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Comparison of Clinic-Based Biomechanical Measures During Walking to Laboratory Measures after Total Knee Arthroplasty

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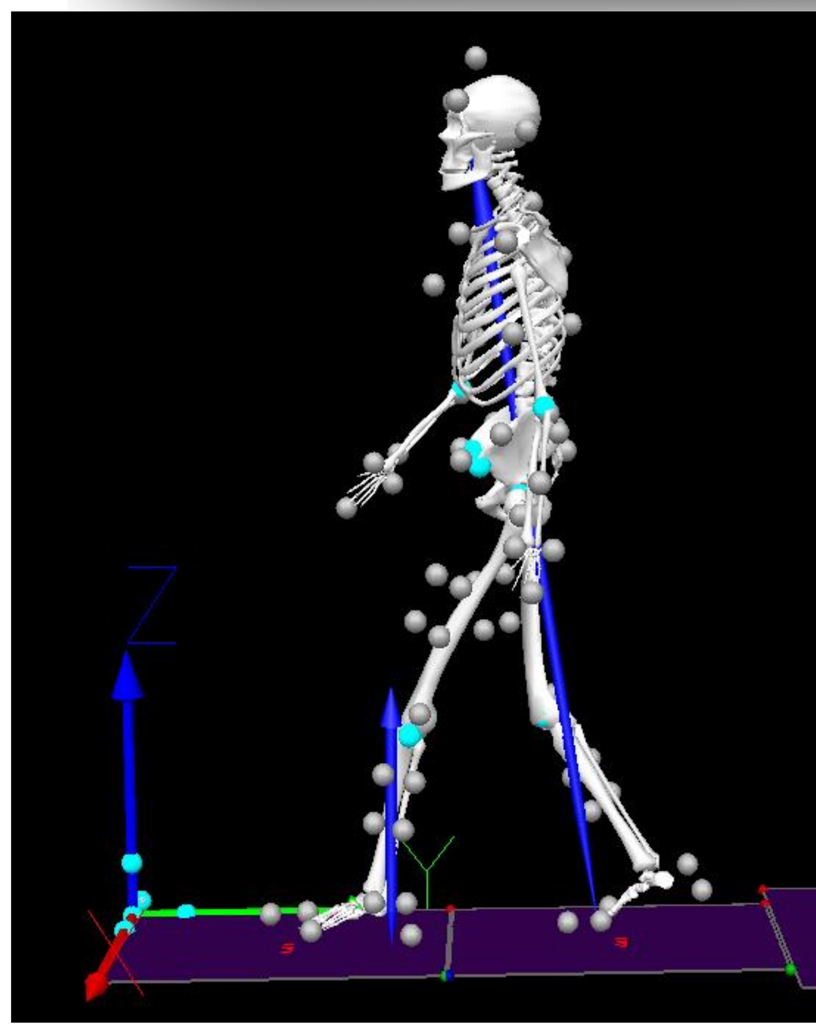
PURPOSE

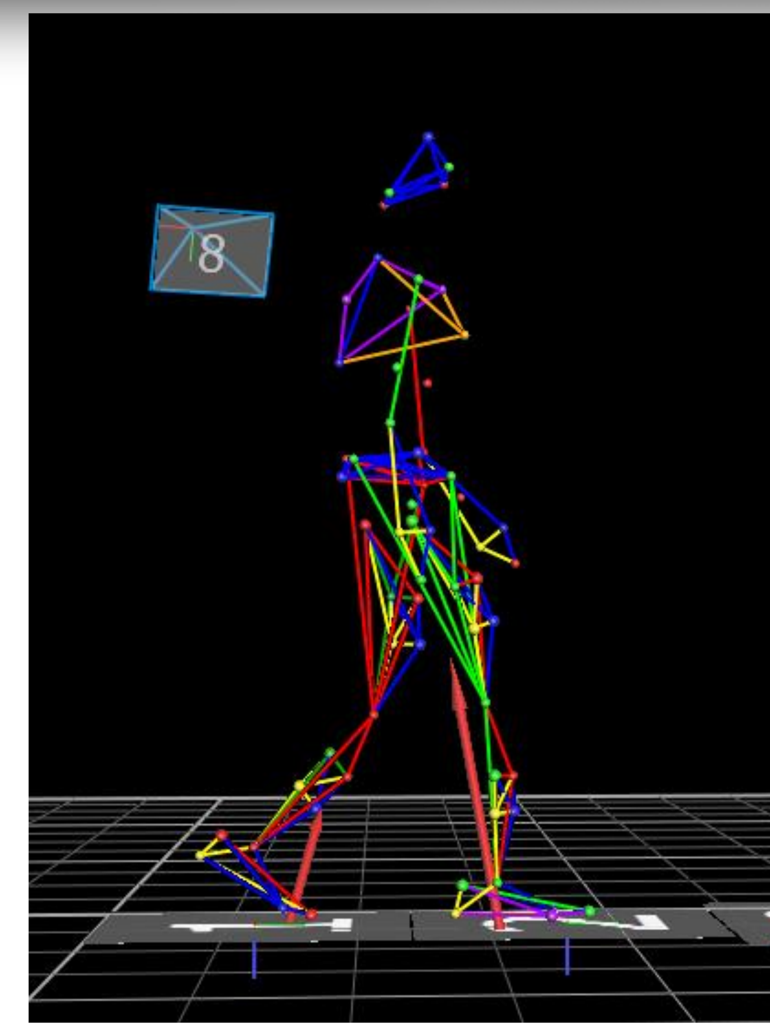
Clinically feasible methods to assess movement biomechanics post total knee arthroplasty are needed. However, the relationship between measurements collected clinically to those collected in a laboratory setting has not been examined. Therefore, the purpose of this study was to compare clinic-based measures of gait biomechanics using insole sensors collected during a physical therapy session to laboratory-based motion capture measurements 10-weeks after TKA.

ACKNOWLEDGEMENTS

This research was funded : NIH R01 AG056585, NIH/NCATS UL1-TR001082, NIH F32-AG066274, NCATS KL2 TR001870, Eastern Colorado Geriatric Research Education and Clinical Center, Academy of Orthopaedic Physical Therapy Career Development Award

Insole pressure measurement systems may have **clinical utility** as a **less-costly** *alternative* to **motion capture systems** for investigating between-limb kinetic symmetry.





Figures 1 and 2. Laboratory-Based Analysis Using Motion Capture and Embedded Force Plates of Self-Selected Walking Speed at 10 weeks after TKA

	Gait Mean (SD)	Clinic Mean (SD)	Paire t-test p-value	Correlation (95% CI)	ICC (95% CI)	Bias (95% LoA)
Involved Loading Rate (BW/s)	8.43 (3.7)	6.781 (2.1)	0.0006	0.34* (0.10, 0.54)	0.451 (0.09, 0.67)	1.65 (-5.32, 8.63)
Uninvolved Loading Rate (BW/s)	10.31 (3.9)	7.499 (2.4)	<0.0001	0.28** (0.03, 0.50)	0.405 (0.008, 0.64)	2.81 (-4.97, 10.6)
Loading Rate Ratio	0.848 (2.7)	0.927 (0.19)	0.07	-0.06 (-0.30, 0.20)	-0.115 (-0.86, 0.33)	-0.079 (-0.74, 0.58)
Involved GRF (N/BW)	1.05 (0.09)	0.980 (0.08)	<0.0001	0.22 (-0.04, 0.44)	0.353 (-0.08, 0.61)	0.066 (-0.14, 0.27)
Uninvolved GRF (N/BW)	1.09 (0.09)	1.06 (0.22)	0.34	0.04 (-0.21, 0.29)	0.059 (-0.57, 0.44)	0.028 (-0.42, 0.48)
GRF Ratio	0.962 (0.04)	0.940 (0.10)	0.14	-0.01 (-0.26, 0.24)	-0.016 (-0.69, 0.39)	0.022 (-0.20, 0.25)
Involved Impulse (BW*s)	0.538 (0.04)	0.609 (0.17)	0.002	0.14 (-0.12, 0.38)	0.120 (-0.47, 0.47)	-0.070 (-0.41, 0.27)
Uninvolved Impulse (BW*s)	0.567 (0.05)	0.617 (0.08)	<0.0001	0.27** (0.02, 0.49)	0.389 (-0.02, 0.63)	-0.050 (-0.22, 0.12)
Impulse Ratio	0.952 (0.06)	0.980 (0.14)	0.20	-0.28** (-0.50, -0.03)	-0.517 (-1.53, 0.09)	-0.028 (-0.36, 0.30)

Table 1. Summary Statistics, Correlations, ICC (3,k), Bias (n=61)
*p<0.01; **p<0.05. Abbreviations: BW, bodyweight

Figure 3. Clinic-Based Analysis Using Single Sensor Insoles of Self-Selected Walking Speed at 10 weeks after TKA (image credit www.NovelUSA.com/loadsol)

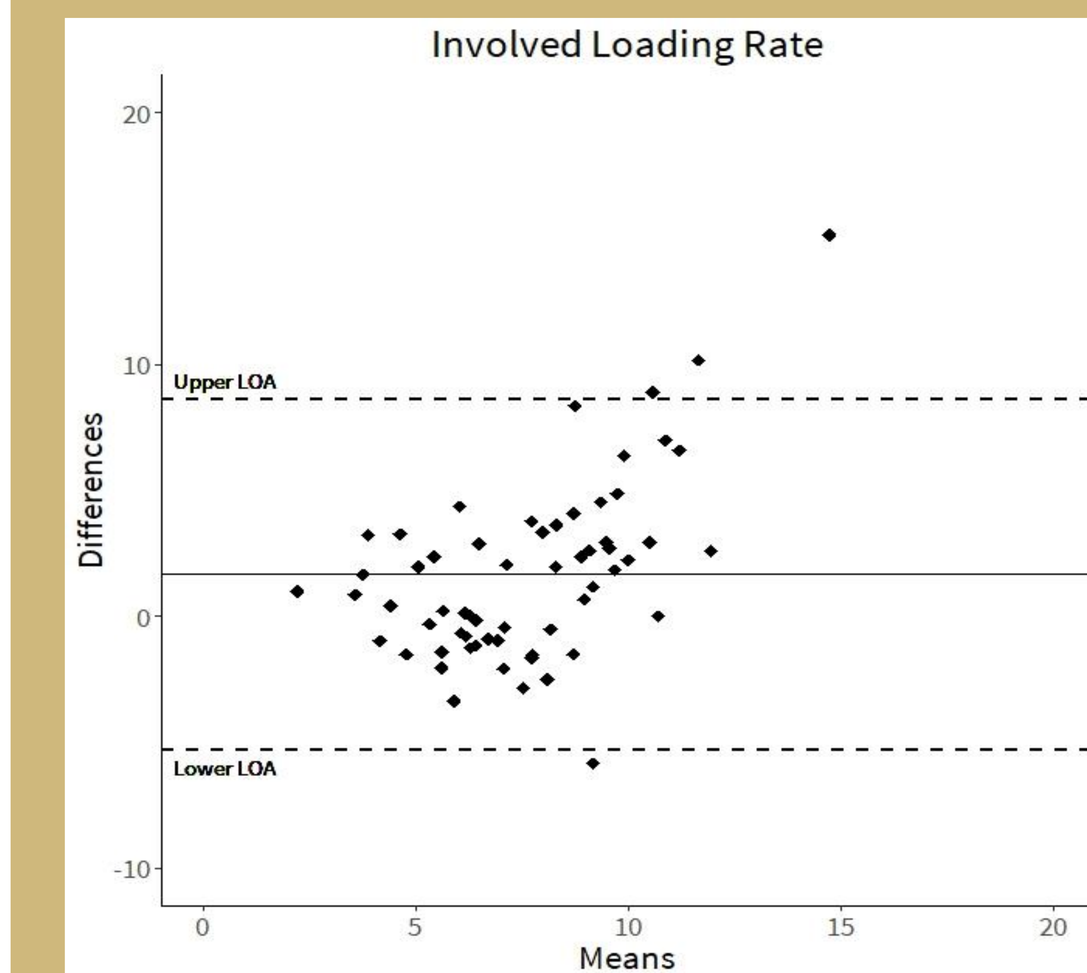


Figure 4. Bland-Altman Plot of Involved Loading Rate

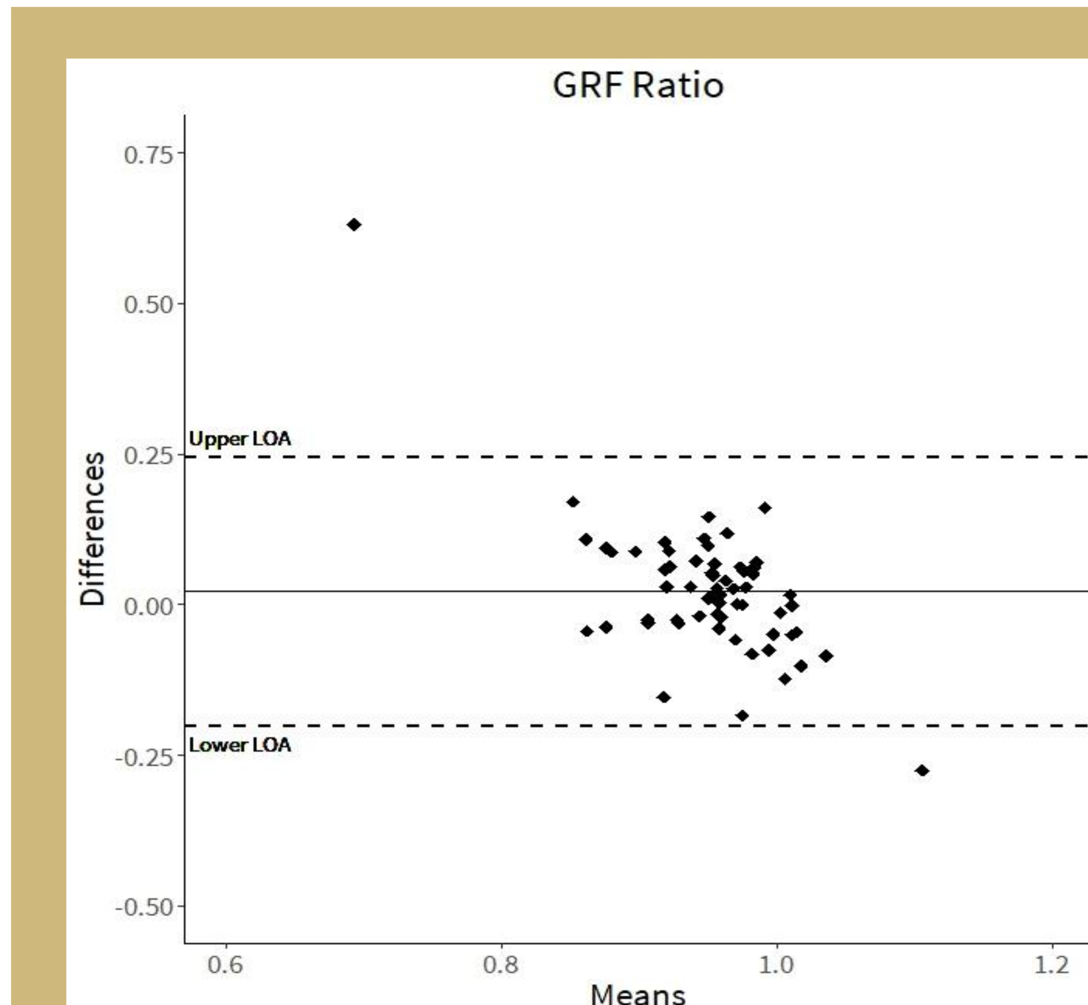


Figure 5. Bland-Altman Plot of Ground Reaction Force Ratio

PARTICIPANTS

61 participants (aged 65±8 years)

METHODS

Subjects underwent biomechanical assessments while walking 10-weeks after TKA: 1) using single sensor insoles during an intervention session (clinic-based assessment) and 2) using an 8-camera motion capture system and embedded force plates (laboratory-based assessment).). Average vGRF, impulse, and loading rate for the surgical limb, uninvolved limb, and between-limb symmetry ratio (surgical/uninvolved) were collected.

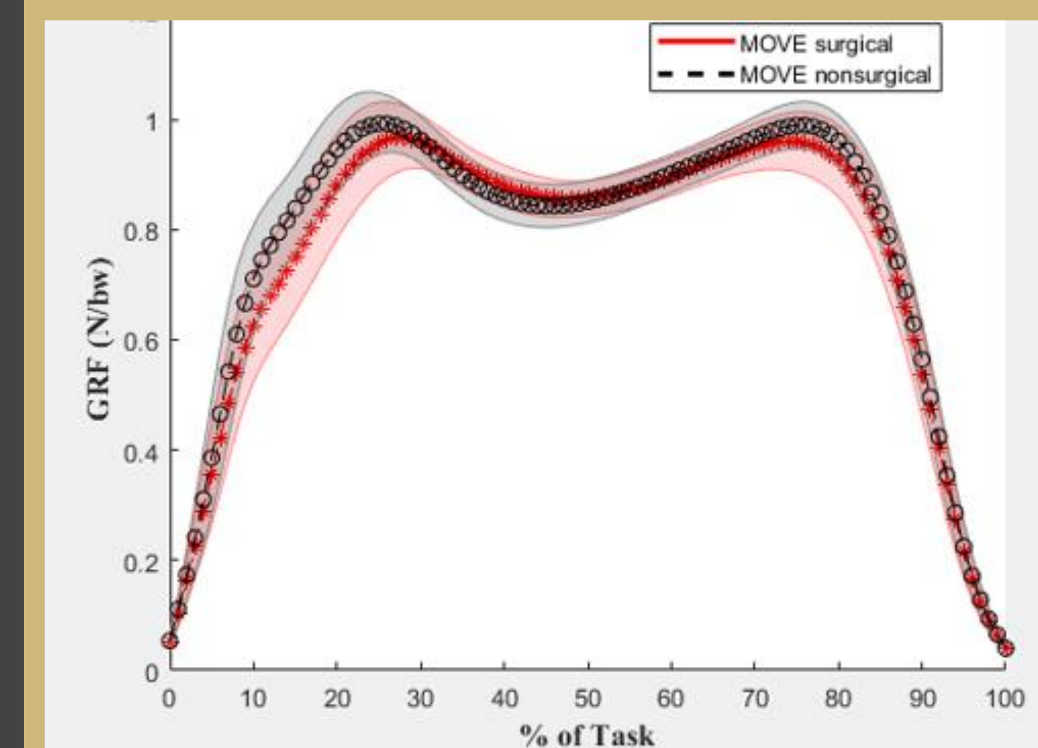


Figure 6: Vertical Ground Reaction Force Curve Over 0-100% of the Gait Cycle

RESULTS

Symmetry ratios and uninvolved-limb vGRF were not different between clinic and laboratory-based assessments (p>0.05) but were different for surgical limb vGRF, impulse and loading rate (p<0.05) and uninvolved limb impulse and loading rate (p<0.05).

CLINICAL RELEVANCE

Clinic-based symmetry ratios demonstrated greater accuracy than individual limb measurements of vGRF, impulse, and loading rate with laboratory-based measurements of walking 10-weeks after TKA. This may be due to ratios having the advantage of correcting for systematic differences in magnitude (e.g. insoles forces being lower on both surgical and uninvolved limbs).