D (C-Motion, Inc) to obtain the external knee adduction moments. Inter-group comparisons were made using a Non-parametric equivalent of Kruskal-

Wallis test and Spearman's coefficients were calculated to assess associations.

RESULTS AND DISCUSSION

A significant difference in peak abductor moments was found between the central obese group and controls ($p<0.001$). Also, a difference in peak extensor moments was found between both obese groups and controls ($p<0.01$). The correlations between the peak frontal and sagittal moments in the three groups were found to be weak.

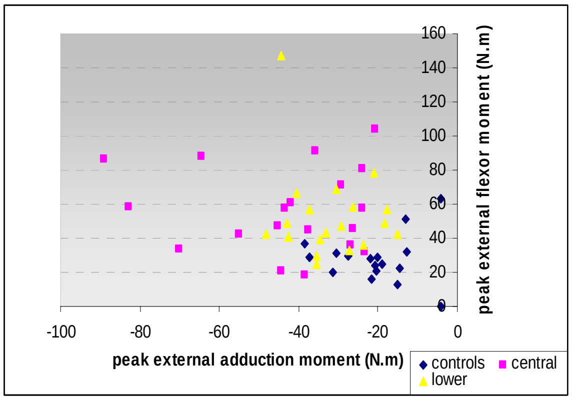

Figure1: This scatter plot illustrates the weak correlation between the peak moments occurring in the sagittal and frontal planes.

The results of this study demonstrate that even though the peak frontal and sagittal moments are increased in obese adults, as compared to their normal weight peers, the association between these moments is weak. Hence, it is unadvisable to deduce conclusions about the overall status of knee loads based on moments in one plane alone. While the central obesity pattern appears to have a differential effect on the frontal moment, mass distribution was not an issue in the sagittal plane where both obese groups had increased moments. It should also be noted that since the magnitude of these moments represents absolute loading at the knee, documented normalized values should otherwise be interpreted cautiously

SUMMARY

Due to the lack of a strong association between the peak frontal and sagittal moments, it is problematic to comment on overall knee joint loads based on just the sagittal moments. Focusing strictly on the muscle loading across the knee, potentially detrimental loads in the frontal and sagittal planes would appear to be independent in the association with medial knee and patellofemoral OA.

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Table 1: Peak moments and correlations in the three groups.

Groups	Peak frontal plane moments (N.m)	Peak sagittal plane moments (N.m)	Correlation between peak frontal and sagittal moments
Obese Central	-43.3+-23.4	56.7+-24.8	-0.056
Obese Lower	-32.3 +-9.9	52.5+-26.1	-0.143
Controls	-21.9+-9.6	27.9 +-11.8	0.024