



# Sleeper stretch accelerates recovery of glenohumeral internal rotation after pitching

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**Background:** The natural time course for recovery of glenohumeral internal rotation (IR) loss after a throwing episode is unknown. In addition, the effect of the sleeper stretch on the time course for recovery of motion after a throwing episode has never been investigated. Therefore, the objectives of this study were to (1) to determine the natural time course for spontaneous recovery of IR after a throwing episode and (2) to evaluate the effect of the sleeper stretch on the time course for recovery of IR after a throwing episode.

**Methods:** The study participants were 17 male high school baseball pitchers (aged  $17.7 \pm 0.9$  years). A crossover designed was used over a 2-week period. For week 1, glenohumeral IR and external rotation (ER) were evaluated in the dominant shoulder 1 day before a throwing episode and at 2 hours, 1 day, 2 days, 3 days, 4 days, and 5 days after pitching. During week 2, participants completed a sleeper stretch protocol before measurements.

**Results:** The natural time course of spontaneous recovery for IR after a throwing episode was 4 days. Stretching reduced the time course of recovery for IR to 2 days.

**Conclusion:** A sleeper stretch program for high school baseball pitchers can accelerate the recovery of commonly observed IR loss and also may mitigate the cumulative effects observed over the course of a season.

**Level of evidence:** Level II; Prospective Cohort Design; Treatment Study

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Baseball pitching places large forces on the glenohumeral joint during overhead throwing.<sup>4</sup> These forces can reach as high as 1.5-times body weight during the deceleration phase

of throwing.<sup>14</sup> Owing to the nature of baseball, these stresses are experienced repetitively in a single game, over the course of a season, and during the span of a player's career. Typically, the stress of repetitive throwing will lead to specific tissue adaptations, which are often represented clinically as decreased glenohumeral internal rotation (IR) and increased glenohumeral external rotation (ER).

The clinical adaptation of reduced IR on the dominant throwing shoulder compared with the nondominant shoulder is referred to as glenohumeral internal rotation deficit

The Toms River Schools Institutional Review Board approved this study (Study #1001).

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(GIRD). GIRD can be caused by several tissue adaptations, including humeral retroversion, posterior capsule thickness/tightness, and posterior rotator cuff tightness. However, regardless of the specific adaptation, GIRD has been linked to upper extremity injuries, including impingement and labral injuries.<sup>3,6,8,13</sup> Wilk et al<sup>15</sup> found that players with 5° of total rotational range of motion deficit are more likely to be injured. Shanley et al<sup>10</sup> also had similar findings, observing a 4-times greater risk of an upper extremity injury in adolescent athletes with 25° or more of GIRD.

Although clinicians often observe GIRD chronically,<sup>2,11</sup> it has been documented to manifest after an acute bout of pitching. Reinold et al<sup>9</sup> found that immediately after a single game of pitching, there was a significant increase in the amount of GIRD among a group of professional pitchers.<sup>1</sup> These changes were still present 24 hours after pitching. They attributed their findings to the large eccentric forces placed on the posterior muscles (including the infraspinatus and teres minor) during throwing, which may lead to microdamage within the muscle and thereby cause increased posterior shoulder tightness. In a similar manner, Kibler et al<sup>5</sup> examined GIRD in professional pitchers before and up to 72 hours after a single bout of throwing. They found a significant and sustained increase in GIRD up to 72 hours after throwing.

Pitchers throw on a regular cycle of pitching, rest, and return to pitching to protect themselves from overuse injuries. Typically, the length of the cycle is 4 or 5 days for starting pitchers with 3 or 4 days of rest. Returning to pitching before returning to baseline values of range of motion may lead to an accumulation of muscular microdamage and could superimpose further reductions in range of motion, placing the athlete at increased risk for injury. Identification of the natural time course of spontaneous recovery of GIRD after throwing could potentially prevent serious consequences but has not yet been defined.

To mitigate the adaptations caused by throwing and to decrease injury risks, athletes routinely participate in stretching exercises. One technique, known as the “sleeper stretch,” has been commonly used to isolate the posterior aspect of the shoulder and increase glenohumeral IR.<sup>7</sup> The goal of the stretch is to elongate the soft tissue of the posterior shoulder and ultimately dissipate the force over a greater distance during the deceleration phase of the throwing motion. This method has been shown to be effective, but the effect of the sleeper stretch on the time course for recovery after an acute throwing episode has never been investigated. Therefore, the objectives of this study were (1) to determine the time course for spontaneous recovery of glenohumeral IR after a throwing episode and (2) to evaluate the effect of the sleeper stretch on the time course of recovery of glenohumeral IR after a throwing episode. We hypothesized that (1) the time course for natural recovery after a throwing episode would be 4 days and that (2) the sleeper stretch would recover glenohumeral IR more quickly than compared with not stretching.

## Materials and methods

### Participants

The study included 17 male high school baseball pitchers (aged  $17.7 \pm 0.9$  years) who volunteered to participate. Exclusion criteria included shoulder pain, a current shoulder disorder, or a history of shoulder surgery. Before testing, participants read and signed an informed consent or assent to participate, or both.

### Study design

This study was a crossover design, with each participant assigned to “no stretch” and “stretch” groups. A minimum of 1 week was required between test sessions for each participant. During the first testing session, no stretching was performed (no stretch group). During the second testing session, participants were instructed to perform a sleeper stretch protocol (stretch group). For the first test session, glenohumeral IR and ER were evaluated in the dominant shoulder of participants 1 day before a throwing episode (baseline measurement) and at 6 times after pitching (2 hours, 1 day, 2 days, 3 days, 4 days, and 5 days). A throwing episode was defined as a minimum of 60 pitches at maximum effort in a game or practice. During the second testing session, the same measurements were repeated, but the participants were instructed to complete the sleeper stretch protocol at least 1 hour before the post-throwing measurements.

### Procedures

#### Glenohumeral IR and ER

Glenohumeral IR and ER were assessed in all participants, as previously described,<sup>12</sup> using a digital inclinometer (Saunders Group, Inc., Chaska, MN, USA). Each participant was positioned supine on a table, with the dominant arm at 90° of abduction. To isolate glenohumeral motion, the examiner placed 1 hand on the participant’s scapula for stabilization, and the arm was rotated until scapular motion was detected. Once the position of scapular motion was detected, the digital inclinometer was placed along the forearm to record the measurement. Each participant was measured 3 times, and the data were averaged.

Test-retest reliability for glenohumeral IR and ER were evaluated a priori in 10 healthy volunteers. The intraclass correlation coefficient (ICC), standard error of measurement (SEM), and minimal detectable change (MDC) values were calculated. ICC values for glenohumeral IR and ER were 0.994 and 0.999, respectively, and the values for SEM were 0.63° and 0.51°, respectively. MDC values were 1.46° for glenohumeral IR and 1.19° for ER.

#### Sleeper stretch

The sleeper stretch was performed during the second test session, as previously described.<sup>7</sup> Participants were instructed to lie on their throwing side and position their shoulder and elbow at 90°, with the scapula positioned firmly against the table. Next, participants were instructed to passively internally rotate their forearm with their opposite arm toward the table until a posterior stretch was felt. The position was held constant at this position for 30 seconds and then repeated twice for a total of 3 repetitions with 30 seconds of rest between repetitions. This was performed once daily for 5 days after the throwing session.

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