

# THE ADDUCTION MOMENT DURING WALKING IS CORRELATED WITH CARTILAGE THICKNESS RATIO IN YOUNGER MALE SUBJECTS

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## INTRODUCTION

Osteoarthritis (OA) is a degenerative disease of cartilage that can be influenced by mechanical factors. Variations in thickness of tibial and femoral cartilage have been found to occur with the presence of OA. Hudelmaier found differences in absolute cartilage thickness in younger and older individuals when dividing men and women into separate groups (Hudelmaier, 2001). It has been suggested that loading during activities of daily living, such as walking, can influence the medial to lateral variations in cartilage thickness (Andriacchi, 2004, Koo, 2007). It is possible that there will be an adaptive response (increased thickness) to load in younger subjects and a degenerative response in older subjects.

The purpose of this study was to test the hypothesis that the magnitude of the adduction moment during walking is correlated with the ratio of medial to lateral articular cartilage thickness when comparing a younger and older population.

## METHODS

Gait data and knee MR images were obtained for forty-six healthy subjects after IRB approval and informed consent were obtained. The subjects were divided into two groups, older and younger: the younger group (Males (16): 30±4 yrs, BMI 24±2 kg/m<sup>2</sup>, Females (8): 25±4 yrs BMI 21±2 kg/m<sup>2</sup>) and an older

group (Males (9): 59±5 yrs, BMI 25±5 kg/m<sup>2</sup>, women (13): 59±4 yrs, BMI 25±4kg/m<sup>2</sup>). In this study the data set includes both the left and right knee.

Gait data was obtained using a previously described Point Cluster Technique (Andriacchi, 1998). The external knee adduction moment was calculated (Andriacchi, 2004).

Three-dimensional models of the distal femoral cartilage were created from the knee MR images using custom software (Koo, 2005). The average thickness of each load bearing regions, found during activities of daily living, on the femur (Figure 1) and tibia was obtained.

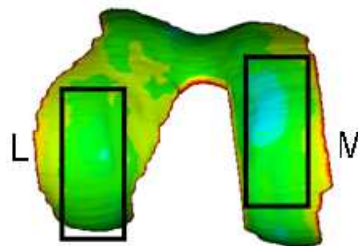


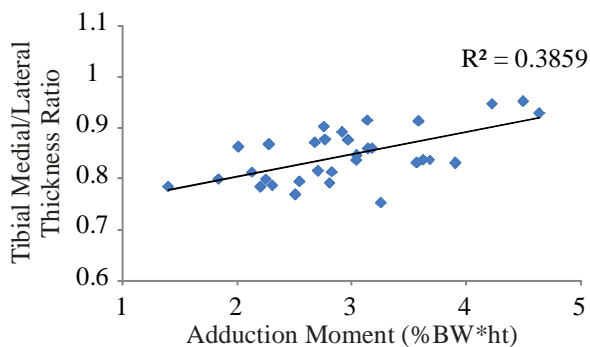
Figure 1: Load Bearing regions of the femoral cartilage were used to measure average cartilage thickness.

Average medial and lateral thicknesses were calculated. Medial to lateral (ML) thickness ratios were then calculated. Regression analysis was used to correlate the ML ratios and the external adduction moment to determine the effect of load during walking on cartilage thickness.

## RESULTS

The medial and lateral thicknesses were larger in the younger group when compared to the older group for the males. These differences were significant for both compartments in the femur and tibia. The women were equally matched, resulting in no significant difference in cartilage thickness.

Regression analysis was used to determine the correlation between the ML thickness ratios (femur and tibia) and the external knee adduction moment. Results show that there were no correlations between ML thickness ratios and adduction moment for the women (younger or older). However, there was a positive correlation between ML thickness ratios for the younger males when compared to older males. This correlation was significant (femur:  $p < 0.04$ ,  $r^2 = 0.14$ , tibia:  $p < 0.001$ ,  $r^2 = 0.39$ , Figure 2, only tibia shown).



**Figure 2:** Adduction Moment vs. Tibial ML thickness ratio showing a significant correlation for the younger male group (shown alone for clarity).

## DISCUSSION

This study has shown that there was a correlation between the loading at the knee during walking and the medial to lateral cartilage thickness ratio in the younger male group. There was no such correlation for the older groups, possibly due to variations in cartilage health and the capability of cartilage to respond to mechanical stimulus.

The correlation could not be found in young female group. This could be due to the significantly lower BMI in this group could have lower levels of cartilage mechanical stress compared to the male counterparts.

In all groups, the lateral compartments cartilage thickness was greater than or equal to the medial. The absolute thickness was greater for the males but not the females.

## REFERENCES

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## ACKNOWLEDGEMENTS

NIH Grant # 1R01AR04970

**Table 1:** Average femoral and tibial thickness normalize to height and their ratios. Data are means (SD).

	Medial	Latateral	ML Ratios	Medial	Lateral	ML Ratios
Female (younger)	1.12 (0.16)	1.19 (0.15)	0.94 (0.11)	1.07 (0.16)	1.41 (0.38)	0.78 (0.12)
Female (older)	1.17 (0.15)	1.16 (0.20)	1.04 (0.25)	1.08 (0.25)	1.34 (0.45)	0.90 (0.44)
Male (younger)	1.32 (0.31)	1.39 (0.15)	0.95 (0.21)	1.35 (0.19)	1.60 (0.21)	0.84 (0.05)
Male (older)	1.19 (0.23)	1.25 (0.19)	0.96 (0.15)	1.19 (0.24)	1.42 (0.29)	0.83 (0.05)