Increased Valgus Carrying Angle at the Elbow Correlates with Shoulder and Elbow Injuries in Professional Pitchers: A Prospective Study

Shah SS; Stein SM; Goldstein J; Gammal I; Gerland RW; Rokito SE

Department of Orthopaedic Surgery, Long Island Jewish Medical Center, New Hyde Park, NY

Background

- Professional baseball pitchers frequently sustain shoulder and elbow injuries.
- Glenohumeral internal rotation deficit, total range of motion deficit >5°, and external rotation deficit >5° correlate with shoulder and elbow injuries.
- Elbow valgus carrying angle (VCA), which is defined as the angle created by the longitudinal axis of the humerus and forearm with the elbow in extension, is commonly increased in professional throwers.
- Our objective was to determine if increased dominant arm (D) VCA correlated with shoulder injuries in professional baseball pitchers on 3 minor league teams.
- Our hypothesis was that a higher D VCA is correlated with increased shoulder injuries during the baseball season.

Methods

- During spring training, physical examination measurements were obtained from 3 minor league baseball teams.
- Glenohumeral joint passive external rotation, internal rotation, forward flexion and elbow VCA and presence of flexion contracture (EFC) for the D and non-dominant (ND) arms were assessed.
- A bubble goniometer was used for measurements by the same two experienced examiners.
- Inclusion criteria was any athlete participating in spring training.
- Exclusion criteria was inability to compete in daily spring training activities and shoulder/ elbow pain or symptoms at the time of testing.
- Any shoulder injury necessitating treatment was defined as an injury. If a player left the team for any reason (trade, released, retired, etc.), every attempt was made to locate and contact that player to determine any injury occurrence.

Results

- 61 athletes (34 pitchers, 27 position players).
- Higher mean D VCA was noted in older/more experienced players (14.5° vs. 10.9°, p = 0.026) (Table 1).
- Mean D VCA 13.6° for pitchers versus 11.1° for position players (p = 0.04).
- No significant difference in D EFC for pitchers vs. position players (5.4° vs. 4.8°, p = 0.76) (Table 2).
- Seasonal shoulder injury rate for pitchers of 1.67 per team.
- Pitchers with an increased D VCA were **1.34 times** more likely to sustain a shoulder injury (P = 0.033; 95% CI 0.94 to 1.90).
- The clinically important threshold value of D VCA for shoulder injury was **22°**.

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR</th>
<th>P-Value</th>
<th>95% CI</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>-</td>
<td>0.007</td>
<td>-</td>
<td>47.41%</td>
</tr>
<tr>
<td>D EFC</td>
<td>0.62</td>
<td>0.016</td>
<td>0.3488-1.0871</td>
<td>-</td>
</tr>
<tr>
<td>D VCA</td>
<td>1.34</td>
<td>0.033</td>
<td>0.9372-1.9118</td>
<td>-</td>
</tr>
<tr>
<td>ER difference (D ER - ND ER)</td>
<td>0.74</td>
<td>0.015</td>
<td>0.5426-1.0057</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 3. Multivariate logistic regression: all significant (p < 0.05) or near-significant factors (p < 0.10) from univariate analyses were entered into a multivariate logistic regression model where three independent risk factors for D shoulder injury were identified. Significant P values are bolded.

Discussion

- Pitchers with an increased D VCA one degree above the threshold value of 22° were associated with a 34% increase in the odds of shoulder injury.
- One reason for this finding may be that a larger than normal compensatory shoulder IR torque is required in the late-cocking phase causing injury (Figure 2).

Consideration of the vast number of pitchers across all levels, further strategies to identify at risk pitchers need to be developed to decrease the impact of cost of rehabilitation and time missed due to shoulder injuries.

- Limitations to the study include a small total number of injuries occurring during the study period, which may be due to the shorter minor league season.
- Additionally, generalization of this study based on a population of older minor league players may be limited.
- Future directions include continuing to prospectively collect data for five seasons.

In conclusion, to our knowledge this represents the first investigation to demonstrate a relationship between VCA and shoulder injury in pitchers.

References