We assessed transverse plane knee kinematics in both limbs at four points in stance. We compared limbs at heel-strike, mid-stance, terminal extension and toe-off using analysis of variance. Based on that analysis, we then compared differences between limbs (external rotation offset in patients with mild and severe OA using independent t-tests.

**Results:** There was a significant limb by point-in-stance interaction (p < 0.003). External rotation was greater in the affected limb at heel-strike (p < 0.001) and mid-stance (p < 0.001). External rotation offset at heel-strike was greater (p < 0.012) in patients with severe OA (7.4° ± 7.3°) than in patients with mild OA (1.8° ± 8.6°) (Figure 1).

**Conclusions:** A between-limb tibial external rotation offset exists at heel-strike and mid-stance in patients with ACL deficiency and medial compartment knee OA, and is greater in patients with more severe tibiofemoral degeneration. These findings are consistent with the hypothesis that abnormal transverse plane kinematics are involved in the progression of knee OA after an ACL tear.

172

**THE RELATIONSHIP BETWEEN TOE-OUT DURING WALKING AND CLINICAL CHARACTERISTICS OF 1ST METATARSOPHALANGEAL JOINT OSTEOARTHRITIS: THE MOST STUDY**


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**Purpose:** The 1st metatarsophalangeal joint (MTPJ) is the most common site for OA in the foot. While clinical diagnostic criteria have not been defined, characteristics of 1st MTPJ OA include frequent joint pain, hallux valgus malalignment, and restricted joint motion during gait (functional hallux limitus). The degree to which a person toews when walking is of interest to OA investigators because of the desirable effects that toe-out can have in reducing mechanical load on the medial knee. However, some evidence suggests that toe-out may also increase loading of the 1st MTPJ, possibly placing this joint at greater risk of OA. The purpose of this study was to determine the cross-sectional relationship of toe-out with common clinical characteristics of 1st MTPJ OA, including joint pain, alignment, and motion in a population of older adults that are at risk for OA.

**Methods:** The NIH-funded Multicenter Osteoarthritis Study (MOST) includes older adults who have or are at risk for knee OA. At the 60-month data collection, we included about frequent 1st MTPJ pain, hallux valgus angular alignment from standardized foot photos, and measured peak 1st MTPJ angular motion in extension from 60 Hz videos during 3 self-paced walking trials. Toe-out angle was measured by a 4.88 meter instrumented GAITRite walkway during 4 self-paced walking trials. Using the quintile distribution among pain cases to form category cutpoints, we applied logistic regression to determine the relative odds of 1st MTPJ pain within categories of increasing toe-out while adjusting for age, sex, BMI, and walking velocity. Generalized estimating equations (GEE) accounted for the inclusion of two feet from a subject. Using linear regression with GEE, we then estimated mean hallux valgus alignment and mean 1st MTPJ motion within each category while making similar adjustments.

**Results:** 2027, 534, and 626 participants with available 60-month exam data contributed 4054, 1066, and 1247 feet to assess the relation of toe-out to 1st MTPJ pain, alignment, and motion, respectively. Mean toe-out was 6.8 ± 5.6 degrees, mean hallux valgus alignment was 20.6 ± 10.2 degrees, and mean 1st MTPJ motion was 39.6 ± 10.8 degrees. After adjustment for covariates, the odds of 1st MTPJ pain and the means of hallux valgus alignment were similar across categories of increasing toe-out (p for trend = 0.36 and 0.22, respectively). Mean 1st MTPJ motion decreased, but only slightly (±2 degrees), across these same categories (p for trend = 0.04) (see Table).

**Conclusions:** Increased toe-out during walking was not associated with either an increased prevalence of 1st MTPJ pain or increased hallux valgus alignment. While greater toe-out was cross-sectionally associated with slightly reduced 1st MTPJ motion, the magnitude of this association was small and its relevance to disease etiology remains equivocal. Based on these findings, gait training to increase toe-out among older adults with medial knee OA could be considered without substantial concern for prevalent OA characteristics at the 1st MTPJ.

**Table:** Adjusted odds of 1st MTPJ pain, mean hallux valgus alignment, and mean 1st MTPJ motion within categories of increasing toe-out during walking

<table>
<thead>
<tr>
<th>Toe-Out Categories</th>
<th>1st MTPJ Pain N = 4054 feet,</th>
<th>Hallux Valgus N = 1066 feet, 534 gpts</th>
<th>1st MTPJ Motion, N = 1247 feet, 625 gpts</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (%) of feet</td>
<td>Adj. OR* (95% CI)</td>
<td>N (%) of feet</td>
<td>Adj. Mean* (95% CI)</td>
</tr>
<tr>
<td>Lowest 10.3–2.3°</td>
<td>825 (20.9)</td>
<td>0.9 (0.3, 2.2)</td>
<td>198 (21.0)</td>
</tr>
<tr>
<td>2nd 10.3–4.9°</td>
<td>3rd 4.9–8.5°</td>
<td>4th 8.5–12°</td>
<td>5th 12°–20.2°</td>
</tr>
<tr>
<td>940 (20.1)</td>
<td>256 (21.4)</td>
<td>19.2 (18.7, 21.1)</td>
<td>301 (39.4)</td>
</tr>
<tr>
<td>11 (12.3)</td>
<td>10.8 (10.1, 11.6)</td>
<td>11.7 (11.4, 12.0)</td>
<td>194 (20.9)</td>
</tr>
<tr>
<td>0.8 (1.0, 1.3)</td>
<td>1.1 (1.0, 1.2)</td>
<td>1.2 (1.0, 1.5)</td>
<td>1.9 (1.7, 2.1)</td>
</tr>
<tr>
<td>144 (13.4)</td>
<td>214 (21.0)</td>
<td>244 (21.0)</td>
<td>268 (40.2)</td>
</tr>
<tr>
<td>747 (14.4)</td>
<td>194 (20.9)</td>
<td>240 (39.8)</td>
<td>38.6 (34.9, 42.3)</td>
</tr>
<tr>
<td>107 (14.3)</td>
<td>174 (18.7)</td>
<td>213 (38.7)</td>
<td>37.4 (34.0, 41.0)</td>
</tr>
</tbody>
</table>

*p for trend p=0.36 p=0.22 p=0.04

173

**BIOMECHANICAL EFFECTS OF WEIGHT LOSS IN KNEE OSTEOARTHRITIS PATIENTS – IS IT ALL ABOUT BODY WEIGHT?**

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**Purpose:** Both excess body weight and dynamic knee joint loads seem to play an increasingly important part in knee OA progression – but the effect of mere body weight on such knee loads remains largely unknown. Weight loss is advocated as the treatment of choice for overweight knee OA patients, as it yields clinically significant improvements in pain and function. However, while weight loss interventions above 10% is advocated by obesity specialists only two studies have investigated clinical relevant weight-loss induced effects on knee loads (1;2) and none have so far isolated the effect of weight loss. The purpose was therefore to improve our understanding of weight-loss induced responses in knee loads by isolating the mere effect of body weight loss inducing an experimental weight gain following a clinically relevant weight loss (>10%) in obese knee OA patients.

**Methods:** Participants included 143 obese (>30 BMI) subjects with symptomatic knee osteoarthritis according to the ACR criteria. Three dimensional gait analyses were performed before and after a dietary intervention aiming at a weight loss of at least 10%. Following weight loss the participants then, "regained" the same weight by wearing a weighted vest and their gait was again analyzed biomechanically. Only subjects achieving a weight loss larger than 5 kg had their gait analyzed with the exact weight loss experimentally regained. The analysis focused on experimental weight gain effects on knee loads compared to baseline (i.e. pre-weight loss level) during level walking at self-selected walking speed. The statistical model was adjusted for age, gender, height, knee pain, mechanical alignment, and walking speed.

**Results:** On average the weight loss resulted in a reduced body weight of 13.7 kg corresponding to 13.5%. Subsequently, the subjects "regained" the same amount of body weight (i.e. 13.5%) by means of the experimental weight gain. The weight loss elicited a 4% (p<0.05) increase in walking speed and decreased the peak knee loads and force impulses by 9% (P<0.0001) and 13% (P<0.0001) respectively. At experimental weight gain walking speed, peak forces and the force impulses were approximately brought back to pre-weight loss level (Figures 1A,B). However, while the weight loss lowered the knee extensor moment by 6% (P<0.0001) the weight gain subsequently increased this to a 9% higher knee extensor moment compared to baseline (P<0.0001, Figure 1C). Normalised values of the extensor moment (Nm/kg), increased 10% (P<0.0001) after the weight loss and settled at this higher level (i.e. no difference between weight loss and weight regain, Figure 1C).

**Conclusions:** While weight loss magnitude and knee loads were directly related, changes in the kinetic strategy during walking are exposed by joint moments and reflect a reorganisation in the neuromuscular coordination of joint moments during walking. There are more to weight loss than body weight and losing weight improves knee joint mechanics in obese knee OA patients.
Purpose: Knee osteoarthritis (OA), a progressive disease of joint structure, has a considerable effect on joint function. Understanding this relationship can help to inform clinical decision making. Recent surface electromyographic studies during fundamental movements have examined the relationships between knee OA and periarticular muscle activation patterns in an attempt to understand these functional alterations. Muscle activation patterns are altered with disease presence and severity; however, to establish the measurement properties for testing outcomes of treatment, the reliability of the protocol needs to be ascertained. The present study examined reliability of a protocol for measuring periarticular muscle activation patterns for patients with knee OA.

Methods: Eighteen patients with medial compartment knee OA based on clinical and radiographic evidence were included. Those on a wait list for TKA surgery were excluded. Using standardized procedures including electrode placement and validation exercises, surface electromyograms (EMG) were sampled at 2000Hz from lateral and medial gastrocnemius, vastus lateralis and medialis, rectus femoris, and lateral and medial hamstrings while participants walked at their self selected speed along a 5 meter walkway. After completing 5–7 walking trials, a series of maximum voluntary isometric contraction (MVIC) exercises for each muscle were performed. Joint effusion presence, active knee range of motion, Kellgren and Lawrence radiographic scores and WOMAC index scores were recorded. This procedure was repeated on a second occasion, separated by a minimum of 2 weeks. EMG signals were corrected for bias and gain, linear enveloped (Fc=6 Hz), time-normalized to percent of gait cycle and amplitude-normalized to MVIC. Principal Component Analysis, a method to reduce the dimensionality of the data, identified principal patterns (PP) that captured amplitude and temporal waveform characteristics. Each waveform was then scored against the PP to yield a PP-score. Intraclass correlations coefficients (ICC) with 95% confidence intervals were calculated for PP-scores.

Results: Average time between pre and post test was 5.6 weeks. There was no significant difference (p>0.05) in the gait speeds between the first (1.22±0.19 m/s) and second testing occasions (1.24±0.17 m/s). Three principal patterns explained over 90% variance in the waveform data and were analysed. ICCs for the gastrocnemius PP-scores ranged from 0.72–0.96, for the vasti muscles from 0.81–0.95, for the rectus femoris 0.57–0.98 and for the hamstrings 0.81–0.98. Of the 21 ICCs calculated (7 muscles and 3 PP-scores) only two were below 0.8. These results support moderate to very high reliability between test sessions.

Conclusions: Reliability for surface EMG recordings has been reported in asymptomatic individuals, but has not to our knowledge, been previously studied in knee OA. Issues specific to knee OA were considered, including number of walking trials, position and number of trials for the normalization exercises, standardized electrode placement, and validation exercises, such that participants across the OA spectrum could be tested. Using this standardized protocol, periarticular muscle activation patterns can be measured with a high degree of reliability from individuals with knee OA during gait.

175 FRONTAL PLANE MOTION DURING GAIT AND KNEE CONFIDENCE IN KNEE OSTEOARTHRITIS


Purpose: Persons with knee osteoarthritis (OA) have greater frontal plane instability than persons without knee OA. The contribution of this instability to symptoms potentially reflecting it, such as knee confidence, has been minimally examined. Low knee confidence very likely influences physical activity choices and has been shown to be associated with poor function outcome. Most studies evaluating frontal plane instability have relied on laxity measured under static, non-weightbearing conditions. Quantitative gait analysis affords an opportunity to evaluate frontal instability under dynamic conditions. Our goal was to examine the relationship between dynamic knee frontal plane instability during gait and knee confidence.

Methods: Eligible participants all had knee OA defined by osteophyte presence in at least one knee. Knee motion in the frontal plane during ambulation on a 35 x 4 foot walkway was captured at a rate of 120 Hz, using external passive reflective markers and an eight-camera Digital Real-Time Eagle motion analysis system. Frontal plane motion was measured using the peak knee varus angle during stance (and each subdivision of stance), peak knee varus angular velocity, and total knee varus-valgus motion during stance. For each person, data from the limb with the higher (worse) value were analyzed. Confidence was defined as moderately, severely, or extremely troubled (i.e., worst three categories). To evaluate the relationship between frontal plane motion measures and low knee confidence, logistic regression...