Overview

DATA INTERPRETATION AND ANALYSIS

Numerical and Curve Analysis

Ref: Compendium of Isokinetics

George Davies
# Report Parameters

**Overview**

**Report Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>ID:</strong></td>
<td>304236280</td>
</tr>
<tr>
<td><strong>Session:</strong></td>
<td>6/5/2002 9:23:53 AM</td>
</tr>
<tr>
<td><strong>Following:</strong></td>
<td>None</td>
</tr>
<tr>
<td><strong>Protocol:</strong></td>
<td>Isokinetic Bilateral</td>
</tr>
<tr>
<td><strong>Birth Date:</strong></td>
<td>12/88/08 1:12 (MM/AAAA)</td>
</tr>
<tr>
<td><strong>Clinician:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Pattern:</strong></td>
<td>Extension/Flexion</td>
</tr>
<tr>
<td><strong>Referral:</strong></td>
<td>7105</td>
</tr>
<tr>
<td><strong>Joint:</strong></td>
<td>Knee</td>
</tr>
<tr>
<td><strong>Mode:</strong></td>
<td>Isokinetic</td>
</tr>
<tr>
<td><strong>Contraction:</strong></td>
<td>CON/CON</td>
</tr>
<tr>
<td><strong>Diagnosis:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>CON/CON:</strong></td>
<td>29 FT-LBS at 30 Degrees</td>
</tr>
</tbody>
</table>

**EXTENSION 60 DEG/SEC**

<table>
<thead>
<tr>
<th># OF REPS: Right 5</th>
<th>LEFT</th>
<th>RIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Peak Torque</strong></td>
<td>201.5</td>
<td>206.4</td>
</tr>
<tr>
<td><strong>Peak Torq %</strong></td>
<td>91.6</td>
<td>94.6</td>
</tr>
<tr>
<td><strong>Time to PK TG</strong></td>
<td>1120.0</td>
<td>1120.0</td>
</tr>
<tr>
<td><strong>Angle at PK TG</strong></td>
<td>70.0</td>
<td>70.0</td>
</tr>
<tr>
<td><strong>Torq @ 00 DCS</strong></td>
<td>10.7</td>
<td>10.0</td>
</tr>
<tr>
<td><strong>Torq @ 1.0 SEC</strong></td>
<td>10.7</td>
<td>10.0</td>
</tr>
<tr>
<td><strong>Cost of Work %</strong></td>
<td>12.6</td>
<td>13.0</td>
</tr>
<tr>
<td><strong>Max Effort work</strong></td>
<td>216.5</td>
<td>230.5</td>
</tr>
</tbody>
</table>

**FLEXION 60 DEG/SEC**

<table>
<thead>
<tr>
<th># OF REPS: Left 5</th>
<th>LEFT</th>
<th>RIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Peak Torque</strong></td>
<td>95.6</td>
<td>98.4</td>
</tr>
<tr>
<td><strong>Peak Torq %</strong></td>
<td>91.2</td>
<td>94.6</td>
</tr>
<tr>
<td><strong>Time to PK TG</strong></td>
<td>1120.0</td>
<td>1120.0</td>
</tr>
<tr>
<td><strong>Angle at PK TG</strong></td>
<td>70.0</td>
<td>70.0</td>
</tr>
<tr>
<td><strong>Torq @ 00 DCS</strong></td>
<td>10.7</td>
<td>10.0</td>
</tr>
<tr>
<td><strong>Torq @ 1.0 SEC</strong></td>
<td>10.7</td>
<td>10.0</td>
</tr>
<tr>
<td><strong>Cost of Work %</strong></td>
<td>12.6</td>
<td>13.0</td>
</tr>
<tr>
<td><strong>Max Effort work</strong></td>
<td>216.5</td>
<td>230.5</td>
</tr>
</tbody>
</table>

**Biodex**

---

**Biodex**
Peak Torque

- Highest muscular force output at any moment during a repetition.
- Similar to a one repetition maximum effort in isokinetics
- Can be compared to:
  - Range of Motion
  - Time
  - Absolute value
- Comparisons can be made to:
  - Baseline and Bilaterally
- Ideally should be \( \leq 10\% \) deficit Uninvolved : Involved

Can be looked at in the following ways.....
Overview

Peak Torque

Typically compared bilaterally or to a base line measure

<table>
<thead>
<tr>
<th>PEAK TORQUE</th>
<th>FT-LBS</th>
<th>201.5</th>
<th>209.4</th>
<th>-3.9</th>
<th>99.4</th>
<th>96.5</th>
<th>2.9</th>
</tr>
</thead>
</table>
Peak Torque: Body Weight

- Represented as a percentage normalized to body weight and compared to an established goal.
Overview

Time to Peak Torque

- Measures time from start of the muscular contraction to the point of the highest torque development
- An indicator of the muscle’s functional ability to produce torque quickly

<table>
<thead>
<tr>
<th>TIME TO PK TQ</th>
<th>USEC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1190.0</td>
</tr>
</tbody>
</table>
Angle of Peak Torque

- Point in the ROM where the peak torque is produced
- Usually occurs at the same point in the ROM for similar movements and speeds, typically in the mid range
TORQUE AT 30°

- Displays torque produced at specific angle in ROM
- 30° is a critical point in knee stabilization
- May be re-set in the Software to evaluate other needs

<table>
<thead>
<tr>
<th>TORQ @ 30.0 DEG</th>
<th>FT-LEBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>79.5</td>
<td>87.9</td>
</tr>
</tbody>
</table>
Torque at .20 Seconds

- Displays TRTD
- This value represents the amount of tension developed at this time.
- Has been documented that upon heel strike it takes the leg extensors .2sec to develop enough force to support the body in normal ambulation
- Wilk determined that by this time 80-90% of peak torque should be achieved with knee extension
- May be reset in the Software
Overview

Coefficient of Variance

- Determines the reproducibility of the test based on the amount of variation between repetitions
- Large Coefficient of Variance could be related to underlying factors such as: pain, apprehension, lack of instruction, or lack of effort
- Large muscle groups: ≤ 15%
- Small muscle groups: ≤ 20%

| COEFF. OF VAR. | % | 12.5 | 13.9 | 2.5 | 19.3 |
Max Rep Total Work

- Total muscular force output for the repetition with the greatest amount of work.
- Work is indicative of a muscles capacity to produce force throughout the range of motion
- Should occur during the beginning of the test session
Max Work Rep #

- Indication of which repetition in the set where the most work was performed
- Can determine if max work was accomplished at start or end of test/exercise bout
Work: Body Weight Ratio

- Ratio displayed as a percentage of the maximum work rep to the subject’s body weight

| WORK/ BODYWEIGHT | % | 99.3 | 103.9 | 51.4 | 55.9 |

Work / Body Weight
Total Work

- Amount of work accomplished for the entire set
- Better indicator of the function of a muscle group than peak torque, as torque must be maintain throughout the Range of Motion as opposed to torque at one point in the Range of Motion

| TOTAL WORK | FT-LBS | 932.0 | 900.2 | 3.4 | 527.9 | 417.8 | 20.9 |
Overview

**WORK 1^{ST} 1/3 ..LAST 1/3**

- Sum of work produced in the first 1/3 and last 1/3 of the test bout
- Used to determine work fatigue
- Represents the endurance capabilities of a muscle
Work Fatigue

• Ratio of difference between the first 1/3 and the last 1/3 of work in the test bout
• Valuable in documenting progress during endurance training to detect the amount of fatigue throughout the test bout

<table>
<thead>
<tr>
<th>WORK FIRST THIRD</th>
<th>FT-LEBS</th>
<th>266.0</th>
<th>252.6</th>
<th>182.8</th>
<th>168.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>WORK LAST THIRD</td>
<td>FT-LEBS</td>
<td>337.5</td>
<td>313.9</td>
<td>174.9</td>
<td>115.1</td>
</tr>
<tr>
<td>WORK FATIGUE</td>
<td>%</td>
<td>-26.9</td>
<td>-24.3</td>
<td>4.3</td>
<td>31.8</td>
</tr>
</tbody>
</table>
Averag Power

• Total work divided by time
• Power indicates how quickly a muscle can produce force
• Used to provide a true measure of work rate intensity
• Indicates a muscle group’s ability to perform work over time
• Compared Bilateral or Pre/Post rehab

| Avg. Power | Watts | 114.8 | 108.0 | 5.9 | 71.4 | 53.3 | 25.4 |
Overview

Acceleration Time

- Total time used to reach Isokinetic Speed
- Indicates a muscle’s neuromuscular capabilities to move a limb from at the beginning of the range of motion
Deceleration Time

- Total time to go from isokinetic speed to zero speed
- Indicates a muscle’s neuromuscular capability to eccentrically control the limb at the end of the range of motion
Gravity Effect Torque

- Weight of limb and attachment
- Used to eliminate the additional torque applied to the muscle tested
- G.E.T added to torque when limb working against gravity
- G.E.T subtracted when working with gravity
- Allows standardization between subjects

GET: 29 FT-LBS at 30 Degrees
Curve Analysis

• There is correlation between the shape of the torque curve and the patient’s symptoms. (Davies)

• However, keep in mind that curves should have a consistent variation to them, and you can not base pathology on one curve or curves alone. (Davies)
Curve Analysis

Four Regions of Curve:
  a. Time Rate of Tension Development
  b. Torque Obtainment
  c. Force Decay Rate
  d. Reciprocal Innervation Time

Can correspond to pathomechanics, pain, and effort produced during contraction
Time Rate of Tension Development (TRTD)

- The up slope of the torque curve
- Indicates how quickly torque is developed during a muscle contraction
- Should be within the first 1/3 of the curve
- If prolonged, there is a problem developing force quickly
TRTD is Examined Relative to:

**Peak Torque**
measured from start of muscle contraction to the highest point on the torque curve
TRTD is Examined Relative to:

**Predetermined Torque Value**

Measured from start of the contraction to a predetermined torque along the curve.
TRTD is Examined Relative to:

**Predetermined Time**

Start of contraction to a predetermined time

[Diagram showing torque as a function of time with a peak at .2 seconds]
TRTD is Examined Relative to:

**Specific Point within Range of Motion**

From start of contraction to specific point in range of motion
Force Decay Rate (FDR)

The downward slope of the torques curve
Indicative of neuromuscular control at the end range of motion of a contraction

Concavity may be indicative of poor neuromuscular control, pain, or pathomechanical problem
Agonist / Antagonist Ratio

- The reciprocal muscle group ratio
- Excessive imbalances may predispose a joint to injury
Reciprocal Innervation Time (RIT)

- Time interval between the end of the agonist contraction and the beginning of the antagonist contraction.
Windowed vs. All Data

Removes data below percentage of Isokinetic Speed determined in the software

Percentage can be modified by the User
All vs. Windowed Data
Deficits

- 1 to 10% = no significant difference between extremities
- 11 to 25% = rehabilitation recommended to improve muscle performance balance
Biodex Medical Systems, Inc.
20 Ramsay Road, Shirley, New York, 11967-0702
Tel: 800-224-6339 (In NY Call 631-924-9000), Fax: 631-924-9338
Email: sales@biodex.com, www.biodex.com