HSS

ISAKOS CONGRESS 2023

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Novel Arthrometer Provides Quantitative And Objective Measures Of Uniplanar And Multiplanar Knee Laxity

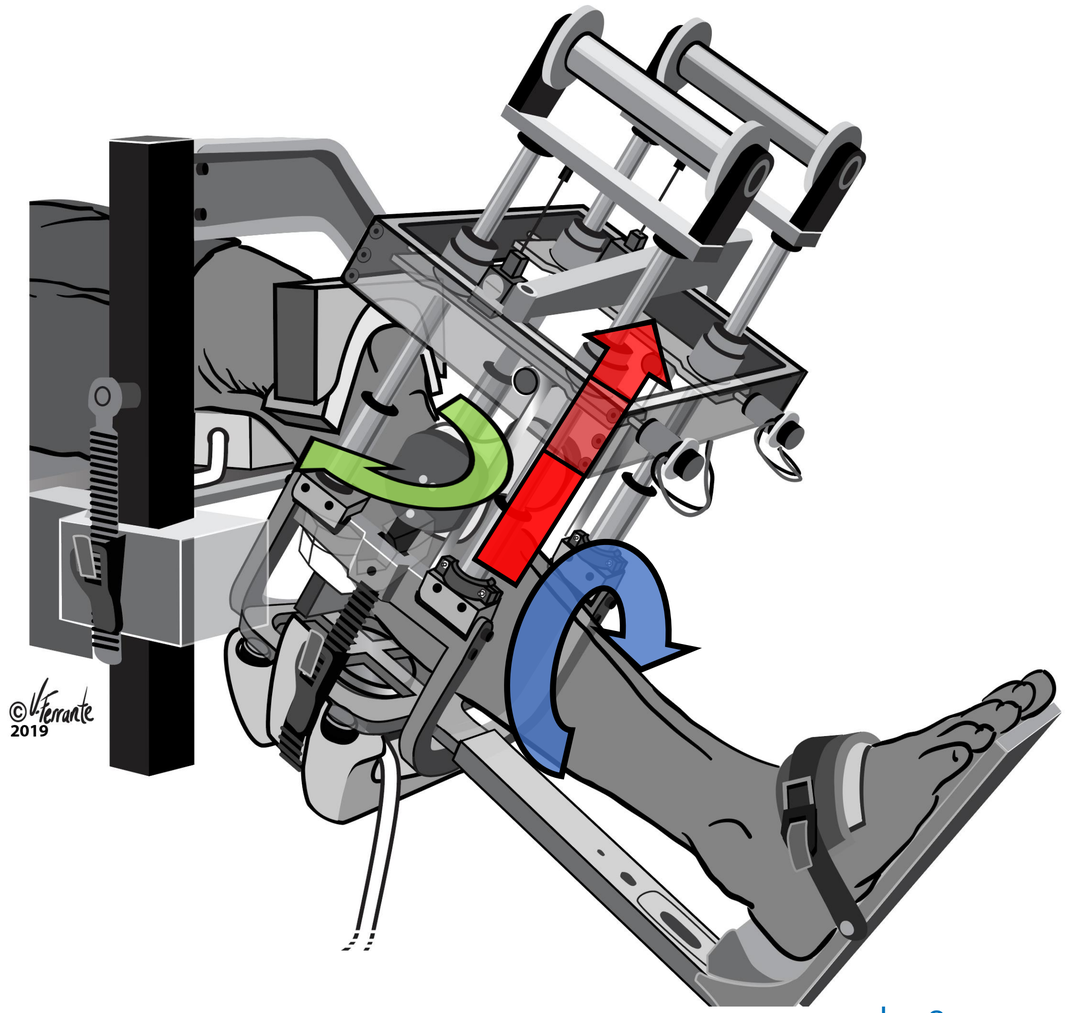
Erin Berube, Akinola Oladimeji, David Shamritsky, Deborah Jones, Michael Parides, Danyal Nawabi, Andrew Pearle, Thomas Wickiewicz, Carl Imhauser

Disclosures

- A. Pearle — *Exactech, Smith & Nephew, Stryker, Zimmer Biomet, Arthrex, Engage Surgical, Knee Guardian, PerfectFit, Therma1*
- D. Nawabi — *Arthrex, Gotham Surgical Solutions, Stryker, BetterPT, Engage Uni*
- T. Wickiewicz — *Stryker*

Introduction

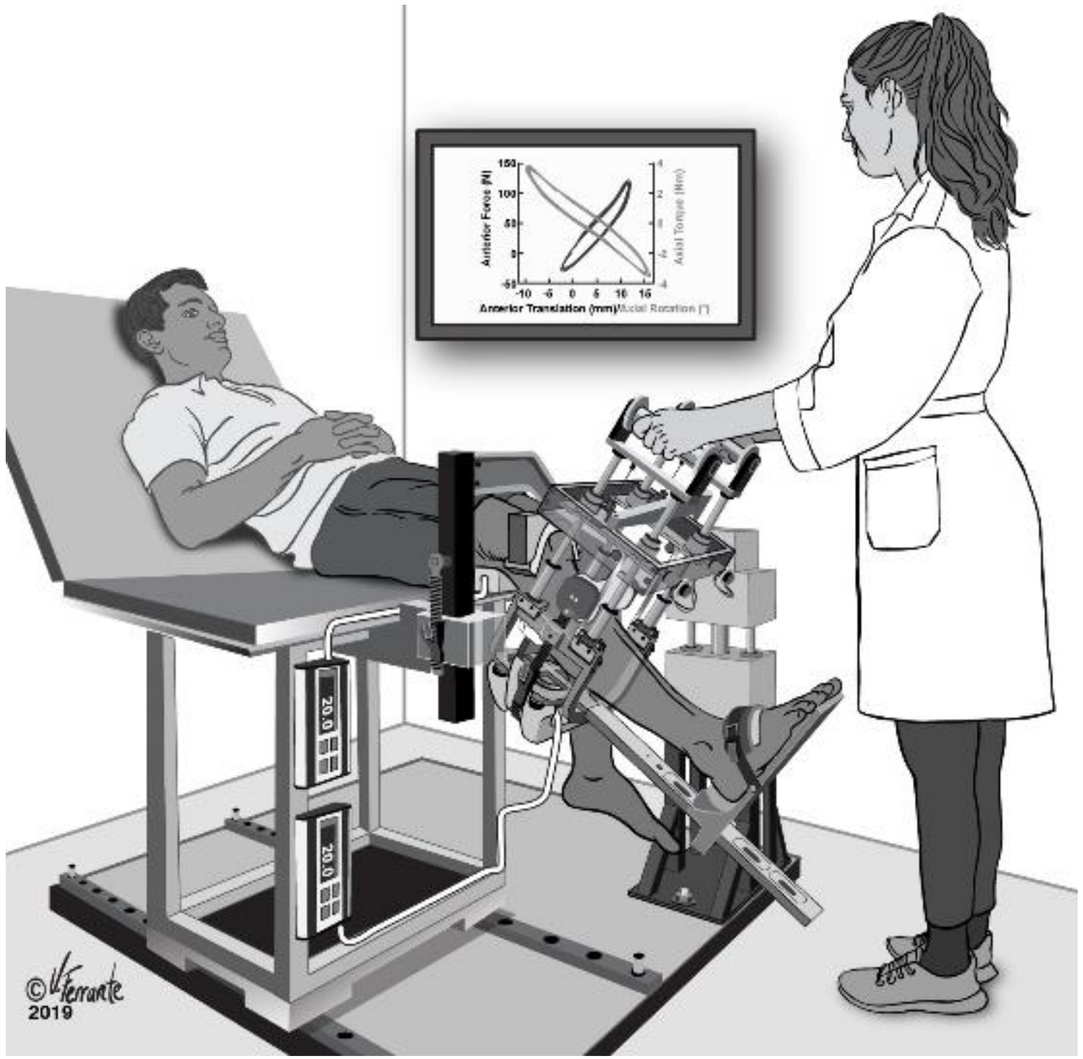
- Excessive knee laxity in one or multiple planes is related to increased risk of graft rupture following ACL reconstruction[1]
- Limited tools exist to quantify knee laxity in multiple planes
- We designed and developed a novel arthrometer to assess knee laxity in multiple planes

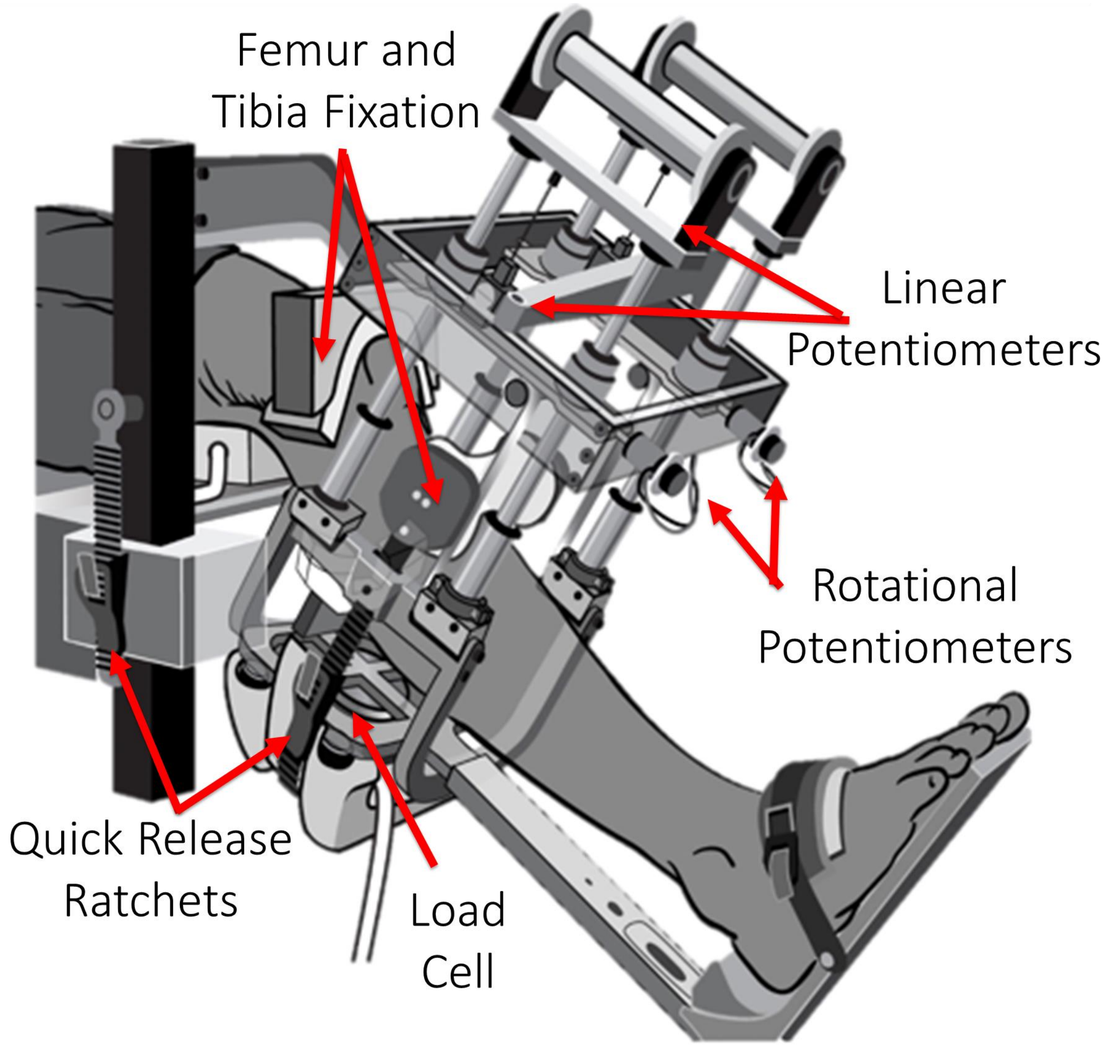


Objectives

1) To assess our instrument's safety, test time, and reliability
2) To quantify left-right symmetry in both uniplanar and multiplanar assessments of knee laxity

Methods – Device Overview





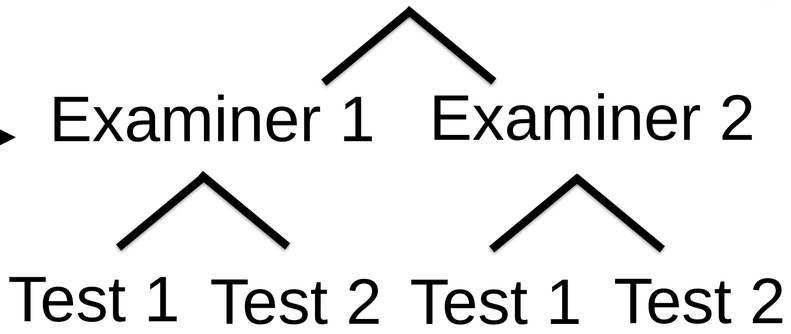
Methods – Reliability Study Design

Subjects

- N = 15
- 7 female, 8 male
- 28 ± 6 years
- BMI: 22.8 ± 3.0

Reliability Assessment

Each Knee from Each Subject

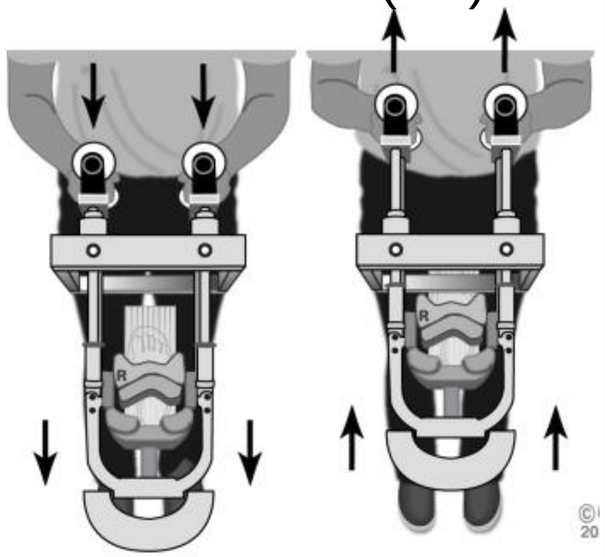


Laxity Measures

- AP Translation (mm)
- IE Rotation (°)
- VV Rotation (°)
- Pivot Shift (mm)

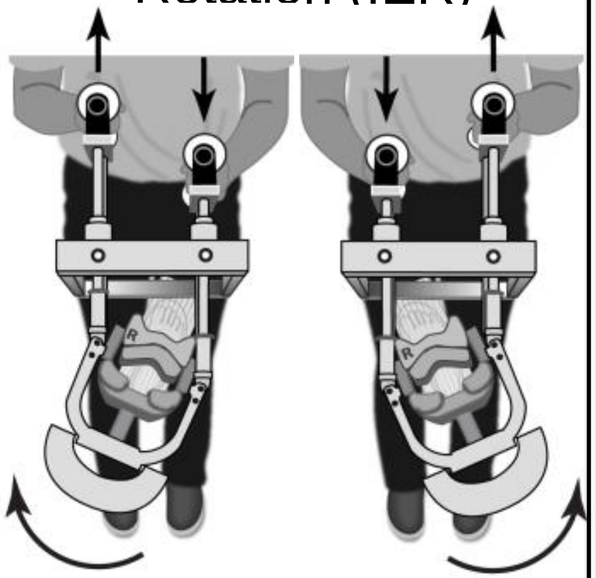
Methods – Device Operation

4x Anterior/Posterior Translation (AP)



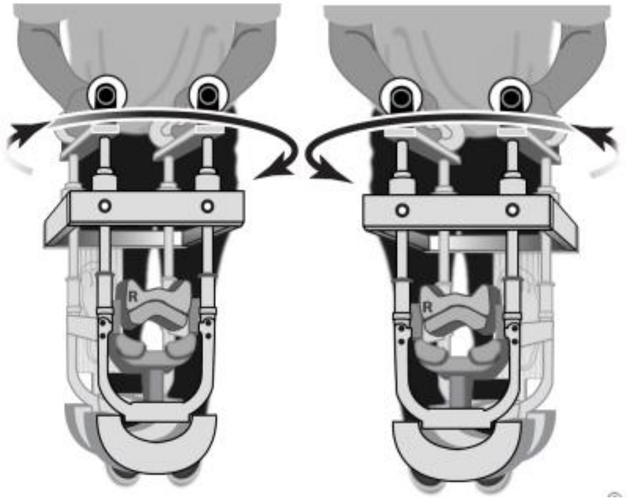
50 Posterior to 135 N Anterior Force

4x Internal/External Rotation (IER)



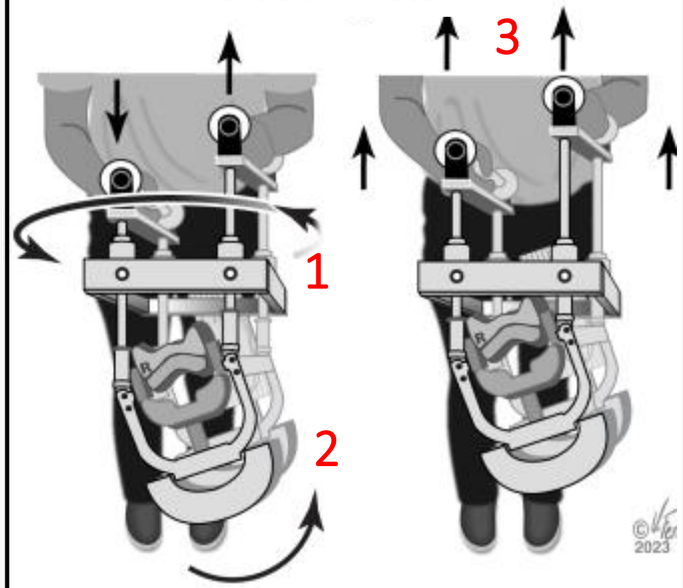
±2.5 Nm IER Torque

4x Varus/Valgus Rotation (VV)



±4 Nm VV Torque

4x Simulated Pivot Shift



1. 6 Nm Valgus
2. + 2 Nm Internal
3. + 50 N Anterior

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Outcome Measures and Statistical Analysis

1. Safety and Test Time

- **Safety** assessed via visual analog pain scale from 0 (No Pain) to 10 (Agonizing Pain)
- **Time** assessed via stop watch

2. Reliability of Laxity Measures

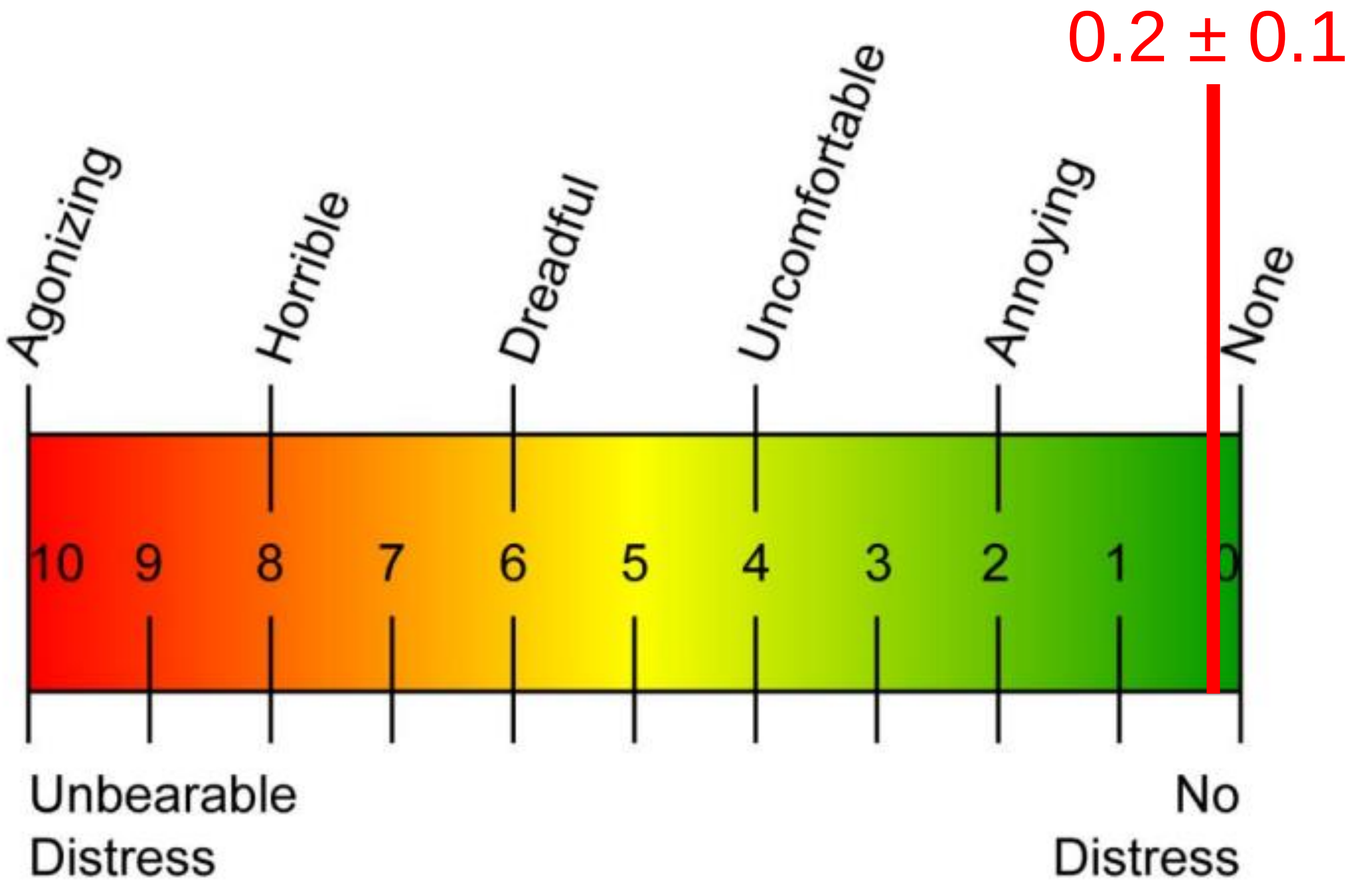
Intraclass Correlation Coefficient (ICC) and 95% Confidence Interval (CI)

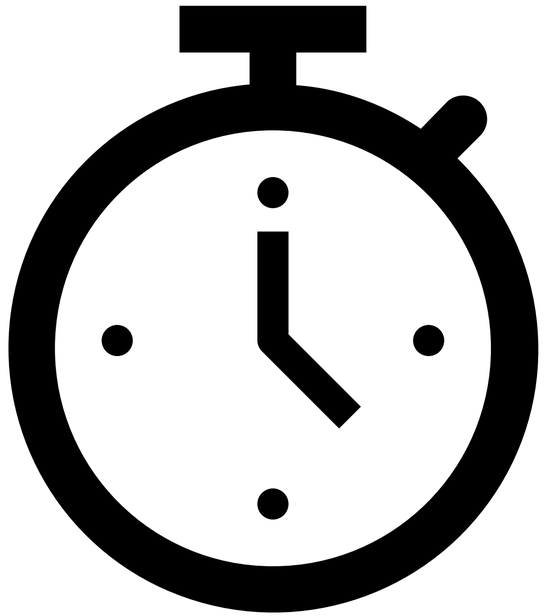
1. Intra-Test:
   - Reliability of four cycles in each test
2. Intra-Examiner:
   - Examiner 1: Test 1 vs. Test 2
   - Examiner 2: Test 1 vs. Test 2
3. Inter-Examiner:
   - Examiner 1 Test 1 vs. Examiner 2 Test 1

3. Left-Right Symmetry

- Difference in displacements of left and right (L-R) knees
- Expressed as mean and standard deviation for each motion
- Symmetry analyzed via K-S Tests of Normality and Skewness Tests (α=0.05)

Results – Safety and Test Time





8 ± 3 Minutes

Results – Reliability of Laxity Measures

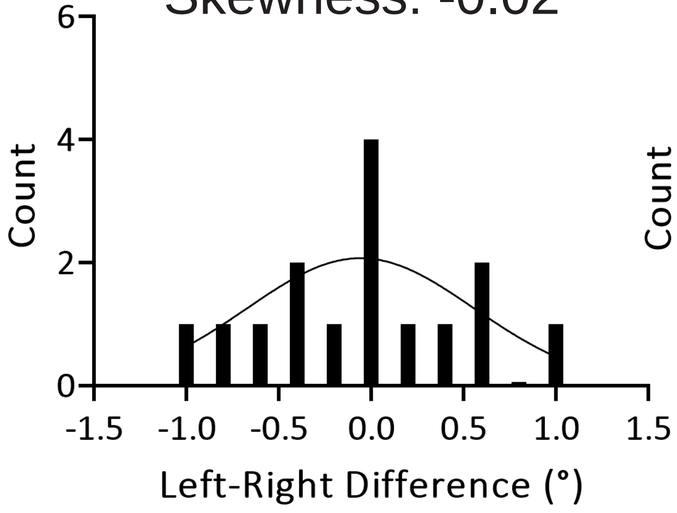
	Examiner	ICC [-CI, +CI]		
		Intra-Test	Intra-Examiner	Inter-Examiner
AP	1	0.94 [0.92, 0.96]	0.70 [0.45, 0.85]	0.63 [0.28, 0.80]
	2		0.66 [0.40, 0.82]	
IER	1	0.96 [0.95, 0.97]	0.89 [0.78, 0.95]	0.62 [0.35, 0.80]
	2		0.76 [0.55,0.88]	
VV	1	0.92 [0.89, 0.94]	0.92 [0.84, 0.96]	0.74 [0.42, 0.88]
	2		0.74 [0.52, 0.87]	
Pivot Shift	1	0.95 [0.93, 0.98]	0.75 [0.51, 0.88]	0.55 [0.24, 0.76]
	2		0.56 [0.24, 0.76]	

Key[2]
Excellent
Good
Fair

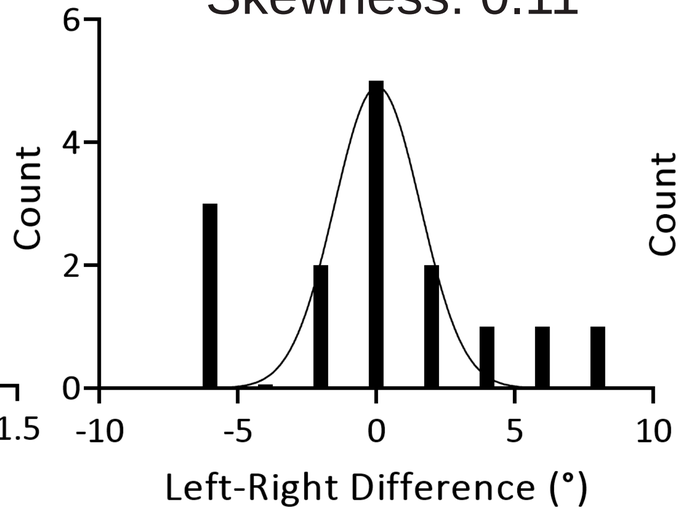
Results – Left-Right Symmetry

- L-R differences were normally distributed
- Skewness ranged from -0.02 to 1.3

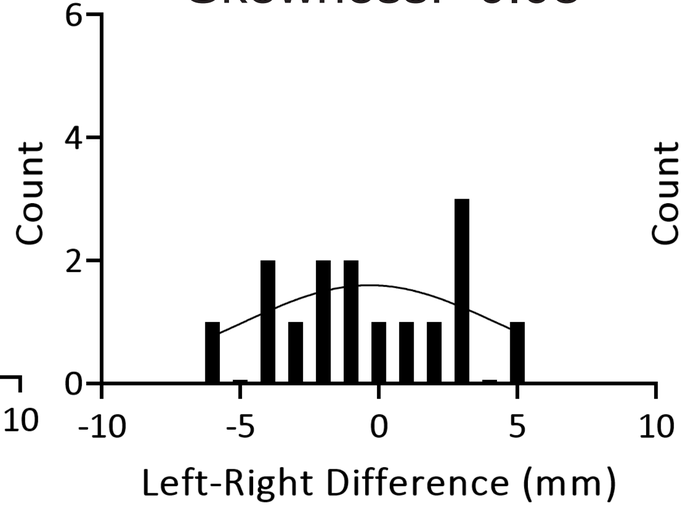
VV
Mean: 0.0 ± 0.5
Normality: p >0.1
Skewness: -0.02



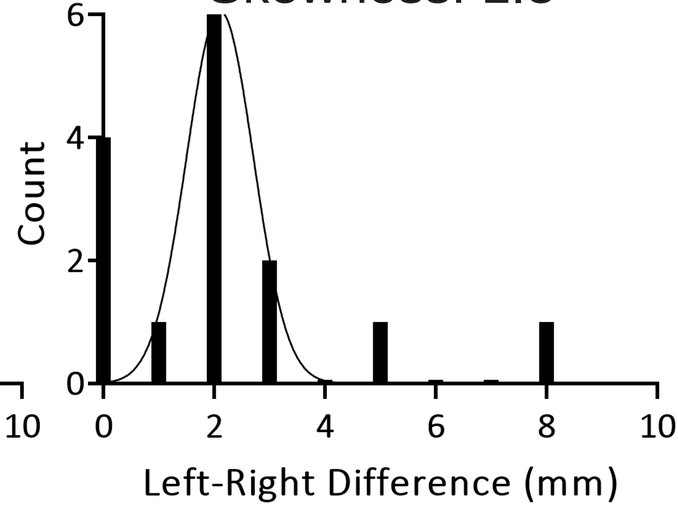
IER
Mean: 0.1 ± 4.1
Normality: p >0.1
Skewness: 0.11



AP
Mean: 0.4 ± 3.0
Normality: p >0.1
Skewness: -0.08

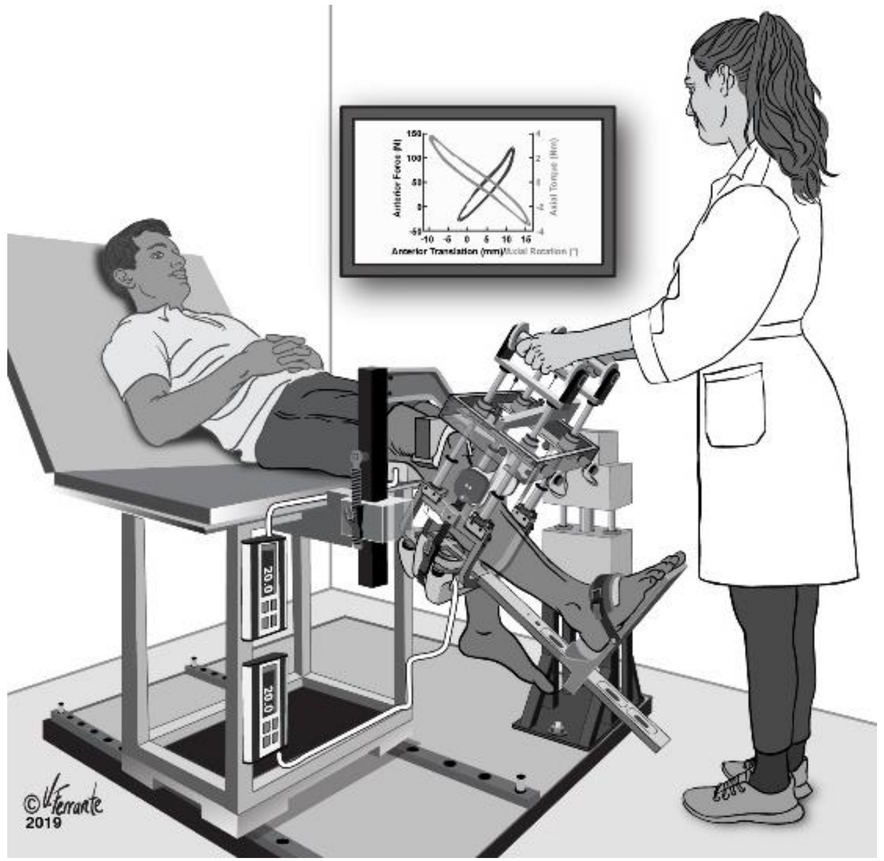


Pivot Shift
Mean: 2.2 ± 2.0
Normality: p >0.1
Skewness: 1.3



Discussion & Conclusions

- We have developed a multiplanar arthrometer that is safe, efficient, and demonstrates fair to excellent reliability
- Healthy subjects demonstrated L-R symmetry
- The magnitude and directionality of asymmetry may indicate severity and type of unilateral knee injury



References and Acknowledgements

References

1. Magnussen 2016 Am J Sports Med
2. Cicchetti 1994 Psychol Assess

Acknowledgements

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- Kirby Foundation
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