New aspects of exercise testing on dynamometer

S. Müller¹, H. Baur¹, P. Mayer¹, J. Väth², F. Mayer³

¹Institute of Sports Medicine and Prevention, University of Potsdam, Germany
²Medical Clinic, Department of Rehabilitative and Preventive Sports Medicine, University of Freiburg, Germany

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/JP/TP/W5 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
• Modi: 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/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
  • 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:

Table 1: Realized maximum velocity in knee, lower limb and shoulder/arm flexion/extension at preset speed [°/s; m/s]

<table>
<thead>
<tr>
<th>joint/movement</th>
<th>preset speed</th>
<th>Extension</th>
<th>Flexion</th>
</tr>
</thead>
<tbody>
<tr>
<td>knee 60 [°/s]</td>
<td>60.9</td>
<td>60.9</td>
<td>60.8</td>
</tr>
<tr>
<td>knee 180 [°/s]</td>
<td>181.1</td>
<td>181.0</td>
<td>181.3</td>
</tr>
<tr>
<td>knee 360 [°/s]</td>
<td>349.9</td>
<td>350.0</td>
<td>347.1</td>
</tr>
<tr>
<td>lower limb 0.3 [m/s]</td>
<td>0.305</td>
<td>0.301</td>
<td>0.300</td>
</tr>
<tr>
<td>lower limb 0.6 [m/s]</td>
<td>0.592</td>
<td>0.593</td>
<td>0.421</td>
</tr>
<tr>
<td>lower limb 0.9 [m/s]</td>
<td>0.670</td>
<td>0.678</td>
<td>0.420</td>
</tr>
<tr>
<td>trunk 60 [°/s]</td>
<td>60.5</td>
<td>60.6</td>
<td>60.5</td>
</tr>
<tr>
<td>trunk 120 [°/s]</td>
<td>116.1</td>
<td>120.5</td>
<td>98.5</td>
</tr>
<tr>
<td>shoulder/arm 60 [°/s]</td>
<td>61.5</td>
<td>61.4</td>
<td></td>
</tr>
<tr>
<td>shoulder/arm 180 [°/s]</td>
<td>136.1</td>
<td>182.5</td>
<td></td>
</tr>
<tr>
<td>shoulder/arm 360 [°/s]</td>
<td>360.0</td>
<td>360.5</td>
<td></td>
</tr>
</tbody>
</table>

Author’s address: Steffen Müller; Institute of Sports Medicine and Prevention, University of Potsdam, Am Neuen Palais – Haus 12, D-14469 Potsdam, Germany, Tel.: (+49) 331-977-1127; Fax (+49) 331-977-1296
E-mail: stefmue@uni-potsdam.de