COMPARISON OF ISOKINETIC AND JUMPING KNEE TORQUES

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Abstract

INTRODUCTION: Isokinetic movements occur at a fixed angular velocity, regardless of torque applied by the subject. Isokinetic testing has been associated with GMH tests and clinical predictions such as recovery from surgery. Peak torque is a great angular velocity in the near-maximal torque measure. Although isokinetic tests are associated with GMH tests such as the vertical jump, there is little research comparing the same variables. Three-dimensional motion analysis systems can accurately model a subject's movement. Software then models virtual kinematics based on the anatomical markers captured by the camera system. The virtual construction of the subject provides forces and kinematics data at the joints and segments. This system can linearly measure peak torques during various movements and provide useful information. While clinicians have demonstrated isokinetic testing for the lower extremity, little research has been done on incorporating it into upper extremity training.

METHODS: Five male students (age: 23.4 ± 0.89 years, height: 179.2 ± 6.4 cm, weight: 78.05 ± 10.29 kg) from the University of Texas at Arlington (UTA) Kinesiology Department volunteered for the study. Each subject was body prepared for the BioDex isokinetic system. Infrared markers were placed on anatomical landmarks and 4 clusters were attached to the lateral thighs and shanks according to the UTA Lower Body Model and calibrated for the Vicon 3D tracking system. The subjects were then fitted and trained on the BioDex System 3 3-d dynamometer, with a maximal isometric extension to set the minimum torque needed for the isokinetic test. The isokinetic test began with the knee extended. The machine forced the knee into flexion as the subjects resisted in a maximal eccentric contraction. Upon reaching the end of flexion range of motion, the subjects forcefully extended the knee in a maximal concentric contraction. Angular velocity was maintained by the dynamometer. Subjects were allowed to practice before the trials began. Three recorded trials were performed at 150 degrees per second and 75 degrees per second. Peak torque was recorded during both the flexion (eccentric) phase and the extension (concentric) phase. A repeated measures ANOVA was performed to compare the three conditions. There was a significant difference between the means in the eccentric phase (F(2,8)=61.63, p = .000) as well as the concentric phase (F(2,8)=27.62, p=.000). Sidak post hoc analysis indicated that the torques in the jump were significantly different than in the isokinetic tests.

Results (cont’d)

The subjects were then fitted and trained on the BioDex System 3 3-d dynamometer, with a maximal isometric extension to set the minimum torque needed for the isokinetic test. The isokinetic test began with the knee right extended. The machine forced the knee into flexion as the subjects resisted in a maximal eccentric contraction. Upon reaching the end of flexion range of motion, the subjects forcefully extended the knee in a maximal concentric contraction. Angular velocity was maintained by the dynamometer. Subjects were allowed to practice before the trials began. Three recorded trials were performed at 150 degrees per second and 75 degrees per second. Peak torque was recorded during both the flexion (eccentric) phase and the extension (concentric) phase.

Methods (cont’d)

The purpose of this study was to compare the torques in the knee produced during vertical jump and those in an isometric movement designed to mimic the jumping motion.

Methods

Five students from the University of Texas at Arlington Kinesiology department volunteered to participate in the study. Subjects were physically active males with no illnesses and no history of or current knee injuries. Subjects were 23.4 ± 0.89 years old, 179.2 ± 6.4 cm in height, and 78.05 ± 10.29 kg in weight.

Each subject was first prepared for the Vicon 3D tracking system. 26 reflective markers were placed on anatomical landmarks and 4 clusters were attached to the lateral thighs and shanks according to the UTA Lower Body Model and calibrated for the Vicon Nexus software. The subjects were then recorded performing 3 maximal countermovement jumps on the force plate. They then performed the isokinetic tests such as the jump test. The peak angular velocities were 212.3 ± 3.309 deg/s in the right knee. During the jump, peak angular velocity were recorded during both the flexion (eccentric) phase and the extension (concentric) phase.

Results

<table>
<thead>
<tr>
<th>Movement Phase</th>
<th>Eccentric</th>
<th>Concentric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Years)</td>
<td>23.4</td>
<td>23.4</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>179.2</td>
<td>179.2</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>78.05</td>
<td>78.05</td>
</tr>
<tr>
<td>Isometric Peak Torque (N·m/kg)</td>
<td>3.309</td>
<td>3.309</td>
</tr>
</tbody>
</table>

Conclusions

A repeated measures ANOVA was performed to compare the three conditions. There was a significant difference between the means in the eccentric phase (F(2,8)=61.63, p = .000) as well as the concentric phase (F(2,8)=27.62, p=.000). Sidak post hoc analysis indicated that the torques in the jump were significantly different than in the isokinetic tests.

The results of this study indicate that torques produced in the knee during both phases of a countermovement jump are significantly less than those produced during isokinetic testing. This could be due to the greater angular velocity and the force/velocity relationship.