Table 1
Baseline values and changes in outcomes in groups and mean differences between groups among the participants who adhered to the protocol

Variable	Control group (n = 15)		Training group (n = 15)		*Group mean difference	p
	Baseline	Change	Baseline	Change		
Self-selected walking speed (m/s)	1.52 ± 0.61	-0.04 (-0.10 to 0.01)	1.43 ± 0.21	0.04 (-0.01 to 0.09)	-0.08 (-0.15 to -0.01)	0.018
1st peak knee compressive fore; (N/kg)	40.7 ± 5.4	-1.60 (-4.35 to 1.15)	34.5 ± 6.7	0.86 (-1.91 to 3.64)	-2.47 (-6.47 to 1.53)	0.22
1st Quadriceps peak force (N/kg)	21.7 ± 5.9	-0.54 (-2.83 to 1.75)	17.3 ± 5.4	1.96 (-0.26 to 4.18)	-2.50 (-5.71 to 0.70)	0.12
Quadriceps Isometric strength (Nm/kg)	1.52 ± 0.61	-0.11 (-0.41 to 0.19)	1.32 ± 0.43	0.26 (-0.03 to 0.54)	-0.37 (-0.73 to -0.002)	0.049
WOMAC pain (0-100 score, higher score is worse)	25.0 ± 18.2	3.20 (-2.3 to 8.6)	19.7 ± 17.2	-5.30 (-11.6 to -0.1)	9.0 (1.7 to 16.3)	0.018
WOMAC Function (0-100 score, higher score is worse)	29.9 ± 13.3	-2.1 (-8.6 to 4.4)	21.9 ± 14	-14.0 (-20.9 to -7.0)	11.9 (2.6 to 21.1)	0.014
WOMAC stiffness (0-100 score, higher score is worse)	31.9 ± 24.9	-1.8 (-10.5 to 6.9)	24.7 ± 20.7	-10.4 (-19.4 to -1.3)	8.55 (-3.1 to 20.2)	0.14
WOMAC total (0-100 score, higher score is worse)	34.0 ± 14.7	-0.4 (-7.5 to 6.8)	27.7 ± 14.6	-15.9 (-23.4 to -3.4)	15.5 (5.4 to 25.6)	0.004

Baseline values are mean ± standard deviation. Changes are per protocol mean (95% confidence interval). *Based on ANCOVA, adjusted for age, gender, baseline value, and study center location. P-values indicate whether changes are significantly different between groups. Level of significance p<0.05.

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INTEGRATIVE ASSESSMENT OF FRONTAL PLANE ALIGNMENT OF THE HIP AND KNEE AMONG SUBJECTS WITH AND WITHOUT KNEE OSTEOARTHRITIS: THE MOST STUDY

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Purpose /Aims: Knee alignment is a putative risk factor for medial and lateral knee osteoarthritis (OA). Anatomical variations at the hip have potential to influence knee alignment and thereby increase risk of medial or lateral knee OA. To better understand the relationship between malalignment and knee OA, it is useful to explore whether anatomical variations more proximal in the kinetic chain are associated with the static alignment of the knee and whether these associations differ between the two main methods of assessing static knee alignment.

This study has two aims: 1) compare how variations in pelvic anatomy relate to the mechanical axis, anatomical axis, and also the magnitude of difference between axes, and 2) explore whether any differences between axes relate to prevalence of compartment-specific knee OA.

Methods: This cross-sectional study uses publicly released data from the Multicenter Osteoarthritis Study (MOST), an observational cohort study of incident and progressive knee OA in men and women ages 50-79 years at baseline.

We report on 1,328 hips/knees from 664 subjects: 160 subjects with lateral OA (101 unilateral/ 59 bilateral), 168 subjects with medial OA (76 unilateral / 92 bilateral), and 336 control subjects. All participants with LOA at the baseline MOST visit were included. An equal number of participants with MOA, and twice the number of controls were then randomly selected. Case knees were identified as having Kellgren/ Lawrence (K/L) ≥ 2 with joint space narrowing (JSN) score ≥ 1 (0-3 OARSI atlas scale) in the specified compartment with no JSN in the adjoining compartment.

Measurements of hip anatomy and knee alignment were taken from full-limb standing radiographs using custom OsiriX software by an author (AB) blinded to knee OA status, and unreadable radiographs (N = 8) were discarded prior to unblinding. Knee measurements included the hip-knee-ankle angle (HKA-mechanical axis), femoral-shaft tibial-shaft angle (FSTS-anatomical axis), and femoral mechanical-anatomical angle (FMA). The FMA represents the magnitude of difference between the anatomical and mechanical axes (FSTS – HKA), with neutral alignment defined as 0°, valgus >0° and varus <0° (Fig 1a). Hip measurements included femoral neck-shaft angle (NSA), femoral neck length (FNL), and femoral offset (FO).

Hip variables were compared to knee alignment using Pearson bivariate correlation analyses. Multiple logistic regression with generalized estimating equations (GEE), to account for potentially correlated observations for knees and hips from the same person, was used to evaluate the relationship between knee alignment and prevalence of medial or lateral knee OA. All analyses were adjusted for age, gender, and body mass index (BMI).

Results: The FMA angle correlated strongly with FO (r = 0.82, p<0.001) and NSA (r = -0.71, p<0.001), and moderately with FNL (r = 0.53, p<0.001). As NSA increased, or as FO decreased or FNL shortened, FMA decreased. FMA had a significant inverse relationship to HKA (r = -0.13, p<0.001), and a non-significant direct relationship to FSTS (r = 0.06, p = 0.053). Femoral NSA, FO, and FNL all had statistically significant relationships (p<0.001) with HKA, but the strength of these relationships was weak: FO (r = -0.23), NSA (r = 0.19), FNL (r = -0.15). None of the hip variables had a significant relationship with FSTS: FO (r = -0.05, p = 0.067), NSA (r = 0.04, p = 0.159), FNL (r = -0.03, p = 0.225).

The mean ± standard deviation for FMA was 5.55° ± 0.77 for those with lateral OA, 5.76° ± 0.79 for medial OA, and 5.80° ± 0.74 for controls. Regression analyses showed FMA is associated with an increased prevalence of lateral OA (OR 1.61, 95% CI 1.27 to 2.05) but not medial OA (OR 0.98, 95% CI 0.77 to 1.24) (Table I). When HKA is controlled for, FMA

Table I
Knee alignment and prevalence of knee OA

	Compared to controls:	
	Medial OA (or (95% CI))	Lateral OA (or (95% CI))
HKA	1.45 (1.35 to 1.57)	1.68 (1.54 to 1.83)
FSTS	1.47 (1.37 to 1.59)	1.59 (1.47 to 1.72)
FMA	0.98 (0.77 to 1.24)	1.61 (1.27 to 2.05)
FMA (controlling for FSTS)	1.19 (0.91 to 1.55)	2.23 (1.66 to 3.00)
FMA (controlling for HKA)	0.81 (0.62 to 1.05)	1.34 (1.00 to 1.81)

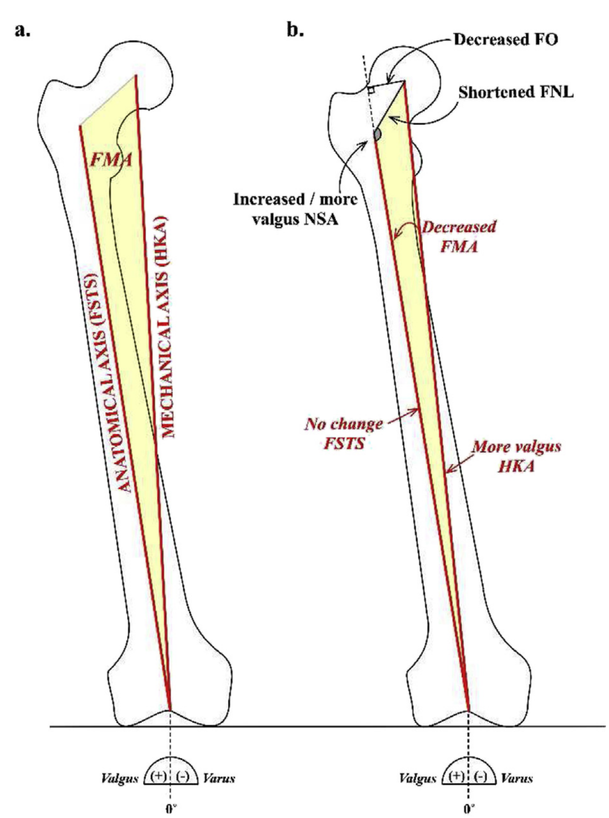

Figure 1. The relationship between hip geometry and knee alignment.

is no longer associated with an increased prevalence of lateral OA. In contrast, there is an increased association between FMA and prevalence of lateral OA when FSTS is controlled for.

Conclusion: Our study shows that anatomical variations at the hip alter the mechanical but not anatomical axis of the knee, and correlate strongly with the magnitude of difference between these axes (Fig 1b). Because FSTS did not correlate with hip anatomy or FMA, the decrease in FMA is likely the result of shifting the mechanical axis in a more valgus orientation relative to the anatomical axis, rather than vice versa. Such results suggest HKA is the more robust measure with respect to association with lateral OA and the results from our regression analyses further support this claim.

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A BIOMECHANICAL THERAPY PROGRAM FOR PATIENTS AFTER TOTAL KNEE ARTHROPLASTY – A RANDOMIZED CONTROLLED TRIAL (PRELIMINARY RESULTS)

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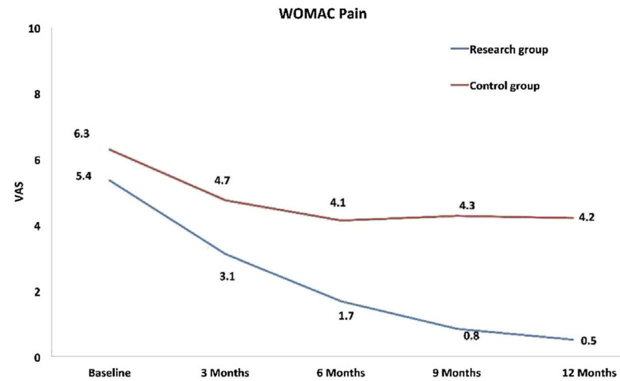
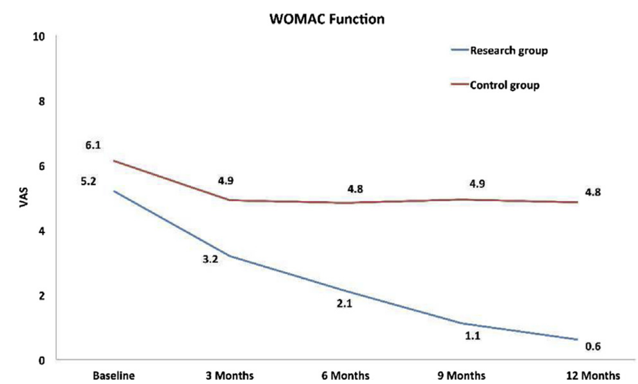
Purpose: The predicted increase in primary and revision total knee arthroplasty (TKA) for knee osteoarthritis is a major concern. The demand for primary TKA in the United States alone is expected to grow by 673% (3.48 million annual procedures) by 2030 and the demand for TKA revisions is expected to grow by 601%. Yet, up to 50% of patients continue to suffer from pain and disability following the surgery. In most of the cases those finding cannot be explained by implant factors or surgical technique. Additionally, physiotherapy functional exercises after discharge result in small to moderate effect sizes with no long-term benefits. Evidence shows that gait patterns after TKA do not return to healthy ranges. These pathological gait patterns may partially explain the difficulty in postoperative recovery in pain and function, as well the wear and tear of the TKA implant in the long-term. In this study we applied a biomechanical therapy program after surgery aimed at reducing pain, improving function and correcting gait patterns.

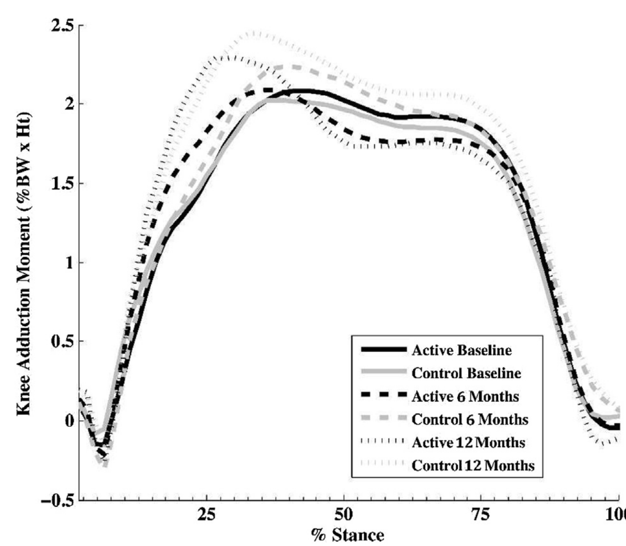
Methods: We conducted a randomized, controlled, double-blind trial involving fifty patients after unilateral TKA for end-stage knee OA. The active group underwent a therapy program using a biomechanical foot-worn device, while the control group received a similar training program with a sham walking shoe. Treatment was initiated 6 weeks postoperatively. Patients were examined at baseline, 3 months, 6 months, 9 months and 12 months postoperatively. Outcomes were the Western Ontario and McMaster Osteoarthritis Index (WOMAC), the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) and three-dimensional gait analysis measurements in the frontal and sagittal planes. Comparisons of categorical variables between the intervention groups (active vs. control) were carried out with the chi-square tests. Comparisons of continuous variables such as demographic data and baseline gait data between the groups were done by the Wilcoxon-Mann-Whitney rank-sum test. A linear mixed effect model was used to determine the effect of the treatment over time in each parameter.

Results: There were no differences between groups at baseline. Both groups improved with time after surgery, but the active group consistently showed significantly better outcomes in WOMAC pain (Figure 1; 91% reduction compared to 33%), function (Figure 2; 93% reduction compared to 21%) and stiffness (85% reduction compared to 32%) sub-scales (all $p = 0.001$), in SF-36 physical score (107.3% increase compared to 59%) and mental scores (51% increase compared to 45%) (all $p<0.001$). Patients from the active group also showed lower second peak knee adduction moment (Figure 3; $p = 0.007$) and greater peak knee extension moment ($p = 0.009$). Linear mixed effect models over time showed faster improvements in the active group in all clinical parameters, stride, cadence, double-limb-support, step-length, knee range of motion and impulses of the knee flexion and extension moments, as well as slower regression of the knee adduction impulse (all $p<0.01$). The knee varus angle did not differ between groups over time.

Conclusions: A patient-specific biomechanical therapy program applied to patients after unilateral TKA may lead to a greater improvement and more rapid recovery time in pain and function, as compared to regular rehabilitation protocols after TKA. Furthermore, this biomechanical training program may lead to healthier loading patterns on the knee joint.







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NEUROMUSCULAR STRATEGIES DURING GAIT IN WOMEN WITH EARLY AND ESTABLISHED KNEE OSTEOARTHRITIS

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Purpose: Osteoarthritis (OA) has become one of the leading causes of pain and disability in the elderly worldwide. Medial compartment knee