

VALIDITY OF HAND-HELD DYNAMOMETRY IN MEASURING QUADRICEPS STRENGTH AND RATE OF TORQUE DEVELOPMENT

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ABSTRACT

Background: A hand-held dynamometer (HHD) offers a reliable and valid method to quantify quadriceps strength in a clinical environment. While measures of peak strength provide functional insights, most daily activities are performed quickly and do not require maximum strength. Rate of torque development (RTD) measures better reflect both the demands of daily activity and athletic movements. The capacity to obtain RTD measures in clinical settings is possible with an HHD, but the validity of RTD measures has not been quantified.

Hypothesis/Purpose: To determine the validity of an HHD to measure quadriceps isometric strength metrics compared to isometric strength measures obtained on an isokinetic dynamometer. It was hypothesized that the HHD would be a valid measure of peak torque and RTD at all time intervals when compared to the isokinetic dynamometer.

Study Design: Descriptive laboratory study.

Methods: Twenty healthy participants (12 male, 8 female) (age = 23.7 ± 2.9 years, height = 174.6 ± 10.1 cm, mass = 76.4 ± 15.9 kg, and Tegner = 6.7 ± 1.2) performed maximum isometric quadriceps contractions on an isokinetic dynamometer and with an HHD. Outcome measures included quadriceps peak torque and RTD at three intervals (0-100, 0-250 ms, and average). Pearson product-moment correlation coefficients and Spearman's rank correlation coefficient were used to determine relationships between devices. Bland-Altman Plots with Limits of Agreement (LOA) calculations were used to quantify systematic bias between measurement techniques.

Results: There was a significant correlation between the isokinetic dynamometer and the HHD for peak torque ($p < .001$, $r = .894$) and all RTD measurements ($p < .002$, $r = .807$; $\rho = .502-.604$). Bland-Altman plot LOA indicated the HHD overestimated peak torque values (19.4 ± 53.2 Nm) and underestimated all RTD measurements (-55.2 ± 190.7 Nm/s to -265.2 ± 402.6 Nm/s).

Conclusion: These results show it is possible to obtain valid measures of quadriceps peak torque and late RTD using an HHD. Measures of early RTD and RTDAvg obtained with an HHD were more variable and should be viewed with caution.

Level of Evidence: Diagnostic, Level 3

Key Words: dynamometry; explosive strength; lower limb; knee extension

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