THE TEST-RETEST RELIABILITY OF A LOW-COST, PORTABLE TENSION DYNAMOMETER

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BACKGROUND

In recent years, researchers have focused on finding strategies to prevent injury and re-injury in younger populations, identifying muscle strength as a significant risk factor for lower extremity injuries.[1] Specifically, evidence has suggested that increasing knee flexor strength reduces the risk for hamstring strain[2] and quadriceps strength is an important measurement for injury risk after anterior cruciate ligament injury.[3] The properties of muscle strength are primarily measured with dynamometers. Previous studies have investigated the reliability and validity of several types of dynamometers; however, these devices are costly ($1,000-50,000), which has presented an accessibility barrier for clinicians.[3,4,5] The Progressor 150 by Tindeq is a recently released tension dynamometer with a low cost ($150) and high portability (phone-sized). Overall, little research has been done concerning the reliability of this device. We aim to study the reliability of the Progressor 150. This will help inform clinicians how to implement this device in practice and understand its' psychometric properties.

PURPOSE

To determine test-retest reliability for Tindeq Progressor 150 of thigh muscle strength among healthy individuals.

METHODS

Participants

- 30 healthy individuals (18 females and 12 males; ages: 18-40; dominant limb: 28 right) reported to the lab for two visits, one week apart.

Device

- Progressor 150 (Tindeq, Norway)
- Tension dynamometer
- Sampling frequency: 80 Hz

Figure 1. Progressor 150 by Tindeq.

Study Procedure

- Mass (76.8kg), height (1.7m), and limb length (from lateral epicondyle to center of ankle strap) were measured
- Participants were tested for 3 trials (in addition to 1-3 practice trials)
- Average peak torque (highest peak of all 3 trials and averaged)
- Average RTD peak (the highest instantaneous slope)
- Average RTD 2080 (the slope of the 20% to 80% peak torque interval)

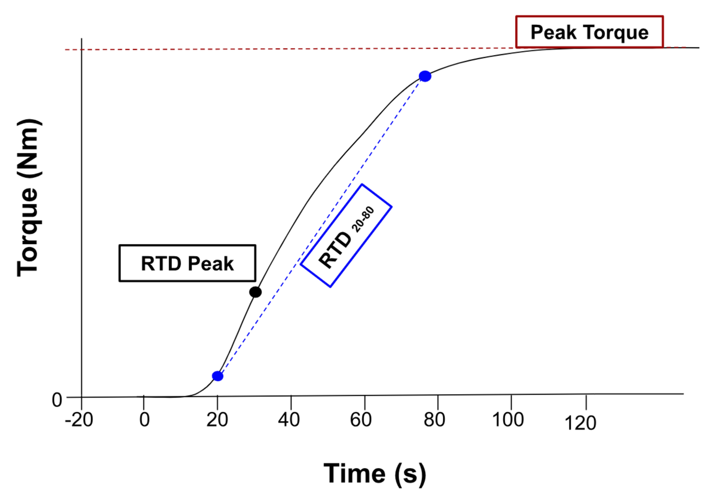

Figure 2. Torque time curve example with variables of interest. Rate of torque development (RTD) measured in Nm/s.

Device Set-Up

- Measurements were performed in an adjustable chair with positioning standardized using torso, waist, and thigh restraints to minimize change of knee angle.
- Progressor 150 was placed perpendicular and anchored to an ankle strap placed superior to the lateral malleolus.
- Tests began when individuals maintained a 90-degree knee angle. 3 trials were completed with 30 seconds of rest in between.

Figure 3. Progressor 150 anchored to Humac with ankle strap.

Statistical Analysis

- Two-way random effects model with a single rater (ICC 2,1).
- ICC interpretations: 0.5 and 0.75 indicated moderate, 0.75 and 0.9 indicated good, and greater than 0.9 indicated excellent reliability.[6]

RESULTS

Table 1. Descriptive Statistics for Knee Extension of the Dominant side

	Tindeq Visit 1		Tindeq Visit 2	
	Mean	SD	Mean	SD
Peak Torque (Nm)	159.83	± 58.10	159.44	± 64.90
RTD 2080 (Nm/s)	566.80	± 280.85	567.62	± 288.15
Peak RTD (Nm/s)	1220.71	± 615.71	1171.10	± 607.69

Notes: Kilogram, kg; Newton-meter, Nm; Newton-meter per second, Nm/s; rate of torque development, RTD.

Table 2. Descriptive Statistics for Knee Flexion of the Dominant side

	Tindeq Visit 1		Tindeq Visit 2	
	Mean	SD	Mean	SD
Peak Torque (Nm)	71.29	± 21.57	79.46	± 28.71
RTD 2080 (Nm/s)	368.67	± 220.74	335.60	± 202.07
Peak RTD (Nm/s)	694.37	± 373.11	652.85	± 328.05

Notes: Kilogram, kg; Newton-meter, Nm; Newton-meter per second, Nm/s; rate of torque development, RTD.

Table 3. Intraclass Correlation for Test-Retest Reliability

		ICC [95% CI]		
		Peak Torque (Nm)	Peak RTD (Nm/s)	RTD 2080 (Nm/s)
Extension	dom	**0.944** [0.878,0.975]	**0.836** [0.666,0.924]	**0.752** [0.518,0.882]
	non	**0.913** [0.808,0.962]	**0.844** [0.672,0.931]	**0.746** [0.495,0.883]
Flexion	dom	**0.818** [0.546,0.924]	**0.787** [0.577,0.899]	**0.695** [0.425,0.853]
	non	**0.898** [0.778,0.955]	**0.828** [0.642,0.923]	**0.676** [0.380,0.848]

Notes: dominant leg, dom; non-dominant leg, non; rate of torque development, RTD.

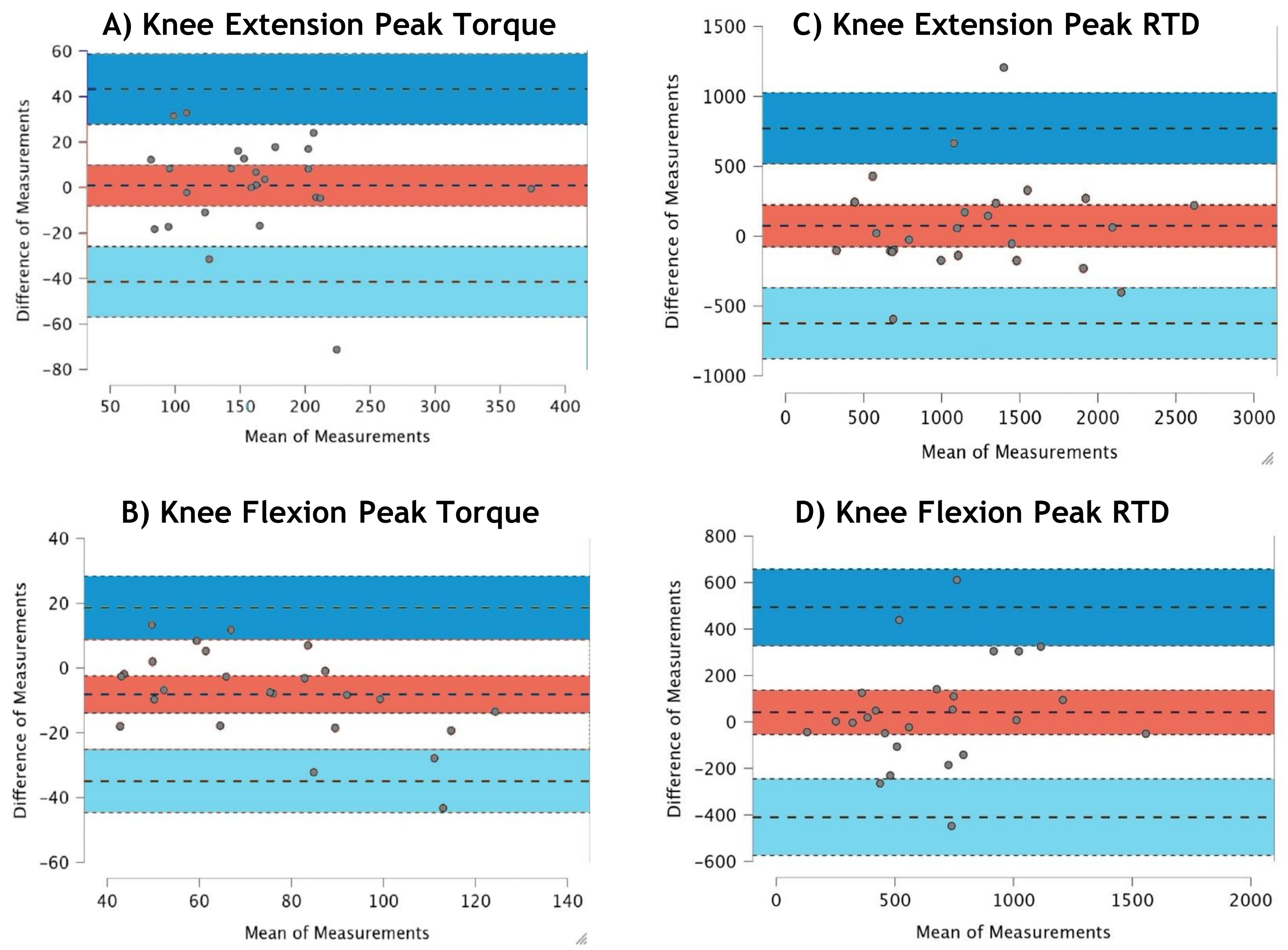

Figure 4A-D. Bland Altman Plots with limits of agreement. Notes: Units are in Nm (torque) and Nm/s (RTD). The red-shaded region indicates the average differences between visits. All measurements had average differences near zero, indicating minimal bias between visits. The blue-shaded regions indicate the upper and lower limits of agreement. These regions provide insight into the observed measurement error of the device across visits. Peak RTD demonstrated very large ranges for their limits of agreement compared to tighter intervals observed in the peak torque measures.

DISCUSSION

Prior evidence has suggested that the risk of injury increases when there exists an imbalance in muscle strength.[4,7,8] It has become important to prioritize testing of muscle strength to better facilitate prevention and rehabilitation strategies. However, many clinicians have limited access to high-end isokinetic dynamometers that are bulky and can cost upwards of $50,000. Previous research has indicated that tension dynamometry is a reliable method when measuring isometric muscle strength.[4,7] Recently, the Progressor dynamometer demonstrated high reliability and agreement when assessed in a mechanical testing device.[9] We expanded this work by testing the reliability of the Progressor device in healthy athletes. This step is important to dissolve the barriers and increase the accessibility of these novel dynamometers.

Our results reinforce that the Progressor, a portable and low-cost dynamometer, is reliable for measuring lower extremity torques. All results indicated good to excellent reliability for both knee flexion and extension with the exception of knee flexion RTD 2080 being of moderate reliability. Peak torque was found to have the strongest reliability in both knee flexion and extension.

Future Directions:

We encourage future studies to perform the same study on injured populations and test whether clinical improvement can be documented with this device.

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