Table 1
Group mean (SD) and p- values for parameters of the knee adduction moment

	Barefoot	Rocker-sole Shoes	Control Shoes	ANOVA p-values
Peak KAM (Nm/ BW*ht%)	3.4 (1.37)*	3.55 (1.31)*	3.84 (1.36)	<0.001
KAM impulse (Nm.s/BW*ht%)	1.03 (0.49)**	1.14 (0.53)	1.18 (0.51)	<0.001
Velocity (m/s)	1.29 (0.23)	1.30 (0.22)	1.30 (0.23)	0.086

* denotes significant difference compared with control shoes
** denotes significant difference compared with unstable rocker-soled shoes and control shoes

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THE ROLE OF FOOTWEAR IN ATTENUATING IMPACT LOADS IN INDIVIDUALS WITH KNEE OSTEOARTHRITIS

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Purpose: During gait, impulse forces at footstrike are suggested to play a possible role in the development and progression of knee osteoarthritis (OA). Footwear, in particular midsole characteristics and use of insoles can greatly influence impact forces. Much of the research examining impact forces and footwear involves running. However, for an OA population the impact loads experienced during walking are of greater importance. The purpose of this study was to examine if shoes (a standard walking shoe and a modified shoe which incorporate both a lateral wedge insole and variable-stiffness midsole) influence impact loading compared to barefoot walking in individuals with knee OA.
Methods: 30 individuals (17 females; age: 63.3±9.7yrs; body mass index: 28.6±3.6kg/m^2) with radiographic knee OA (Kellgren and Lawrence grade greater than or equal to 2) and pain on most days were recruited. Participants underwent 3-dimensional gait analysis across three testing conditions in random order and blinded to shoe type i) wearing the modified shoes, ii) wearing a standard recreational walking shoe (control shoes) and iii) barefoot. Walking speed during the gait analyses was controlled within 5%. For each condition, five trials with clean force plate strikes were collected from the study limb. Primary outcome was maximum rate of loading (BW/s) defined as the maximum rate of change of the post-foot-contact vertical ground reaction force (F_z). Secondary outcomes included i) average rate of loading (BW/s; peak F_z divided by the time taken to reach peak F_z), ii) peak F_z (BW; maximum F_z during first half of stance) and iii) proportion of individuals who had heel strike transients (HST) (present in at least 4 of 5 trials) versus those who did not (HST present in 1 or less of 5 trials). Differences in maximum and average loading rates, peak F_z between conditions were examined using repeated measures ANOVA. When significances were obtained, Bonferroni post-hoc tests were performed. Cochran's Q test was used to examine differences in the proportion of individuals with HST across the three conditions.

Table 1
Mean (SD) of Impact Loading Variables

	Modified Shoes	Control Shoes	Barefoot	P-value
Maximum rate of loading (BW/s)	19.39 (8.04)	19.49 (8.09)	87.04 (61.19)	<0.001*†
Average rate of loading (BW/s)	6.67 (2.14)	6.78 (2.07)	7.70 (2.64)	<0.001*†
Peak F_z (BW)	1.14 (0.12)	1.14 (0.12)	1.11 (0.12)	<0.001*†
Speed (m/s)	1.29 (0.25)	1.30 (0.25)	1.29 (0.25)	0.11

*denotes significant post-hoc difference between modified shoe and barefoot
† denotes significant post-hoc difference between control shoe and barefoot

Table 2
Proportion of participants with heel strike transients present/absent (n=19)

	Heel strike Transients	
	Absent (N)	Present (N)
Modified Shoes	18	1
Control Shoes	16	3
Barefoot	7	12

Results: Maximum rate of loading, average rate of loading, and peak F_z are presented in Table 1. There were significant differences in maximum rate of loading, average rate of loading, peak F_z ($p< 0.001$) across test conditions. Post-hoc testing revealed that the maximum and average rates of loading were higher when walking barefoot than when wearing the modified shoes or control shoes ($p< 0.001$). Peak F_z was less when walking barefoot than wearing the modified shoes or the control shoes ($p< 0.001$). There were no post-hoc differences noted between the two shoe conditions ($p> 0.05$). Only 19 of the 30 participants demonstrated a clear presence or absence of HST in all three conditions. A greater proportion of individuals had HSTs in the barefoot condition compared to when walking with the modified shoes and control shoes ($p< 0.001$). There was no difference in the two shoe conditions (Table 2).
Conclusions: Both the modified shoe and the standard control shoes reduce the rate of loading parameters compared to barefoot walking. However, peak F_z was lower when walking barefoot, indicating time to reach peak F_z occurred earlier in stance. The modified shoes did not change the impact loading compared to the control shoe.

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STATIC AND DYNAMIC KNEE ALIGNMENT, MUSCLE BALANCE AND CARTILAGE COMPOSITION IN YOUNG ADULTS

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Purpose: Knee varus and related adduction moment (KAM) are risk factors associated with knee osteoarthritis (OA). It is unknown if these factors relate to pre-radiographic changes in cartilage composition as assessed by quantitative MR imaging of T1ρ- and T2 relaxation times. Also, since knee loading during dynamic activities is under neuromuscular control, any muscle imbalance could lead to dynamic overload in certain compartments accentuating the mechanical impact of malalignment. Muscle imbalance and altered loading patterns during walking are modifiable risk factors amenable to neuromuscular retraining interventions. Therefore, the purpose of this study was to analyze the relationship between static and dynamic knee malalignment, knee muscle cross-sectional area (CSA), and articular and meniscal cartilage composition.
Methods: 33 young healthy (49 knees), active subjects, between the ages of 20-35 years, BMI < 28 kg/m2 completed 3-T MRI scans of the knee and 3-D motion capture while walking. Standard sequences were used for quantification of cartilage thickness (Th.Ct), T1ρ- and T2 relaxation times for 6 cartilage regions (medial/lateral- femoral condyle (MF/LF) tibial plateau (MT/LT), patella (P), and trochlea (TrF)), and 6 meniscus regions (anterior/body/posterior horn for medial and lateral meniscus). Medio-lateral ratios of Th.AC T1ρ- and T2 relaxation times were also calculated for tibia (T), femur (F), tibiofemoral (TF) compartment, patellofemoral (PF) compartment and global knee. Quadriceps (Q) and hamstrings (H) CSA were calculated along with medio-lateral (M:L) and Q:H muscle CSA ratios from axial T1W scans at mid-thigh. Sagittal and frontal plane kinematic (peak and excursion), kinetic (peak and rate of loading(ROL)) during stance phase of walking were calculated for each subject. Pearson's correlations were used to analyze relationships. Long limb radiographs were available from 27 knees for assessment of static alignment.
Results: Static varus was associated with greater M:L ratio of articular cartilage T2. 1st and 2nd peaks of KAM and frontal plane ROL were related to high M:L ratio of meniscus T1ρ and T2 and high overall M:L ratio of Th.Ct. Frontal plane excursion and flexion excursion were related to lower TF and PF Th.Ct. In sagittal plane, peak external flexion moment was