The Immediate Effects of Two Different Stretching Interventions on Passive Shoulder Internal Rotation in Collegiate Baseball Players

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ABSTRACT

Objectives: To determine if a modified version of the cross body stretch that incorporates scapular stabilization immediately following a bout of pitching will increase passive shoulder range of motion more than the standard cross body stretch in male collegiate baseball players. Background: Overhead athletes, mainly baseball players, often exhibit pathologic gross internal rotation deficit (pGIRD) in their dominant arm due to the unique repetitive shoulder motion of throwing. If not addressed, this repetitive motion in combination with pGIRD may lead to future arm injuries over time. Following throwing, immediate stretching intervention may increase passive shoulder range of motion, decrease shoulder tightness, and decrease the risk of future injury. Methods and Measures: Forty asymptomatic collegiate baseball players were randomly assigned to one of two groups with each group receiving a different intervention of stretching. Using a standard inclinometer, shoulder PROM measures were taken at three intervals: 1) after warm up, 2) immediately after throwing and 3) immediately after assigned intervention. One group received the standard cross-body stretch while the other group received a modified version of the cross-body stretch. The modified version included active stretching with the use of a 4-inch foam roller for scapular stabilization. Examiners taking the shoulder measurements were blinded to the participants’ dominant throwing arm, as well as to which stretch the subjects executed. Results: A mixed between-within subjects analysis of variance showed that mean throwing shoulder IR, HAD and TROM differed statistically significantly across the three time points (p=.002, p=.007, p=.016 respectively). A test of between-subjects effects showed no significant difference for IR, ER, HAD and TROM when the two groups were compared across the various time points (p=.939, p=.765, p=.763, p=.806 respectively). Conclusion: Both the modified cross-body stretch and standard cross-body stretch appears to improve passive shoulder internal rotation and total shoulder range of motion in the overhead athlete after an acute bout of throwing.

Background

A loss in shoulder internal rotation (IR) is a common dysfunction seen in the overhead athlete, mainly baseball players. In 2011, Wilk et al described a loss in IR as glenohumeral internal rotation deficit (GIRD) and classified it as a 20° or greater loss of IR in the throwing shoulder compared with the non-throwing shoulder. In 2013, Manske et al classified GIRD in the overhead athlete into two different categories, one that is anatomic (aGIRD) and one that is pathologic (pGIRD). aGIRD, which is normal in the overhead athlete, is defined as a loss in shoulder IR of less than 18°-20° with symmetrical total rotational motion (TROM) bilaterally. pGIRD is defined as a loss of glenohumeral joint IR greater than 18°-20° with a resultant loss of TROM greater than 5° when compared bilaterally. Due to the unnatural shoulder motion performed when throwing a pitch, especially in the late cocking phase, the...
posterior capsule and musculature (i.e. supraspinatus, infraspinatus and teres minor) are placed under heavy stress. When such stress is placed on the shoulder due to adaptive tightening of the posterior shoulder musculature and capsule, atypical translation of the humeral head into an anterior and superior direction often results with the execution of overhead movements.

Reinold et al stated that an immediate decrease in shoulder IR of 9.5° existed following a bout of fifty to sixty pitches thrown at full intensity by professional baseball pitchers. This range of motion loss remained over a twenty-four hour period. Over time, this stress can lead to a loss in shoulder IR and various shoulder pathologies including impingement and labral injuries. In 2008, Laudner et al found that performing the sleeper stretch for thirty seconds and repeating it twice improved shoulder IR in the throwing arm of Division One baseball players from 43.8° to 46.9°, pretest to posttest measurements. Study findings are not significant due to a 5° measurement error.

Studies have shown two mechanisms for a loss in shoulder IR; an increase in posterior shoulder musculature tightness and capsule tightness, as well as bony adaptations in the humerus over time. Osbahr et al noted that goniometric measures and radiographic imaging of the humerus of the throwing shoulder had greater external rotation (ER) at 0° and 90° of abduction. Also greater retroversion was found in the humerus of the dominant arm in collegiate pitchers. Mirroring the outcomes of Oshbahr’s research, Reagan et al also found evidence of humeral retroversion in collegiate pitchers. Humeral retroversion measured 36.6° in the dominant arm compared to 26° in the non-dominant arm. This evidence supports that a loss of shoulder IR may be due to gains in ER due to adaptive changes in the humerus, in contrast to or in combination with the changes in soft tissue. Recent literature has discussed various stretches that can be performed by overhead athletes (mainly baseball players) in hopes of increasing shoulder IR. Both collegiate and professional pitchers as well as those in the general population, have been examined using various stretches to increase shoulder IR. The six stretches are, but are not limited to, the sleeper stretch, modified sleeper stretch, cross-body stretch, modified cross-body stretch, towel stretch, and manual shoulder mobilization. Literature supports both stretching and manual mobilization as a means to increase shoulder IR. Studies by Aldridge et al, Manske et al and McClure et al either compare two stretching procedures or compare a stretch versus manual mobilization. Using a convenience sample, McClure et al studied eighty-three college students and found that the traditional cross body stretch improved shoulder internal rotation more than the traditional sleeper stretch in individuals with limited shoulder IR range of motion (p = .009). Shoulder IR for the stretched side was 46.6° pre-intervention to 66.6° post-intervention for the cross body stretch, compared to 48.2° and 60.6°, respectively, for the sleeper stretch. Tyler et al also found that the cross body stretch improved shoulder IR and stated that a loss in shoulder horizontal adduction has been linked with increased injury rates, such as internal impingement of the shoulder.

Current stretching procedures do not accurately address both the posterior capsule and posterior musculature despite their claims. To adequately stretch the posterior capsule, a force needs to be directed through the glenohumeral joint in a posterior direction with the appropriate scapular stabilization to minimize compensation. Due to a lack of resources, not all collegiate athletes have regular availability to a
qualified trainer or physical therapist to adequately stretch their posterior capsule prior to or after throwing. Therefore, athletes need an appropriate way in which they can effectively and efficiently stretch their shoulder prior to and after competition of throwing to maintain adequate IR of the throwing shoulder to decrease the risk of future injury.

The purpose of this study is to compare the immediate effects of the standard cross body stretch with a modified version of the cross body stretch by stabilizing the scapula on the dominant shoulder and combining active shoulder internal rotation and horizontal adduction in collegiate baseball players. This is based on recent literature by Wilk et al that incorporates scapular stabilization and shoulder internal rotation stretching to improve passive shoulder range of motion in the collegiate baseball player with decreased shoulder mobility due to capsular and muscular restrictions. This study will expand upon current ideas and studies, while examining if a modified technique may be superior to previously used techniques.

**Methods**

**Design**

A double blind randomized controlled trial was used to compare the immediate effects of two different stretches to increase shoulder passive range of motion in asymptomatic collegiate baseball players. Data collection took place between November 30th, 2014 and January 25, 2015 at Desales University and Dominican College respectively. For the purpose of our study, two hour time blocks were used in which ten players completed the following: warm up, measuring of shoulder PROM, bouts of throwing, and stretching as assigned. Using a standard deck of cards, participants were randomly assigned to one of two stretching groups. Black suited cards represented the standard cross-body stretch while the red suited cards represented the modified version. All cards were placed face down and only examiner three was aware of what card represented which stretch. The participants as well as the examiners who were measuring ROM, were blinded to the specific stretch.

The independent variables were the two different stretches performed while the dependent variable consisted of the various recorded shoulder range of motion measurements.

**Participants**

A convenience sample of forty asymptomatic male collegiate baseball players, ages eighteen to twenty-one in the New York and Pennsylvania area were invited to participate in the study. Prior to beginning the study, approval from the Institutional Review Board (IRB) was granted (Application # 2014-0331-01). An informed consent approved by the IRB was obtained from every participant prior to beginning any testing. By no means were participants obligated to complete the study once initially agreeing to participate. Based on prior studies and literature, participants were included in the study if they were asymptomatic of shoulder or elbow pain and demonstrated no signs of injury at the time of testing. Participants had to be at least eighteen years of age. Exclusion criteria consisted of a history of shoulder/elbow surgery, shoulder/elbow symptoms that required medical treatment within the last twelve months and/or shoulder/elbow pain of greater than five out of ten using a numerical pain rating scale. After eligibility was determined, participants were randomly assigned to one of two groups: the standard cross-body stretch group (n = 20) and a modified cross-body stretch group (n = 18). Characteristics including age, height...
(cm), weight (kilograms), body mass index (BMI)(kg/cm²), number of years playing baseball, position, and dominant arm used for throwing were gathered prior to testing (Table 1).

**Procedure**

This study used three examiners. All range of motion measurements were performed by one examiner while another examiner moved the participant’s arm through the appropriate range of motion. A third examiner randomized the groups, as well as provided instructions on how to perform each stretching intervention. The examiners taking the measurements were unaware of the dominant arm used for throwing or stretching intervention that the players executed. A standard inclinometer was used to assess bilateral shoulder passive ROM. Evidence by Manske and Cools et al demonstrated the intratester reliability of an inclinometer for range of motion measurements of the shoulder. All testers taking measurements were trained physical therapy students with adequate practice both in the classroom and clinical setting at taking range of motion measures of the shoulder using an inclinometer.

Participants’ shoulder range of motion was measured at three different intervals: 1) after their initial warm up but before throwing (BT) twenty-five pitches, 2) after throwing (AT) twenty-five pitches, and 3) after stretching (AS) intervention implementation. Based on previous studies and literature, prior to measurements being taken, players went through a light warm up of a full body stretching routine and finishing, with ten minutes of moderate throwing at a distance of less than ninety feet. During the light warm up, no aggressive or prolonged stretching of the shoulder took place. Warm up techniques such as arm circles and active shoulder horizontal adduction/abduction were performed.

Bilateral measurements of passive shoulder IR, ER, and horizontal adduction (HAD) were taken and recorded. For measurement of shoulder IR, the participants were supine with the arm abducted to 90° in the frontal plane with a small towel placed under the subject’s distal posterior humerus to ensure neutral horizontal shoulder positioning. The extremity was passively moved into IR until the examiner felt the joint end feel or until the shoulder began to visually lift from the table. The position was held briefly while the other examiner took the measurement using a standard inclinometer on the dorsal surface of the patient’s forearm. The participant’s shoulder was returned to a resting position following each measurement.

For shoulder ER measurements, the participant was supine and the shoulder was abducted to 90°in the frontal plane with a small towel placed under the subject’s distal posterior humerus to ensure neutral horizontal shoulder positioning. The extremity was moved into ER until the examiner felt the joints end feel or end of available range of motion or scapular substitution. This position was held briefly while the other examiner took the measurement using an inclinometer on the ventral surface of the participant’s forearm.

For shoulder HAD measurements, the participant was supine with one examiner at the test side palpating the lateral scapular border. For the starting position of the measurement, the shoulder was held at 90° of abduction with the elbow bent to 90°. While the shoulder was maintained at 90°of abduction with neutral rotation, the examiner horizontally adducted the arm passively, stopping the movement once compensatory movement was felt at the
lateral scapular boarder, indicating the end of the range of motion at the glenohumeral joint. The examiner held this position while the other examiner took a measure using an inclinometer placed on the ventral surface of the humerus.  

The participants were instructed to throw twenty-five pitches at 60% of their maximum effort from a distance of sixty feet, which is in concert with literature authored by Reinold et al and the number of pitches thrown during a session for a collegiate pitcher. Maximum throwing effort for the players correlated with 100% of the effort one could throw in a single throw. 60% of maximum effort was not objectively measured but instead, players were told to make twenty-five throws at 60% of their best/max effort. The authors decided to have the subjects throw twenty-five pitches at 60% of maximum effort to prevent potential injury of the players due to the fact that the players were in pre-season. Following throwing, a second round of shoulder ROM measurements was taken. After being measured a second time, participants were given a stretch based on assignment. Examiner three gave verbal instructions and visual demonstrations on how to perform the standard cross-body stretch or on how to perform a modified version of the cross-body stretch described by Wilk et al but with slight modifications to allow for scapular stabilization. Stabilizing the scapula when performing the cross-body stretch prevents additional abduction of the scapula and holds the scapula for adequate posterior capsule stretching.  

For the standard cross-body stretch (SCBS) (Figure 1A), participants were standing with the throwing arm at 90° of shoulder flexion and 90° of elbow flexion. Participants were instructed to actively pull the throwing arm across their body using their non-throwing arm while maintaining 90° of shoulder and elbow flexion. They were told that a moderate to strong stretch that is not painful should be felt. Once felt, the stretch was held for thirty seconds. This stretch was performed five times with a fifteen second rest between each stretch. Rationale for holding the stretch for thirty seconds with a fifteen second break was based on previous literature by McClure et al.  

For the modified cross-body stretch (MCBS) (Figure 1B), participants were positioned in side lying on the same side as the throwing shoulder to be stretched. A standard foam roller four inches in diameter was placed horizontally under the participant’s lateral scapular border to provide external stabilization while the stretch was performed. Prior to stretch initiation, the foam roller was checked to insure proper placement and alignment on the lateral scapular border. Visual and verbal instructions were given on how to actively pull the throwing arm across the body using the non-throwing arm while maintaining 90° of shoulder and elbow flexion. Once a moderate to strong stretch that was not painful was felt, the participant was instructed to slightly internally rotate the throwing arm using the non-throwing arm and maintaining the horizontal adduction until an increased stretch that was moderate to strong but not painful was felt. The stretch was held for thirty seconds and performed five times with a fifteen second break between each stretch. Again, rationale for holding the stretch for thirty seconds with a fifteen second break was based on previous literature by McClure et al.  

Following review of informed consent, administration of the inclusion/exclusion screening and randomization, the flow of the data collection session followed. Participants began with a typical baseball warm up described in detail above. After warm up, initial bilateral passive shoulder ROM measures were taken BT. After the first set of PROM measures, participants...
threw twenty-five pitches on flat ground from a distance of sixty feet at 60% maximum effort. After completion of throwing, participants had a second bout of bilateral shoulder PROM measures taken AT. Following the second bout of measurements, participants received one of two stretches according to the random selection. Following stretching intervention, one last session of bilateral shoulder PROM measurements was taken AS. All measurements were taken immediately after warm up, after throwing and after stretching.

**Statistical Analysis**

Statistical analysis was performed using IBM Statistical Package for the Social Sciences (SPSS) version 19. Descriptive statistics were calculated for the participant’s characteristics (age, height, weight, BMI and number of years playing baseball) as well as all other dependent variables (all PROM measures). This data was assessed for normal distribution and homogeneity of variance assumptions. A mixed between-within subject analysis of variance (ANOVA) with α level set at p=.05 and confidence interval (CI) set at 95% was used to determine if any significant differences between groups existed, as well as within groups for passive ROM values at the three intervals: 1) BT, 2) AT, and 3) AS. The post-hoc Bonferroni method was performed for multiple comparisons following mixed design ANOVA to analyze differences between time periods and stretching types. Levene’s test was used to assess the equality of the variance for each mixed design ANOVA. Mauchly's Test of Sphericity was used to assess if the assumption of sphericity had been violated.

**Figure 1:** (A) Standard cross-body stretch, (B) Modified cross-body stretch.
Results

The group that received that SCBS will be referred to as group one (n=20) while the group that received the MCBS will be referred to as group 2 (n=18). No significant differences were found for height, weight, BMI and numbers of years playing baseball between SCBS and MCSB (Table 1). There was a significant difference between SCBS and MCSB for age (p <.05). Of the forty participants included in the study, thirty-eight had bilateral shoulder PROM data recorded for internal rotation, external rotation, and horizontal adduction. Based off of informed consent, inclusion criteria and exclusion criteria, forty participants were eligible for the study but two of the subjects were dropped from the study due to reports of pain in their arm when throwing. The decision to terminate the session was made by examiner three in order to prevent further injury to the subjects.

IR: Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated. A Greenhouse-Geisser correction determined that mean throwing shoulder IR differed significantly across the three time points (F(2,60) = 7.60, p=.002) with a partial eta squared of .174, indicating a large effect size. Post hoc tests using a Bonferroni correction revealed shoulder stretching caused an increase in throwing shoulder IR for both groups from BT to AS, as well as from AT to AS (Table 2). The change in IR across all three ROM measures is illustrated in Figure 2. A test of between-subjects effects showed no significant difference when the two groups were compared across the various time points for IR (F(1,36) = .006, p=.939) with a partial eta squared of .000, indicating a small effect size.

TROM: Sphericity was assumed for TROM. Mean TROM differed statistically significantly between time points (F(2,72) = 4.40, p=.016) with a partial eta squared of .109, indicating a moderate to large effect size. Post hoc tests using a Bonferroni correction revealed shoulder stretching caused an increase in throwing shoulder TROM for both groups from BT to AS, as well as from AT to AS (Table 2). The change in TROM across all three ROM measures is illustrated in Figure 3. A test of between-subjects effects showed no significant difference when the two groups were compared across the various time points for TROM (F(1,36) = .09, p=.763) with a partial eta squared of .000, indicating a small effect size.

HAD: Sphericity was assumed for HAD. Mean HAD differed statistically significantly between time points (F(2,72) = 5.32, p=.008) with a partial eta squared of .129, indicating a moderate to strong effect size. Post hoc tests using a Bonferroni correction revealed that there was a statistically significant decrease in throwing shoulder HAD from BT to AT throwing shoulder ROM gains after stretching (Table 2). A test of between-subjects effects showed no significant difference when the two groups were compared across the various time points for HAD (F(1,36) = .09, p=.763) with a partial eta squared of .003, indicating a small effect size.

ER: Sphericity was assumed for ER. Mean ER did not differ statistically significantly between time points for either of the two groups (F(2,67) = .45, p=.623) with a partial eta squared of .012, indicating a small effect size. ER ROM measures are listed in Table 2. A test of between-subjects effects showed no significant difference when the two groups were compared across the various time points for ER (F(1,36) = .09, p=.765) with a partial eta squared of .003, indicating a small effect size.
Table 1: Subjects’ Characteristics

<table>
<thead>
<tr>
<th></th>
<th>SCBS (n=20)</th>
<th>MCBS (n=18)</th>
<th>p</th>
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<tbody>
<tr>
<td>Age*</td>
<td>18.9 (.94)</td>
<td>19.9 (1.3)</td>
<td>.048</td>
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<tr>
<td>Weight (kg)*</td>
<td>87.6 (7.4)</td>
<td>84 (4.9)</td>
<td>.508</td>
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<tr>
<td>Height (cm)*</td>
<td>184.4 (12.4)</td>
<td>183.1 (12.0)</td>
<td>.779</td>
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<td>BMI*</td>
<td>25.7 (2.7)</td>
<td>25.1 (3.1)</td>
<td>.420</td>
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<tr>
<td>Number of Years Playing*</td>
<td>13.8 (2.1)</td>
<td>14.1 (2.6)</td>
<td>.294</td>
</tr>
<tr>
<td>Position (P,C,OF,IF) (n)</td>
<td>10,2,5,3</td>
<td>4,2,7,5</td>
<td></td>
</tr>
<tr>
<td>Throwing Arm (right, left) (n)</td>
<td>17,3</td>
<td>14,4</td>
<td></td>
</tr>
</tbody>
</table>

*Values represented as a mean (SD). No significant differences found with demographics except for age (p = 0.04)
BMI= Body mass index, P=Pitcher, C=Catcher, OF=Outfield, IF=Infield

Table 2. Range of Motion Measures of Dominant Shoulder BT, AT, and AS Using Either the SCBS or MCBS

<table>
<thead>
<tr>
<th></th>
<th>SCBS (n=20)</th>
<th>MCBS (n=18)</th>
<th>Between-subject effects</th>
<th>Within-subject effects</th>
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<tr>
<td></td>
<td>BT</td>
<td>AT</td>
<td>AS</td>
<td>BT</td>
</tr>
<tr>
<td>IR</td>
<td>65.9 ± 10.1*</td>
<td>64.9 ± 11.3**</td>
<td>68.3 ± 10.3</td>
<td>65.1 ± 10.5*</td>
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<td>ER</td>
<td>80.6 ± 10.6</td>
<td>80.7 ± 9.8</td>
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<td>82.5 ± 9.4</td>
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<td>TROM</td>
<td>146.5 ± 15.4</td>
<td>145.6 ± 17.9§</td>
<td>148.4 ± 16.8</td>
<td>147.6 ± 13.0</td>
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<tr>
<td>HAD</td>
<td>98.4 ± 11.3†</td>
<td>96.3 ± 11.1</td>
<td>95.3 ± 10.3</td>
<td>101.1 ± 11.4†</td>
</tr>
</tbody>
</table>

Abbreviations: IR= internal rotation, ER= external rotation, TROM= total shoulder range of motion, HAD= horizontal adduction. All values represent mean ± SD
* Before throwing to after stretching compared with post hoc testing (p<0.023)
** After throwing to after stretching compared with post hoc testing (p<0.000)
§ After throwing to after stretching compared with post hoc testing (p<0.004)
† Before throwing to after throwing compared with post hoc testing (p=0.020)
Figure 2: Throwing shoulder internal rotation ROM change from (BT) to (AT) to (AS) group SCBS versus MCBS. * Significant change AT to AS for MCBS compared to SCBS (p< .000).

Figure 3: Throwing shoulder total ROM change from (BT) to (AT) to (AS) group SCBS versus group MCBS. * Significant change AT to AS for MCBS compared to SCBS (p<.004).
Discussion

Both stretch groups showed an increase in throwing shoulder IR when (BT) to (AS) were compared as well as when (AT) to (AS) was compared. Although the MCBS appeared to have larger measured gains in passive throwing shoulder IR from AT to AS, these gains were not statistically significant when compared with the SCBS. The authors determined that the MCBS group demonstrated similar increases in passive throwing shoulder IR as the SCBS group due to the scapula being stabilized with the use of a foam roller when actively stretching. Total shoulder range of motion (TROM) for both groups also increased when BT to AS and AT to AS were compared (Table 2). We determine that the gains in throwing shoulder TROM were due specifically to increases in IR, which resulted after stretching.

In 2007, McClure et al found that the SCBS improved shoulder IR more than the traditional sleeper stretch in individuals with limited shoulder IR range of motion (p=.009). Similarly, after stretching in both groups, we found an increase in throwing shoulder IR ROM.

The MCBS group demonstrated an increase in HAD ROM when AT to AS was compared (2.7 degrees compared 0 degrees respectively). Although the MCBS showed gains in HAD, the between subjects effects was not statistically significant when the two groups were compared. In 2013, Wilk et al published a paper recommending the use of scapular stabilization when performing either the sleeper stretch or cross-body stretch. By not stabilizing the scapula when stretching, the scapula is allowed to abduct and upwardly rotate, potentially causing shoulder impingement of the supraspinatus, infraspinatus, and teres minor musculature. Although scapular stabilization showed no significant difference between groups in our study, we believe that stabilizing scapula would have beneficial effects on shoulder biomechanics due to the scapula being stabilized via a foam roller.

There were no statistically significant changes on throwing shoulder ER before and after stretching in both SCBS and MCBS groups. We did not anticipate to see increase on throwing shoulder ER, since the cross body stretch is implemented to stretch the posterior capsule and musculature, which increases mostly shoulder internal rotation.

Recently published articles by Wilk et al and Manske et al looked at the relationship between PROM of the throwing shoulder and injuries to the elbow. The authors found that pitchers with GIRD exhibited almost twice the risk of sustaining a shoulder injury as compared to pitchers without GIRD. They also reported that pitchers whose TROM between shoulders was outside the 5° acceptable difference range, exhibited a 2.5-times greater risk of sustaining a shoulder injury. A TROM measure greater than 176° was also considered to place players at risk for shoulder injury. In our current study, players throwing shoulder TROM did not fall above 176° at any time for either group. Also, pGIRD (throwing shoulder IR >18°-20°) was exhibited by six of the thirty-eight participants. Levene’s test showed that the homogeneity of variance was not violated, although six subjects had pGIRD in our study (p>.05). In our current study, the convenience sampling was used and the subjects with pGIRD and TROM deficit were not excluded in order to increase recruitment. This could be an external threat, therefore our study results cannot be generalized for the athletes with pGIRD and TROM deficit because our population would not be representative enough. Another study in 2014 by Wilk et al concluded that pitchers with deficient throwing shoulder total rotation (>5°
difference between shoulders) and deficient side to side throwing shoulder flexion ROM had an increased risk for elbow injury. According to the study, GIRD did not contribute to elbow injury. The current study, similar to previous studies involving overhead throwing athletes, supports the implementation of a stretching program to those who exhibit pGIRD and TROM deficits when shoulder measures are compared side to side. Players who exhibit pGIRD can be successfully treated for the loss in throwing shoulder IR with an effective stretching program that incorporates scapular stabilization. With the use of a four inch foam roller, the MCBS affords overhead athletes the ability to independently, without a trainer or therapist perform a shoulder stretching program that has the ability to efficiently and effectively improve throwing shoulder IR. We recommend the use of the MCBS as well as the SCBS to athletes to help increase shoulder passive IR, TROM and HAD ROM in overhead baseball players.

Limitations of the Study

One limitation to our study is that when data collection transpired, the participants were in pre-season. We were able to see increases in the throwing shoulder IR, TROM and HAD after stretching. It would be interesting to see the effects of this stretching protocol on athletes during a season or over a long period of time since GIRD and TROM deficits would be more serious if the athletes were in-season. That may be a more applicable measure of data and risk of injury. The sample size was very small (n=38) and included only college-age baseball players. A larger sample size would have helped to generalize our study findings.

Future studies should incorporate a control group into their study as well as examining the long term effects a shoulder stretching program has on throwing shoulder PROM.

We determined that it would have been beneficial to have a group that did not receive a stretching protocol for comparison of shoulder PROM numbers to determine stretch intervention efficacy.

Conclusion

Based on the findings, the two stretching interventions, the SCBS and MCBS, appear to both be effective in improving throwing passive shoulder internal rotation. Maintaining appropriate posterior shoulder mobility through implementation of effective stretching intervention is essential to reduce potential shoulder and elbow injuries in overhead athletes, such as baseball players. Further research is warranted using a larger sample size, as well as a control group that does not receive any form of stretching. A foam roller affords college baseball players the ability to stabilize the scapula while performing active shoulder stretching, promoting overall wellness of the throwing arm.

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References


