ments were extracted and averaged across 5 trials. Gait analyses were performed barefooted at the patients' self-selected walking speed. Pain was registered using KOOS and a VAS scale.
Isometric knee-extension force-steadiness was measured with patients seated with hips and knees flexed 90 degrees. A linear strain gauge attached to the patient's ankles measured knee extension force. The exerted force signal was displayed in real-time along with target forces of 20 and 50 N on a screen placed 1-m in front of the patients. The patients were required to produce and maintain the target forces as steady as possible. Force steadiness was expressed as the standard deviation of the force fluctuations (fig) and averaged over 5 trials. Pearson correlations were used to assess relationships between peak knee adduction moments and force steadiness. The independent relationship between force steadiness and adduction moments, and the impact of disease severity, were assess by multiple linear regression analyses, with and without covariates (gender, age, pain, KOOS pain, BMI, height, walking speed).
Results: 23 patients (20 females~91%) had K-L≤2 and 18 patients (13 females~72%) K-L>2. Force-steadiness correlated with neither of the peak adduction moments (Fig. 1) The correlations remained non-significant when the patients were divided according to radiographic disease severity (fig). Regression analyses showed that force-steadiness did not predict peak adduction moments (adj. R^2=0.03, P=0.28). Inclusion of covariates did not change the results (adj. R^2=0.02, P=0.41).
Conclusions: We found no relationship between knee-extension force-steadiness and peak adduction moments, and the relationship was not influenced by radiographic disease severity. These data suggest that force control and joint loads during walking represent two distinctive factors, which may have independent influence on knee OA pathogenesis.

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INTERFERENCE OF CHANGES IN BODY WEIGHT ON THE WEIGHT BEARING OF DOGS WITH NATURALLY OCCURRING OSTEOARTHRITIS

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Purpose: Naturally occurring osteoarthritis (OA) is a common degenerative process in dogs leading to gait disability and functional impairment. Force platform gait analysis is the recognised gold standard to determine therapeutic efficacy in dogs with OA. However, the impact of an increase in body weight (BW) toward the functional outcome of OA dogs remains unclear. It was thought that normalizing peak vertical force (PVF) values relatively to the dog's BW (so PVF expressed in %BW) would allow counteracting any influence of BW change on PVF. Our goal was to evaluate the influence of a change in BW on PVF values in lame client-owned dogs. An increase in BW is hypothesized to induce a major bias on PVF recording (even expressed in %BW), a drawback particularly meaningful when performing clinical trials in dogs with OA.
Methods: Twenty-six lame client-owned dogs were evaluated. In all dogs, lameness was supported by orthopaedic examination performed by a board-certified surgeon and later confirmed by radiographic evidences of the elbow, stifle or hip OA. Force platform gait analysis was performed at Day (D) 0 at a constant velocity (1.9-2.2 m/s) and acceleration (0.5 m/s^2). Abnormally low PVF generated by at least one limb was documented in all dogs. Following baseline data acquisition, dogs were fed a specific diet (supposed to have no effect on BW or PVF) until D30, and a different diet was given from D30 to D90 to induce increase in both BW and PVF. Gait analysis was also performed at D30 and at D90. Significance level was set at 5%. Data were expressed as mean (standard deviation).
Results: Although there was no significant change in PVF (p>0.05, ANOVA) values between D0 [63.9 (17.2)% BW], D30 [65.5 (17.4)% BW] and D90 [66.5 (20.1)% BW], a significant increase in BW was observed (p<0.001, ANOVA). Dogs had a significant increase in BW at D90 [41.3 (7.9) kg] when compared to D30 [39.9 (8.4) kg] and to D0 [40.0 (8.7) kg] (p<0.001). Figure 1 illustrates that the changes in BW against the changes in PVF during the D 30-90 period result in a significant negative correlation (p<0.001, Spearman correlation test). This indicates that an increase in BW potentially has a counter effect on an improvement of PVF, and vice-versa. In spite of PVF values already expressed in %BW, a significant effect of BW (p=0.013, ANCOVA) was recorded. In addition, adjusted PVF to BW resulted in values of 63.4 (17.1)% BW at D0, 65.0 (17.3)% BW at D30 and 67.6 (20.5)% BW at D90. Therefore, in contrary to the raw PVF values (*i.e.* uncorrected for BW), a significant increase in PVF (p=0.018, ANCOVA) was recorded between D0 and D90 when BW was considered a covariable in the ANCOVA analysis.

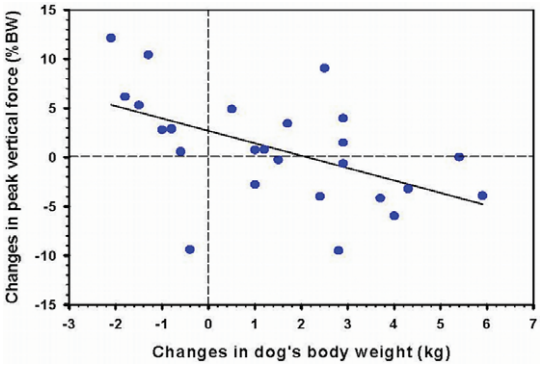

Figure 1. Change in body weight *versus* peak vertical force (D30 to D90 period).

Conclusions: This study demonstrated that a gain in weight was detrimental in dogs afflicted with OA and highlights the need to keep BW constant when using kinetic parameters to document treatment effects. These findings are inline with the deleterious gain in BW for joint integrity and joint support, and its potential to exacerbate lameness associated to OA.

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DIFFERENCES IN GAIT PARAMETERS BETWEEN HEALTHY SUBJECTS AND PERSONS WITH MODERATE AND SEVERE KNEE OSTEOARTHRITIS: A RESULT OF ALTERED WALKING SPEED?

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Purpose: While knee osteoarthritis has been shown to affect a multitude of kinematic, kinetic and temporo-spatial gait parameters, few investigations have examined the effect of increasing levels of radiographic osteoarthritis severity on these gait parameters. Fewer still have investigated the effect of walking speed on gait variables in persons with knee osteoarthritis. The objective of this study was to investigate the influence of walking speed on biomechanical variables associated with joint loading in persons with varying severities of medial compartment knee osteoarthritis.
Methods: Twenty-one persons with moderate osteoarthritis (Kellgren-Lawrence score 2-3) and 13 persons with severe os-

teoarthritis (Kellgren-Lawrence score of 4) participated. Twenty-two persons without knee pain or radiographic evidence of arthritis comprised a healthy control group. Sagittal plane kinetics, knee adduction moment, sagittal plane knee excursion, ground reaction forces and knee joint reaction forces were calculated from 3-dimensional motion analysis at 1.0 m/s, self-selected and fastest tolerable walking speeds. Differences were analyzed using multivariate ANOVA and multivariate ANCOVA with speed as a covariate. A hierarchical regression was used to substantiate the results of the ANCOVA and to determine if radiographic severity of knee OA was related to changes in gait variables, even after accounting for differences in freely chosen walking speed.
Results: Persons with knee osteoarthritis showed significantly lower knee and ankle joint moments, ground reaction forces, knee reaction force and knee excursion when walking at freely chosen speeds. When differences walking in speed were accounted for in the analysis, the only difference found at all self-selected conditions was decreased knee joint excursion (Figure 1). The severity of knee OA was significantly related to the knee adduction moment and knee joint excursion, even when accounting for differences in walking speed.

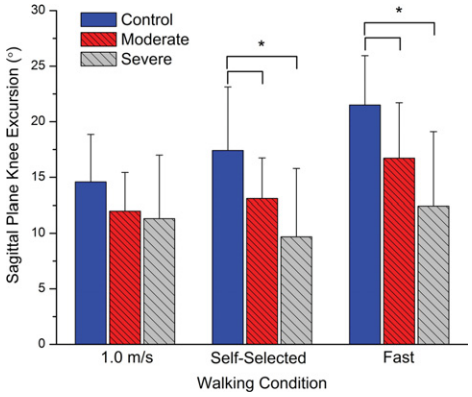

Figure 1

Conclusions: Compared to a healthy control group, persons with knee OA demonstrate differences in joint kinetics and kinematics. Many of these differences in gait parameters may be a result of slower freely chosen walking speeds rather than a result of disease progression. In addition, persons with severe knee OA may have difficulty compensating when challenged to walk faster their self-selected speed.

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CHANGES IN JOINT MOMENTS DUE TO KNEE OSTEOARTHRITIS ARE MODEL-DEPENDENT

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Purpose: In dynamic studies of gait, a mathematical joint model is used to attach physiological meaning to joint moments. However, there is no standard joint model; this means that some differences found in joint moments for OA gait could be artifacts of the choice of joint model. The purpose of this study is to identify features of lower-limb joint moments that are characteristic of subjects with moderate medial knee OA regardless of the choice of joint model.
Methods: 44 subjects with medial knee osteoarthritis and 44 asymptomatic control subjects walked at a self-selected speed. Symptomatic subjects were assessed using the WOMAC and radiographic Kellgren-Lawrence (KL) grading scales. 3D gait analyses were performed using an Optotrak motion analysis system and an AMTI force platform operating at 100Hz and 1000Hz, respectively. Moments were calculated at the ankle, knee, and hip using a 3D inverse dynamics model of the lower extremity. Four alternative joint models were used to obtain clinically relevant moments: the proximal, distal, plane of progression, and joint coordinate system models. Moment features were extracted using both discrete peak estimates and principal component analysis (PCA). OA and control groups were compared using a two-way ANOVA with joint model as the repeated measure.
Results: Subjects with osteoarthritis were taller, heavier, older, and had a greater BMI than control subjects. There was no difference in walking speed between the two groups. OA subjects had mean $\pm$ SD WOMAC pain scores of 7 ± 4 and function scores of 23 ± 13. All OA subjects demonstrated moderate radiographic medial knee osteoarthritis with KL scores between 1 and 3.
Hip adduction moments were smaller for OA subjects at the late-stance peak, regardless of the choice of joint model. PCA also identified an overall reduction in magnitude across the entire stance phase. Knee adduction moments were larger at mid-stance in all joint models, but not significantly different at either the early- or late-stance peak. PCA detected an overall increase in magnitude throughout the stance phase in all joint models. Peak late-stance ankle dorsiflexion moments were significantly lower for OA subjects in all joint models, but no overall change was detected using PCA.
Conclusions: Gait analysis can provide objective measures of function that can be used as outcome measures in studies of OA. We found features of lower-limb joint moments that, regardless of the choice of joint model, were sensitive to gait changes associated with OA. However, we also found that some commonly-reported measures, such as the early- and late-stance knee adduction moment peaks are not reliable across joint models.

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THE RELATION OF DYNAMIC MECHANICAL LOADING TO BONE MARROW LESIONS IN MEDIAL KNEE OSTEOARTHRITIS

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Purpose: Bone marrow lesions (BMLs) are a characteristic feature of knee osteoarthritis (OA) that are associated with pain and increased rapidity of disease progression. To date however their etiopathogenesis remains unclear. Some hypothesise that BMLs are related to excessive mechanical loading. The aim of this study was to assess the relationship between measures of the external knee adduction moment (KAM) during walking (dynamic indicators of medial tibiofemoral compartment load) and presence of BMLs in people with symptomatic medial knee OA.
Methods: 91 (46 F, 45 M) participants with mild to moderate (KL grades 2 & 3) medial compartment knee OA were recruited. A Vicon motion analysis system and force plates were used to measure the external KAM as participants walked in usual footwear at their usual comfortable pace for 5 trials. The variables of interest were the overall peak KAM (Nm/BW*HT%) and the positive KAM angular impulse (Nm.s/BW*HT%) which is equivalent to the positive area under the adduction moment-time graph. BMLs were measured from a knee MRI scan taken in the sagittal plane on a 1.5-T whole body MRI unit with use of a commercial transmit-receive extremity coil. The image sequence was a coronal T2-weighted fat-saturated acquisition. BMLs were assessed by the same reader blinded to gait measurements using BLOKS semi-quantitative scoring system (intra-rater reliability - weighted kappa 0.88). For this analysis only BML grade for size in the medial weight bearing femur and medial tibia were used. Static knee alignment