New aspects of exercise testing on dynamometer

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Introduction:
• Isokinetic tests are a common method to quantify strength capacity.
• In high speed movements, substantial limitations (validity) are still present.
• Effect of gravity and the moment of inertia are influencing factors.

Purpose: To investigate the effect of compensating the moment of inertia (I_{comp}) on the realized speed in single and multijoint movements at different speeds compared to no compensation of the moment of inertia (I_{no_comp}).

Methods:
Subjects
• N=25 healthy subjects (age: 27 ± 4.4 years; N=11/14 ♂/♀)
• Activity level ranged between no exercise up to daily exercise.

Material
• Rotational and linear dynamometers (Con-trex® MJ/LP/TP/WS CMV AG).

Protocol
• 10 min. warm-up run on a treadmill.
• Strength test with maximum effort.
• 5 repetitions each test; 60 seconds break between tests.
• Measurement type: Isokinetic concentric.
• Modus: I_{comp} vs. I_{no_comp} in randomized order.
• Test progression randomized.
• Movements (Fig. 1):
  1. Single joint knee extension and flexion (K) (60, 180 and 360°/s).
  2. Lower limb extension and flexion (L) (0.3, 0.6 and 0.9 m/s).
  3. Trunk extension and flexion (T) (60 and 120°/s).
  4. Complex shoulder/arm extension (S) (60, 180 and 360°/s) (Fig. 1).

Outcome measure: Realized maximum velocity.
Statistics: Descriptive (mean and 95% confidence interval).

Results:
• Effect of I_{comp} mode (compensation of inertia) depends on the movement and on the measurement speed.
  • Knee (Tab. 1): No differences between modi.
  • Lower limb (Tab. 1): No differences in extension.
  • Higher velocities reached in flexion (I_{comp} mode).
  • Trunk (Fig. 2): All subjects reach preset speed at 120°/s with I_{comp} mode but not with I_{no_comp} mode.
  • Shoulder/arm (Tab. 1): Higher velocities in extension (diff. up to 170°/s) (I_{comp} mode).
  • Preset speed not reached by all subjects in all movements due to ROM (range of motion) (independent of modi).

Discussion:
• Validity of isokinetic tests with high velocities is enhanced (I_{comp} mode).
• Limits, due to the ROM, are still present.

Conclusion:
• I_{comp} measurement mode is highly relevant for high speed tests with large body segments involved.
• Patients with lower strength levels will probably benefit already at low test speeds and tests with small inertia (e.g. knee).

References:
• Chow 1997; Mayer 2001.