Importance of Radar Gun Inclusion During Return-to-Throwing Rehabilitation Following Ulnar Collateral Ligament Reconstruction in Baseball Pitchers: A Simulation Study

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IMPORTANCE OF RADAR GUN INCLUSION DURING RETURN-TO-THROWING REHABILITATION FOLLOWING ULNAR COLLATERAL LIGAMENT RECONSTRUCTION IN BASEBALL PITCHERS: A SIMULATION STUDY

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BACKGROUND

• Ulnar collateral ligament reconstruction rehab protocols instruct pitchers to throw with increasing effort, such that they begin throwing at 50% effort and ultimately advance to maximum effort.

• There is little evidence to suggest whether or not pitchers can adequately control pitch velocity to established guidelines, such as those requiring 50% partial effort or 75% partial effort.

• Some coaches and trainers have recommended using radar guns during rehabilitation in order to gain a more objective and reliable assessment of partial throwing effort.
PURPOSE

• To determine the medial elbow torque associated with pitches at various effort levels.

• To determine if radar gun assistance improves players’ abilities to accurately match partial effort pitches with true references based on maximum pitch velocity.
Methods

- Motus Baseball Sleeve
  - Validated against the gold-standard of high-speed motion analysis
  - Precise
  - Used in several recent biomechanical analysis studies
Step 1: Warm-up Routine
*Stretching, jogging, practice throws*

Step 2: Sequence of Self-Perceived Effort Pitches
*Five throws of 50E, 75E, and 100E pitches*

Step 3: Determining Maximum Velocity
*Average velocity calculated for 100E pitches*

Step 4: Sequence of Velocity-Controlled Pitches
*Five throws that qualify as 50V and 75V pitches, as guided by radar gun measurements*
# Results

<table>
<thead>
<tr>
<th></th>
<th>Mean (SE)</th>
<th>Range (Min - Max)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age, years</strong></td>
<td>16.4 (0.4)</td>
<td>14 - 21</td>
</tr>
<tr>
<td><strong>Height, cm</strong></td>
<td>178 (1.6)</td>
<td>152 - 196</td>
</tr>
<tr>
<td><strong>Weight, kg</strong></td>
<td>72.3 (2.6)</td>
<td>40.8 - 113.4</td>
</tr>
<tr>
<td><strong>BMI, kg/m²</strong></td>
<td>22.6 (0.6)</td>
<td>17.0 - 29.5</td>
</tr>
<tr>
<td><strong>Forearm length, cm</strong></td>
<td>42.8 (0.5)</td>
<td>35.5 - 51.4</td>
</tr>
<tr>
<td><strong>Upper arm length, cm</strong></td>
<td>35.8 (0.4)</td>
<td>30.5 - 40.5</td>
</tr>
<tr>
<td><strong>Total arm length, cm</strong></td>
<td>77.1 (0.7)</td>
<td>67.3 - 88.5</td>
</tr>
<tr>
<td><strong>Elbow joint circumference, cm</strong></td>
<td>26.2 (0.3)</td>
<td>22.4 - 30.1</td>
</tr>
</tbody>
</table>

37 total participants
RESULTS

**Ball Velocity**

- **Graph:** Shows percent of maximum ball velocity (%) against partial effort (%).
- **Data Points:** Representative data for subjective effort pitches and velocity-controlled pitches.

**Elbow Torque**

- **Graph:** Shows percent of maximum elbow torque (%) against partial effort (%).
- **Data Points:** Representative data for subjective effort pitches and velocity-controlled pitches.
# Results

<table>
<thead>
<tr>
<th>Pitch Type</th>
<th>Velocity, mph (Percent of Maximum Velocity)</th>
<th>Torque, Nm (Percent of Maximum Torque)</th>
<th>Ability to Maintain Throwing Mechanics, VAS (Percent of Maximum Score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% Effort</td>
<td>70.8 ± 1.4&lt;sup&gt;a&lt;/sup&gt; (reference)</td>
<td>48.9 ± 1.8&lt;sup&gt;a&lt;/sup&gt; (reference)</td>
<td>76.8 ± 3.1&lt;sup&gt;a&lt;/sup&gt; (reference)</td>
</tr>
<tr>
<td>75% Effort</td>
<td>62.6 ± 1.3&lt;sup&gt;b&lt;/sup&gt; (88.5%)</td>
<td>43.3 ± 1.7&lt;sup&gt;ab&lt;/sup&gt; (88.6%)</td>
<td>66.9 ± 2.5&lt;sup&gt;a&lt;/sup&gt; (87%)</td>
</tr>
<tr>
<td>50% Effort</td>
<td>56.1 ± 1.3&lt;sup&gt;c&lt;/sup&gt; (79.4%)</td>
<td>37.1 ± 1.8&lt;sup&gt;bc&lt;/sup&gt; (76.3%)</td>
<td>36.3 ± 3.4&lt;sup&gt;c&lt;/sup&gt; (47%)</td>
</tr>
<tr>
<td>75% Velocity</td>
<td>52.8 ± 1.0&lt;sup&gt;c&lt;/sup&gt; (74.7%)</td>
<td>34.9 ± 1.6&lt;sup&gt;c&lt;/sup&gt; (71.3%)</td>
<td>53.2 ± 2.8&lt;sup&gt;b&lt;/sup&gt; (69%)</td>
</tr>
<tr>
<td>50% Velocity</td>
<td>37.3 ± 0.7&lt;sup&gt;d&lt;/sup&gt; (52.2%)</td>
<td>19.2 ± 0.9&lt;sup&gt;d&lt;/sup&gt; (39%)</td>
<td>22.9 ± 2.8&lt;sup&gt;d&lt;/sup&gt; (30%)</td>
</tr>
</tbody>
</table>
RESULTS
CONCLUSIONS

• Pitchers generate higher-than-intended forces when throwing at 50% and 75% effort during a subjective partial effort throwing protocol.

• A decrease in pitching velocity results in a more proportional and appropriate decrease in medial elbow torque than a reduction of perceived effort.

• Use of a radar gun to guide partial effort throwing during throwing rehabilitation programs may protect the reconstructed elbow from excess medial torque.