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Comparative Analysis of Low-Cost Alternatives for the Assessment of Muscle Strength

Introduction: Dynamometers are used to assess the force properties of muscles.

Electromechanical dynamometers (ED) are widely accepted as the gold standard method for measurement, yet their accessibility is limited as they are cost-prohibitive and lacking in portability. Tension (TD) and hand-held dynamometers (HHD) have been manufactured as potential low-cost and portable alternatives. The purpose of this study was to investigate the validity of a novel TD and HHD by comparing their measurements to the gold standard.

Methods: Isometric knee extension and flexion testing were performed at 90° of knee flexion in 30 healthy participants. Three maximal trials were recorded per device (ED, TD, and HHD). Trials were performed in a standardized setup using the ED's adjustable chair with additional stabilization straps to the torso, thigh, and waist. Validity was assessed using intraclass correlation coefficients (ICC) and Bland-Altman plots.

Results: For the TD, agreement was high (ICC = 0.80-0.84) for peak torque and rate of torque development (RTD) 20-80%. For knee flexion, agreement was good for peak torque (ICC = 0.8-0.88). Bland-Altman analysis for HHD knee extension demonstrated a -50Nm systematic bias. In contrast, knee flexion demonstrated minimal systematic bias. ICCs were 0.281 and 0.81 for VALD knee extension and flexion, respectively.

Conclusion: The tension dynamometer was a valid device for measuring peak torque and rate of torque development. The hand-held dynamometer was a valid device for measuring peak torque and rate of torque development for flexion only.