INTRODUCTION

Baseball pitching is a technically and physically demanding activity, requiring coordination of the entire body to deliver the ball with both speed and accuracy. Injuries are very common in baseball pitching at all levels: 26-35% of youth baseball pitchers report elbow or shoulder pain per season [3, 4] and Major League Baseball pitchers lose on average 22 days per season due to injury [2]. Many potential risk factors for pitching injuries have been explored, but the role of motor control of the lumbar spine and pelvis in pitching injury incidence has not been investigated. A recent study demonstrated that pelvic positional control during a standing single-leg-raise test was positively associated with pitching performance [1]. The purpose of this study was to test the hypothesis that pelvic positional control during the single-leg-raise test would be negatively associated with days missed due to injury in professional pitchers.

METHODS

428 professional baseball pitchers (22.4±4.6 years old) from five organizations enrolled in this study during the last 2 weeks of spring training before the 2011 and 2012 baseball seasons after providing IRB-approved informed consent. A previously-described standing single-leg raise test [1] was performed on each participant. In brief, participants stood with weight evenly distributed on both feet, lifted the foot of the kicking leg approximately 10 cm, held that single-leg-stance position for 2 seconds, and then returned to double-leg-stance under control. The anterior-posterior deviation of the pelvis from its starting position relative to the horizon was measured in degrees using an iPod-based tilt sensor (Level Belt Pro, Perfect Practice, Inc.), and the largest peak absolute deviation was recorded for future analysis (APScore).

Through the course of the season, medical staff from each baseball organization recorded days when the participant’s activity in practices or games was limited within the organization’s own electronic medical record. After completion of the season, these days missed due to injury and all game participation data were compiled for all participants for whom data was available. Participants who retired during the season, who had surgery, or who were traded or released were excluded due to the lack of a complete dataset, leaving 350 pitchers for subsequent analysis.

Pitchers were placed into tertiles based on APScore (LO:<4.0, MD:4.0-7.9, HI:≥8.0; range 1.0-12.5) and into 2 categories based on total number of days missed (<30, ≥30). Pearson Chi-Square and Likelihood Ratio Chi-Square tests were performed to test the hypothesis that those with a greater APScore would be more likely to miss 30+ days due to injury. An a priori alpha level of 0.1 was chosen for statistical significance. A secondary examination was also performed of the number of days missed by players who missed one or more days determine whether those with a greater APScore had a tendency to miss more total days when injured.

RESULTS AND DISCUSSION

As shown in Table 1, pitchers with poorer pelvic positional control were significantly more likely to miss 30 or more days due to injury (Pearson Chi-Square, p=0.045; Likelihood Ratio Chi-Square, p=0.067). The probability of missing 30 or more days in the MD group was 1.44 times that in the LO group, while the probability in the HI group was almost three times that in the LO group.
Table 1: Those with poorer pelvic stability (higher APScore in the Single Leg Raise test) were significantly more likely to miss 30 or more days due to injury (Pearson Chi-Square p=0.045).

<table>
<thead>
<tr>
<th>Single Leg Raise APScore</th>
<th>Missed &lt; 30 days due to injury</th>
<th>Missed 30+ days due to injury</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>LO: &lt;4.0</td>
<td>124 (89.2%)</td>
<td>15 (10.8%)</td>
<td>139</td>
</tr>
<tr>
<td>MD: 4.0-7.9</td>
<td>162 (84.4%)</td>
<td>30 (15.6%)</td>
<td>192</td>
</tr>
<tr>
<td>HI: &gt;=8.0</td>
<td>13 (68.4%)</td>
<td>6 (31.6%)</td>
<td>19</td>
</tr>
<tr>
<td>All</td>
<td>299 (85.4%)</td>
<td>51 (14.6%)</td>
<td>350</td>
</tr>
</tbody>
</table>

Figure 1: Total days missed due to injury during the course of the season by pitchers in the LO, MD, or HI group who missed at least one day during the season due to injury.

Baseball pitchers with poorer pelvic control also demonstrated a tendency to miss more days due to injury than those with better pelvic control (Figure 1), as shown by the higher median value and higher value for the 75th percentile (top of the box). This result could mean either that the pitchers with poorer control are suffering more injuries, or that each individual injury takes longer to recover from.

To the authors’ knowledge, our study is the first to demonstrate that lumbopelvic control is related to injuries in baseball pitchers. Previous studies have shown a relationship between peak ground reaction forces and pitching velocity [5], suggesting that a successful pitch depends on energy generation from the legs and transfer of that energy through the lumbopelvic region to the throwing hand. A lack of lumbopelvic control may lead to an inability of the pitcher to efficiently transfer energy from the legs to the hand, leading to excessive use of the shoulder, arm and wrist muscles to generate ball velocity. It could also lead to early “opening up” of the torso towards the target, forcing the back, shoulder and elbow to the extremes of the range of motion in a whip-like motion, which may cause excessive joint moments that strain the ligaments and other soft tissues leading to back, rotator cuff, medial elbow and other ligament or tendon overuse injuries.

The results of this study should be considered in light of its limitations. A larger sample size would permit a more robust estimate of the difference in injury rates between groups as well as a multi-factorial examination of the relative importance of lumbopelvic control versus other potential injury risk factors. In addition, the players who were released, traded, or retired may have been let go due to poor performance or prior injury history that may or may not have been related to lumbopelvic control deficits to some degree.

CONCLUSIONS

This study observed that poorer lumbopelvic control during a standing single-leg-raise test was a significant predictor of increased risk of missing 30 or more days due to injury in professional baseball pitchers. These results suggest that an increased emphasis on appropriate lumbopelvic control training may reduce the high incidence of injury in baseball pitchers.

REFERENCES


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