

ARE THE GAIT KINETICS OF WOMEN AND MEN WITH KNEE OSTEOARTHRITIS DIFFERENT?

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INTRODUCTION

Despite evidence that the mechanical pathology of knee osteoarthritis (OA) might be unique in women, such as different patterns of joint deformity¹ and muscle weakness,² no studies have compared loading patterns in knee OA between women and men. We aimed to evaluate the sex-specific knee and hip kinetics in medial compartment knee OA during gait.

METHODS

Female Knee OA (FOA): women over age 50 with medial compartment knee OA. Male Knee OA (MOA): men over age 50 with medial compartment knee OA. Pain, stiffness and function were assessed using the Western Ontario McMaster Universities Osteoarthritis Index.

Gait data were collected using the QUESTOR Gait Analysis in Three Dimensions (QGAIT) system, consisting of an Optotrack optoelectric system (Northern Digital, Canada), a force plate (AMTI, USA) and QUESTOR precision radiographs. QGAIT incorporates joint geometry data from standardized radiographs to more accurately transform the surface marker location into the subject-specific joint centre. The radiographs were obtained with subjects standing barefoot on a calibrated turntable, inside a frame fixed relative to the x-ray source. Surface landmarks to be used for gait trials were marked with a lead bead. Anterior-posterior (knee, hip) and lateral radiographs (knee) were obtained. Radiographs were calibrated. Correction vectors were measured from the surface landmarks into the hip and knee joint centre. In addition, medial joint space narrowing (MJSN, mm) was measured. For gait analysis, 6 infrared emitting diodes (IREDS) were used: greater trochanter, lateral femoral condyle, fibular head, lateral malleolus and 2 IREDS on anteriorly projecting probes attached to thigh and shank. Five walking trials were sampled at 100 Hz. Foot contact was determined using trajectory data from the lateral malleolus. Independent t-tests compared FOA and MOA mean age, MJSN, gait speed and WOMAC subscales. A multivariate analysis of covariance (MANCOVA) was performed to compare FOA & MOA gait characteristics, with gait speed and MJSN as covariates.

RESULTS AND DISCUSSION

The FOA (n=32), aged 66.4 ± 9.4 years were younger than the MOA (n=22), aged 71.0 ± 7.1 years. The MJSN was different between the FOA (2.5 ± 1.6mm) and MOA (1.6 ± 1.5mm, p<0.05). Table 1 summarizes participant characteristics.

Table 1: Participant Characteristics

| | Gait Speed (m/s) | WOMAC-Pain (%) | WOMAC-Stiffness (%) | WOMAC-Function (%) |
|-----|------------------|----------------|---------------------|--------------------|
| FOA | 1.1 ± 0.38 | 29.9 ± 19.2 | 44.1 ± 26.8 | 37.4 ± 21.1 |
| MOA | 1.3 ± 0.26 | 30.7 ± 18.2 | 42.2 ± 22.6 | 29.9 ± 16.7 |
| p | 0.03 | 0.88 | 0.78 | 0.17 |

Tables 2 and 3 summarize knee and hip kinetics during gait.

Table 2: Peak Knee Forces and Moments

| Parameter | FOA | MOA |
|----------------------------|--------------|---------------|
| Anterior Force (N/kg) | 3.2 ± 0.67 | 3.2 ± 0.45 |
| Posterior Force (N/kg) | -0.77 ± 0.29 | -0.67 ± 0.23 |
| Medial Force (N/kg) | 0.20 ± 0.11 | 0.17 ± 0.08 |
| Lateral Force (N/kg) | -1.3 ± 0.46 | -1.6 ± 0.47 |
| Proximal Force (N/kg) | 0.92 ± 0.16 | 0.82 ± 0.07* |
| Distal Force (N/kg) | -9.0 ± 0.85 | -9.1 ± 0.81 |
| Adduction Moment (Nm/kg•m) | 0.42 ± 0.16 | 0.52 ± 0.17 |
| Abduction Moment (Nm/kg•m) | -0.06 ± 0.03 | -0.05 ± 0.03 |
| Flexion Moment (Nm/kg•m) | 0.29 ± 0.17 | 0.24 ± 0.12 |
| Extension Moment (Nm/kg•m) | -0.26 ± 0.10 | -0.27 ± 0.10 |
| Int Rot Moment (Nm/kg•m) | 0.11 ± 0.04 | 0.16 ± 0.06** |
| Ext Rot Moment (Nm/kg•m) | -0.01 ± 0.01 | -0.01 ± 0.01 |

*p value < 0.05, **p value < 0.01

Table 3: Peak Hip Forces and Moments

| Parameter | FOA | MOA |
|----------------------------|--------------|----------------|
| Anterior Force (N/kg) | 1.6 ± 0.68 | 1.3 ± 0.36 |
| Posterior Force (N/kg) | -2.0 ± 0.58 | -2.3 ± 0.77 |
| Medial Force (N/kg) | 0.36 ± 0.23 | 0.46 ± 0.38 |
| Lateral Force (N/kg) | -0.86 ± 0.51 | -0.48 ± 0.32* |
| Proximal Force (N/kg) | 1.4 ± 1.3 | 1.8 ± 1.0 |
| Distal Force (N/kg) | -9.3 ± 1.8 | -8.6 ± 1.2 |
| Adduction Moment (Nm/kg•m) | 0.70 ± 0.16 | 0.61 ± 0.16 |
| Abduction Moment (Nm/kg•m) | -0.13 ± 0.07 | -0.21 ± 0.14* |
| Flexion Moment (Nm/kg•m) | 0.63 ± 0.29 | 0.56 ± 0.21 |
| Extension Moment (Nm/kg•m) | -0.76 ± 0.19 | -0.97 ± 0.32** |
| Int Rot Moment (Nm/kg•m) | 0.06 ± 0.03 | 0.05 ± 0.02 |
| Ext Rot Moment (Nm/kg•m) | -0.08 ± 0.40 | -0.12 ± 0.07 |

*p value < 0.05, **p value < 0.01

CONCLUSIONS

The FOA walked more slowly than the MOA. Though women had the same level of impairment as men, noted by WOMAC scores, women were younger and appeared to have less severe medial OA noted by a larger medial joint space. Despite using gait speed and MJSN as covariates, significantly different knee and hip kinetics were noted between women and men, suggesting that the sex-specific differences in the mechanical pathology of knee OA should be studied further. However, we acknowledge that a larger sample size will be necessary to confirm these sex-related differences in knee OA gait.

REFERENCES

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²Fitzgerald, G. et al (2004). *Arthritis Care Res* **51**, 40-48.

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