translations (2cm displacements) of the treadmill belts occurring during 20–50% of the gait cycle. During the walking trials, 3D movement of the lower legs, pelvis and trunk were captured via markers on anatomical landmarks at 100 Hz using a motion-capture system (Vicon, Oxford, United Kingdom). The outcome measure was dynamic knee instability, expressed by the Perturbation Response (PR), i.e. a biomechanics based measure reflecting deviation in the mean knee varus-valgus angle after a controlled mechanical perturbation, standardized to the mean (standard deviation) varus-valgus angle during level walking. Lower PR values indicate less deviation in the mean varus/valgus angle. Linear mixed-effect model analysis was used to evaluate the effect of a brace on dynamic knee instability.
Results: Thirty-eight persons with knee OA and self-reported knee instability from the Amsterdam Osteoarthritis Cohort participated in the study. Wearing a brace significantly reduced the PR compared to not wearing a brace ($P < 0.05$). The PR value reduced from 0.48 when not wearing a brace to 0.32 when wearing a brace. This means that wearing a brace resulted in a reduction of 33% in dynamic knee instability compared to not wearing a brace. There was no difference between a non-tight and a tight brace ($P > 0.05$).
Conclusions: This study is the first to report that wearing a soft brace results in an improvement of objectively assessed dynamic knee instability, beyond the previously reported subjective improvement.

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ACTIVE FEEDBACK GAIT RETRAINING ALTERS FOOT PRESSURE PATTERNS AND REDUCES KNEE ADDUCTION MOMENT IN AN ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTED POPULATION

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Purpose: Anterior cruciate ligament (ACL) tear greatly accelerates osteoarthritis (OA) onset, and ACL reconstruction (ACLR) surgery has not been shown to prevent premature knee OA. It was recently shown that ACLR subjects with higher knee adduction moments (KAM) 2 years after ACLR had worse patient-reported outcomes at 8 years after surgery, and patients with higher relative contribution of KAM to the total loading at the knee joint had greater decreases in medial-to-lateral femoral cartilage thickness ratios over time. As such, interventions such as gait retraining to reduce the KAM in ACLR patients present an opportunity to reduce the risk of developing premature knee OA. The purpose of this study was to test the efficacy of a gait retraining method using active feedback to change the KAM by sensing lateral foot pressure and retraining to produce a medial weight transfer at the foot. Specifically, we hypothesized (1) there would be significant changes in foot pressure patterns (average heel pressure ratio) and joint loading (first peak KAM, KAM Impulse) with active feedback, (2) joint loading change is influenced by pressure threshold feedback setting (Level 1 vs. Level 2), and (3) joint loading is correlated with pressure distribution at the foot during walking.
Methods: Ten individuals with unilateral primary ACLR surgery (7M/3F; age: 37.7 ± 11.1 yrs; BMI: 25.1 ± 4.3 kg/m^2, 42.8 ± 29.0 months post-ACLR) were tested at normal speed in three conditions: control, active feedback ("Level 1"), and active feedback at a higher setting ("Level 2"). For the active feedback trials, if pressure measured under the lateral side of the heel exceeded a subject-specific threshold, a vibration motor placed in contact with the skin at the ankle was activated. Subjects were instructed to walk in a manner to successfully keep the device from vibrating, by shifting weight medially at the foot, which determined Level 1 settings. Level 2 required a greater medial shift by using a lower lateral heel pressure threshold. For control trials the feedback system was inactive. The first peak KAM (KAM1) and KAM Impulse were determined using a motion capture system and force plate. Medial-to-lateral (M/L) heel pressure ratio was determined from OpenGo insoles (Moticon). Differences in outcome variables were analyzed using repeated measures analysis of variance with post hoc paired Student's t-tests. The relationship between KAM variables and heel pressure ratio was analyzed using linear regression analyses. *P*-values < 0.05 were considered significant.
Results: KAM1 was significantly reduced at Level 1 (−29.5%, $P = 0.002$) and Level 2 (−36.3%, $P < 0.001$) feedback settings as compared to control. The KAM Impulse was also significantly reduced at Level 1 (−49.4%, $P = 0.003$) and Level 2 (−57.3%, $P = 0.001$) feedback settings. The reductions at the Level 2 setting were significantly greater than at the Level 1 setting (KAM1: $P = 0.017$; KAM Impulse: $P = 0.020$). The average M/L pressure ratio was significantly increased at both Level 1 (70.9%, $P < 0.001$) and Level 2 (64.7%, $P < 0.001$) feedback settings, with no difference between settings ($P = 0.21$). The reductions in KAM1 and KAM Impulse increased with greater pressure transfer from the lateral to medial heel. Specifically, reductions in KAM1 (Figure 1a) and KAM Impulse (Figure 1b) were significantly correlated with the changes in M/L pressure ratios when considering both Level 1 and Level 2 pressure setting data. However, the patient response to M/L pressure change was variable, with individual subject R^2 ranging from 0.01 to 0.95 for KAM1 and R^2 ranging from 0.10 to 0.95 for KAM Impulse.
Conclusions: ACLR subjects responded to an active feedback gait retraining that produces a medial weight-bearing shift at the foot in a manner that reduces the first peak KAM and KAM Impulse, with greater changes at the Level 2 feedback setting. The results that reductions were associated with increases in the M/L foot pressure ratio suggest a potential dose response for this intervention. The variations in patient dose response suggest that future applications of this method should be further customized to the patients. Finally, considering the long term risk of developing premature medial knee OA in this ACLR population, reducing KAM may be beneficial and these results suggests the need for future research to determine the long-term effect of the active feedback intervention on joint loading as well as clinical outcomes.

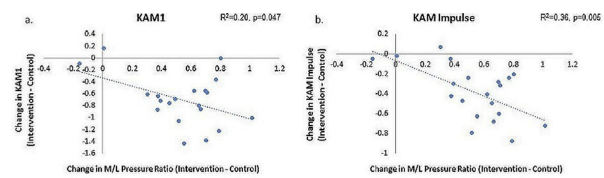

Figure 1. The reductions in both (a) KAM1 and (b) KAM Impulse were significantly correlated with increases in the M/L pressure ratios for all subjects together (at Level 1 and Level 2 settings).

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LOWER PROTEOGLYCAN DENSITY WITHIN THE TALAR ARTICULAR CARTILAGE IS ASSOCIATED WITH WORSE POSTURAL CONTROL IN INDIVIDUALS WITH CHRONIC ANKLE INSTABILITY

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Purpose: Individuals with chronic ankle instability (CAI) demonstrate reduced proteoglycan density (PGD) in the talar cartilage compared to uninjured controls, which may be indicative of deleterious compositional changes consistent with early osteoarthritis development. Additionally, those with CAI demonstrate impaired postural control, which may alter ankle loading and lead to compositional changes in the articular cartilage. Therefore, this study aimed to determine if talar PGD associates with postural control measures in those with CAI.
Methods: Fifteen individuals with CAI (age = 21.1 ± 1.8 years, height = 166.6 ± 8.1 cm, mass = 66.5 ± 8.3 kg) volunteered for this study. CAI was defined as history of at least one ankle sprain (4.0 ± 2.1 sprains) and at least 2 giving way episodes in the past six months (6.9 ± 5.4 episodes). All participants scored ≥ 11 on Identification of Functional Ankle Instability scores (22.7 ± 2.8), ≤ 90% on the Foot and Ankle Ability Measure (85.5 ± 9.0%) and ≤ 80% on Foot and Ankle Ability Measure Sport (67.3 ± 20.8%). T1ρ MRI was performed using a Siemens Magnetom TIM Trio 3T scanner with an 8-channel flex coil. Participants were non-weight bearing for 30 minutes prior to the scan to unload the cartilage. The involved limb was scanned with three-dimensional Fast Low Angle Shot (FLASH) with a spin lock power at 500 Hz and five different spin lock durations (40, 30, 20,10, 0 ms). Voxel by voxel T1ρ relaxation times were calculated from a five-image sequence created with a custom Matlab program. Segmentation of the T1ρ talar cartilage was performed manually using ITK-SNAP software. Four regions of interest (ROI): anteriomeidal (AM), anteriolateral (AL), posteriomedial (PM), and posteriolateral (PL) were identified during segmentation. Greater T1ρ relaxation times interpreted as reduced PGD. Postural control was assessed during 3, 10-second trials of eyes open single limb stance on a force plate. Hands were placed on the hips and the non-involved limb was held at 30 degrees of hip flexion and 45 degrees of knee flexion. Center of Pressure data were collected at 50 Hz and time-to-boundary (TTB) outcomes including the mean (TTBmean) and standard deviation (TTBsd) of the TTB minima in the mediolateral (ML) and anteroposterior (AP) direction were calculated. Lower scores for