The Immediate Effects of Muscle Energy Technique on Posterior Shoulder Tightness: A Randomized Controlled Trial

The glenohumeral joint (GHJ) attains extreme ranges of motion (ROMs), velocities, and forces throughout the throwing motion. GHJ internal rotation reaches peak angular velocities of nearly 7000°/s, and deceleration during the follow-through occurs at 500 000°/s, creating a large force for the posterior shoulder to counteract as the humerus continues to horizontally adduct and internally rotate. It is hypothesized that these substantial speeds and forces occurring at the posterior shoulder result in altered GHJ ROM and posterior shoulder tightness in throwing athletes. Overhead athletes commonly exhibit significantly greater GHJ external rotation ROM at 90° of abduction of the dominant arm compared to the nondominant arm. However, the total arc of motion (sum of maximum GHJ external rotation and internal rotation ROM at 90° of abduction) often does not differ bilaterally, suggesting a corresponding decrease in GHJ internal rotation ROM. This loss of GHJ internal rotation ROM at 90° of abduction in the dominant shoulder is referred to as glenohumeral internal rotation deficit (GIRD).

Adaptive changes to bone and soft tissue believed to occur as a result of the repetitive throwing motion contribute to the presence of GIRD in the overhead athlete. Significantly greater humeral retroversion (the angle of the axis of the humeral head in a medial and posterior direction relative to the axis of the elbow joint) has been reported in the throwing arm of overhead athletes. This adaptive increase in humeral retroversion limits GHJ internal rotation ROM and allows for greater GHJ external rotation, which may serve to protect the throwing shoulder from excessive strain on the anterior structures.

STUDY DESIGN: Randomized controlled trial.

OBJECTIVES: To compare a muscle energy technique (MET) for the glenohumeral joint (GHJ) horizontal abductors and an MET for the GHJ external rotators to improve GHJ range of motion (ROM) in baseball players.

BACKGROUND: Overhead athletes often exhibit loss of GHJ ROM in internal rotation, which has been associated with shoulder pathology. Current stretching protocols aimed at improving flexibility of the posterior shoulder have resulted in inconsistent outcomes. Although utilization of MET has been hypothesized to lengthen tissue, there are limited empirical data describing the effectiveness of such stretches for treating posterior shoulder tightness.

METHODS: Sixty-one Division I baseball players were randomly assigned to 1 of 3 groups: MET for the GHJ horizontal abductors (n = 19), MET for the GHJ external rotators (n = 22), and control (n = 20). We measured preintervention and postintervention GHJ horizontal adduction and internal rotation ROM, and conducted analyses of covariance, followed by Tukey honestly significant difference post hoc analysis for significant group-by-time interactions (P < .05).

RESULTS: The group treated with the MET for the horizontal abductors had a significantly greater increase in GHJ horizontal adduction ROM postintervention (mean ± SD, 6.8° ± 10.5°) compared to the control group (-1.1° ± 6.8°) (P = .011) and a greater increase in internal rotation ROM postintervention (4.2° ± 5.3°) compared to the group treated with the MET for the external rotators (0.2° ± 6.3°) (P = .020) and the control group (-0.2° ± 4.0°) (P = .029). No significant differences among groups were found for any other variables (P > .05).

CONCLUSION: A single application of an MET for the GHJ horizontal abductors provides immediate improvements in both GHJ horizontal adduction and internal rotation ROM in asymptomatic collegiate baseball players. Application of MET for the horizontal abductors may be useful to gain ROM in overhead athletes.

LEVEL OF EVIDENCE: Therapy, level 2b.

KEY WORDS: baseball, manual therapy, pitching, rehabilitation, stretching
TABLE 1

Participant Characteristics*

<table>
<thead>
<tr>
<th></th>
<th>MET for H Abd</th>
<th>MET for ER</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitchers, position players, n</td>
<td>9, 10</td>
<td>8, 14</td>
<td>7, 13</td>
</tr>
<tr>
<td>Age, y</td>
<td>19.5 ± 1.0</td>
<td>20.4 ± 1.1</td>
<td>19.8 ± 1.1</td>
</tr>
<tr>
<td>Height, cm</td>
<td>184.4 ± 6.2</td>
<td>183.7 ± 6.5</td>
<td>186.2 ± 6.5</td>
</tr>
<tr>
<td>Mass, kg</td>
<td>86.9 ± 7.0</td>
<td>88.2 ± 11.2</td>
<td>89.4 ± 7.8</td>
</tr>
<tr>
<td>Dominant GHIR, deg</td>
<td>43.5 ± 10.1</td>
<td>44.5 ± 8.6</td>
<td>50.7 ± 11.3</td>
</tr>
<tr>
<td>Dominant GHER, deg</td>
<td>118.9 ± 13.1</td>
<td>117.8 ± 8.3</td>
<td>122.4 ± 9.6</td>
</tr>
<tr>
<td>Dominant total arc, deg</td>
<td>162.4 ± 16.8</td>
<td>162.4 ± 11.0</td>
<td>173.1 ± 12.9</td>
</tr>
<tr>
<td>Nondominant GHIR, deg</td>
<td>55.6 ± 13.2</td>
<td>54.0 ± 10.9</td>
<td>61.4 ± 11.4</td>
</tr>
<tr>
<td>Nondominant GHER, deg</td>
<td>117 ± 10.3</td>
<td>115.4 ± 10.4</td>
<td>115.3 ± 8.9</td>
</tr>
<tr>
<td>Nondominant total arc, deg</td>
<td>172.2 ± 16.1</td>
<td>169.9 ± 10.5</td>
<td>176.8 ± 14.6</td>
</tr>
</tbody>
</table>

*Abbreviations: ER, glenohumeral joint external rotators; GHER, glenohumeral joint external rotation; H Abd, glenohumeral joint horizontal abductors; GHIR, glenohumeral joint internal rotation; MET, muscle energy technique.

*Values are mean ± SD unless otherwise specified.

labral lesions, subacromial impingement, and pathological internal impingement in the throwing shoulder, indicating a need for investigation of preventative and corrective interventions to restore GHJ internal rotation ROM. While clinicians cannot address GIRD resulting from bony adaptation, soft tissue tightness can be treated.

Several researchers have identified the importance of posterior shoulder stretching in restoring flexibility as part of a prevention program and during rehabilitation. However, investigators have reported conflicting results regarding the effectiveness of current stretching protocols for GHJ internal rotation and horizontal adduction ROM. Additional data are needed to validate the efficacy of specific stretching interventions to increase GHJ internal rotation and posterior shoulder flexibility.

Muscle energy technique (MET) is a manual therapy intervention that can be used to stretch or lengthen muscles and fascia that lack flexibility. MET requires the patient to create a force by activating the targeted musculotendinous unit against a precisely directed counterforce applied by the clinician, followed by relaxation and a passive stretch applied by the clinician. One application of MET may consist of 3 to 5 contractions, held for 5 seconds each, with a stretch following each contraction that ranges from 3 to 5 seconds to 30 to 60 seconds. MET has been relatively unexplored, with only a few published studies supporting its use for cervical, lumbar, and thoracic motion restrictions. Only 3 identified studies have investigated the use of MET for the lower extremity, and none for the upper extremity. The purpose of this study was to compare the immediate effects of an MET applied to the GHJ horizontal abductors and an MET applied to the GHJ external rotators on improving GHJ horizontal adduction and GHJ internal rotation ROM in baseball players without shoulder pathology.

METHODS

Participants

Sixty-one NCAA Division I baseball players voluntarily participated in this study (TABLE 1). Exclusion criteria included any dominant-side upper extremity injury in the previous 6 months or history of previous surgery. Using previously published changes in GHJ internal rotation ROM (cross-body adduction, 20.0° ± 12.9°; sleeper stretch, 12.4° ± 10.4°), an independent sample t test determined a sample size of 29 per group would be required to detect changes between the 2 stretch groups and obtain a power of 0.80 at an alpha of .05. It should be noted that, while interventions were similar, the current study investigated immediate ROM changes, and the values used to estimate sample size were ROM changes following a 4-week stretching intervention.

Instrumentation

We used the Pro 3600 digital inclinometer (SPI-Tronic, Garden Grove, CA) to measure posterior shoulder flexibility, as determined by GHJ horizontal adduction ROM and GHJ internal rotation ROM at 90° of abduction. This device provides a real-time digital reading of angles with respect to either a horizontal or vertical reference and is accurate to 0.1°, as reported by the manufacturer. The digital inclinometer was modified with a reference line positioned along the midline of the device, which was used for proper alignment with anatomic landmarks.

Procedures

Testing was conducted at 3 National Collegiate Athletic Association Division I universities. Each participant attended 1 testing session and provided informed consent. The protocol was approved by The Institutional Review Board of Illinois State University prior to data collection, and the rights of all participants were protected. A single investigator, blinded to group allocation, positioned all participants for ROM measurement, and measurements were obtained prior to any throwing activity. A second examiner, who was not blinded to pretreatment ROM measures, performed all MET treatments. Prior to any measurements, participants were randomly assigned to 1 of 3 groups, according to a randomization table set a priori. The groups consisted of a control group, a group treated with MET for the GHJ external rotators, and a group treated with MET for the GHJ horizontal abductors. Dominant-arm GHJ internal and external rotation ROM and GHJ horizontal adduction...
ROM were assessed in each participant preintervention and postintervention. All postintervention measurements were taken immediately following the MET application or approximately 2 minutes following the pretest measurements. Participants in the control group remained on the examination table for a 2-minute interim between measurements.

**Range-of-Motion Measurements**

To measure passive GHJ horizontal adduction ROM, participants were supine, with both shoulders flat against the examination table. The test shoulder was placed in 90° of abduction, and the elbow in 90° of flexion. The blinded examiner grasped the lateral border of the scapula and applied a posteriorly directed force to maintain the starting position of the scapula. Grasping the participant’s proximal forearm, the examiner passively horizontally adducted the humerus (FIGURE 1). When the first tissue resistance was reached, a second examiner aligned the digital inclinometer along the ventral midline of the humerus for measurement. The angle of the axis of the humerus with respect to 0° horizontal adduction (plane perpendicular to examination table), as determined by the digital inclinometer, was then used to assess the total amount of GHJ horizontal adduction ROM.

To measure passive GHJ internal rotation ROM, participants were supine with the shoulder in 90° abduction and the elbow in 90° flexion. The humerus was supported to maintain a neutral horizontal position. The examiner used one hand to stabilize the scapula by applying posterior pressure at the anterior acromion. The opposite hand was used to passively internally rotate the humerus. The ROM measurement was taken at the first point of resistance as the digital inclinometer was aligned with the long axis of the ulna by the second examiner, indicating the angle between the ulna and a vertical reference point. External rotation ROM was measured using the same procedures. It should be noted that the examiner who aligned the inclinometer was not blinded to group allocation; but potential bias was limited by using definitive bony landmarks and an instrument that provides a digital reading.

Intratester reliability of ROM measurements was established a priori. Twenty-four shoulders with no history of injury or surgery were measured and reassessed at a minimum of 48 hours later. Intraclass correlation coefficient (ICC), standard error of measurement (SEM) with 90% confidence interval (CI), and minimal detectable change (MDC) were calculated for GHJ horizontal adduction ROM (ICC = 0.93; SEM, 2.62°; MDC, 3.70°) and GHJ internal rotation ROM (ICC = 0.98; SEM, 3.28°; MDC, 4.63°).

**Muscle Energy Technique**

A single application of MET was applied to the GHJ horizontal abductors (FIGURE 2). The participant was in a supine position on the examination table. The examiner stabilized the scapula at the lateral border, and, with the elbow flexed, the participant’s shoulder was horizontally adducted to the first barrier of motion. The participant was instructed to perform a 5-second isometric contraction of approximately 25% maximal effort in the direction of external rotation, against an opposing force provided by the examiner at the distal forearm. Following the contraction, the participant was instructed to internally rotate the arm toward the ground as a 30-second active assisted stretch was applied. The participant was instructed to relax, and a new movement barrier was then engaged by the examiner. This protocol was performed for a total of 3 repetitions.

A single application of MET was applied to the GHJ external rotators (FIGURE 3). The participant was in a supine position on the examination table. With the humerus supported and the participant’s shoulder and elbow in 90° of abduction and flexion, respectively, the examiner passively moved the humerus into internal rotation until the first barrier of motion was reached. The participant was then instructed to perform a 5-second isometric contraction of approximately 25% maximal effort in the direction of external rotation, against an opposing force provided by the examiner at the distal forearm. Following the contraction, the participant was instructed to internally rotate the arm toward the ground as a 30-second active assisted stretch was applied. The participant was instructed to relax, and a new movement barrier was then engaged by the examiner. This protocol was performed for a total of 3 repetitions.

**Data Analysis**

We conducted 2 separate 1-way analyses of covariance (ANCOVAs) for GHJ horizontal adduction and GHJ internal rotation ROM. The dependent variable was posttreatment ROM, and the covariate
was pretreatment ROM. Alpha level was set at .05. All data were analyzed using SPSS Version 19.0 (SPSS Inc, Chicago, IL). Effect sizes were calculated using Microsoft Excel. To provide an indication of clinical meaningfulness of the changes in shoulder ROM, between-group effect size was calculated as [experimental group mean – control group mean]/control group SD, and between experimental groups as [MET for horizontal abductors group mean – MET for external rotators group mean]/pooled SD. Within-group effect size was calculated as [postintervention mean – preintervention mean]/preintervention SD. Effect sizes were interpreted according to Cohen’s guidelines.

RESULTS

Demographics for each group are provided in TABLE 1. Descriptive statistics for each group are provided in TABLES 2 and 3. The participants treated with the MET for the GHJ horizontal abductors had significantly greater postintervention GHJ horizontal adduction compared to the control group (P = .011). Postintervention, they also demonstrated significantly greater GHJ internal rotation ROM compared to the control group (P = .029) and those treated with MET for the GHJ external rotators (P = .020). No significant differences were found for any other group comparisons (P >.05). Complete results of the ANCOVAs are provided in TABLES 4 and 5. These tables display the covariate-adjusted means, which are adjusted to account for the variation in pretreatment ROM. This allows for comparison of posttreatment ROM, as if all 3 groups had the same pretreatment mean. No participants were lost to follow-up (FIGURE 4), and no adverse events were reported.

DISCUSSION

Past research has consistently demonstrated that overhead throwing athletes exhibit a significant decrease in GHJ internal rotation ROM in the dominant arm versus the non-dominant arm. This loss of internal rotation ROM in the throwing arm has been attributed to osseous adaptation, posterior muscle tightness, and posterior-inferior capsule tightness. We observed a significantly smaller total arc of motion (P = .001) in the dominant arm (mean ± SD, 165.9° ± 14.3°) compared to the nondominant arm (173.0° ± 14.0°) in our participants. If the alteration is entirely bony, total arc should be similar bilaterally. Therefore, we believe that the deficit in GHJ internal rotation ROM in our participants may be attributed to soft tissue tightness. The smaller total arc observed in the dominant arm compared to the nondominant arm indicates that capsular or muscular tightness may be involved.

GIRD has been associated with decreased performance and several pathologies in the throwing athlete, including superior labral lesions, pathologic internal impingement, and subacromial impingement. Furthermore, symptom resolution has been correlated with improvement in GHJ horizontal adduction ROM in patients. Preventative and rehabilitative interventions, such as stretching of the posterior shoulder, are needed to address GHJ ROM that may be lost as a result of the contribution of soft tissue tightness. Based on clinical observation, a prophylactic stretching program aimed at the posterior-inferior capsule effectively reduced GIRD and prevented associated pathologies over 3 seasons in professional baseball players. Additionally, professional pitchers who participated in a GHJ internal rotation stretching program for 3 or more years were found...
to have an average of 19° more GHJ internal rotation ROM than those who had been in a program less than 3 years.29

While stretching has been shown to effectively regain and maintain GHJ internal rotation ROM in overhead athletes, investigation of specific techniques currently used to stretch the posterior shoulder has produced inconsistent results.26,27,29,31 We observed that an application of MET for the GHJ horizontal abductors resulted in greater GHJ horizontal abduction improvement in that group compared to a control group who did not receive any intervention, and greater internal rotation ROM improvement compared to both the control group and the group treated with MET for the GHJ external rotators. Conversely, internal rotation and horizontal adduction improvements following the application of MET for the GHJ external rotators were not significantly different than the changes in other groups. In the present study, we observed an increase of 4.2° in GHJ internal rotation ROM immediately following a single application of MET for the horizontal abductors. This change reflects a small to moderate effect size (0.42) and is larger than the SEM (0.38°) but doesn’t quite exceed the MDC for GHJ internal rotation ROM (4.63°). The 6.8° increase observed in GHJ horizontal adduction ROM reflects a moderate to large effect size (0.71) and exceeds the MDC for this measure (3.70°). These within-group effect sizes observed for horizontal adduction and internal rotation ROM indicate that the immediate changes in ROM following MET application to the horizontal abductors may be clinically significant.

The use of a shoulder horizontal adduction stretch has been suggested to improve GHJ internal rotation ROM.40 A 4-week program of a self-applied cross-body stretch produced a significant increase in GHJ internal rotation ROM (mean ± SD, 20.0° ± 12.9°; within-group effect size, 1.7) compared to control participants; however, the effect of the stretch on GHJ horizontal adduction ROM was not measured.31 Participants were instructed to perform 5 repetitions of a 30-second self-stretch once daily throughout the 4-week trial. In this previous study,31 the large effect size for differences in GHJ internal rotation ROM between the cross-body and control groups (between-group effect size, 1.5) compares favorably with the moderate to large effect size between the MET for the horizontal abductors group and control group in our study (0.72). The MET for the GHJ horizontal abductors in the present study was similar to the horizontal adduction stretch, but we stabilized the scapula to better isolate the stretch to the GHJ and our stretch was applied by an investigator. However, this technique can also be performed without external assistance in a sidelying position, by pulling the humerus across the body with the contralateral arm. As expected, participants who received an MET treatment for the GHJ horizontal abductors demonstrated significantly greater GHJ horizontal adduction ROM compared to the control group postintervention. These participants also exhibited significantly greater postintervention GHJ internal rotation ROM compared to the control group and the group treated with an MET for the GHJ external rotators.

Stretching of the GHJ external rotators by passively internally rotating the humerus with the arm at 90° of shoulder abduction has also been recommended to improve internal rotation ROM.48 Another technique, described as the "sleeper technique"...
**TABLE 4**

Covariate-Adjusted Postintervention Means for Shoulder Motion*

<table>
<thead>
<tr>
<th>Group</th>
<th>Covariate-Adjusted Mean</th>
<th>95% Confidence Interval</th>
<th>Covariate-Adjusted Mean</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>MET for HAbd</td>
<td>-3.5 ± 79</td>
<td>-71.01</td>
<td>50.2 ± 5.4</td>
<td>478, 527</td>
</tr>
<tr>
<td>MET for ER</td>
<td>-70 ± 8.1</td>
<td>-105.36</td>
<td>46.2 ± 5.4</td>
<td>440, 485</td>
</tr>
<tr>
<td>Control</td>
<td>-102 ± 8.0</td>
<td>-138.66</td>
<td>46.3 ± 5.5</td>
<td>438, 487</td>
</tr>
</tbody>
</table>

*Abbreviations: ER, glenohumeral joint external rotators; HAbd, glenohumeral joint horizontal abductors; MET, muscle energy technique; ROM, range of motion. Values are mean ± SD degrees. Posttreatment values adjusted for the effect of the covariate (pretreatment motion).

**TABLE 5**

Between-Group Covariate-Adjusted Mean Differences and Effect Sizes

<table>
<thead>
<tr>
<th>Group Comparisons</th>
<th>Between-Group Mean Difference</th>
<th>Between-Group Effect Size</th>
<th>Between-Group Mean Difference</th>
<th>Between-Group Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>MET for HAbd and control</td>
<td>4.0 (0.4, 7.5)</td>
<td>0.72</td>
<td>-0.03 (-3.4, 3.4)</td>
<td>-0.01</td>
</tr>
<tr>
<td>MET for ER and control</td>
<td>3.5 (-1.4, 8.6)</td>
<td>0.44</td>
<td>4.0 (0.7, 7.3)</td>
<td>0.75</td>
</tr>
</tbody>
</table>

*Abbreviations: CI, confidence interval; ER, glenohumeral joint external rotators; HAbd, glenohumeral joint horizontal abductors; MET, muscle energy technique; ROM, range of motion.*

stretch,* is performed sidelying, with the shoulder in varying amounts of shoulder flexion up to 90°.9,27,31 The arm is then passively internally rotated by either the clinician or the individual. Clinical observation by Burkhart et al9 indicated that sleeper stretches can effectively increase GHJ internal rotation ROM in patients with symptomatic GIRD within 2 weeks of use. Furthermore, significant increases in GHJ horizontal adduction ROM (2.3°; effect size, 0.32) and GHJ internal rotation ROM (3.1°; effect size, 0.30) were seen following an acute intervention of the sleeper stretch.27 However, a group receiving 4-week intervention of the sleeper stretch, compared to a control group, showed no significant difference in GHJ internal rotation ROM.24 In our study, participants who received an MET for the GHJ external rotators did not exhibit a statistically significant difference in postintervention GHJ horizontal adduction or internal rotation ROM compared to a control group. One reason the MET for the GHJ external rotators did not improve posterior shoulder flexibility may be due to the emphasis on the infraspinatus and teres minor during this stretch, while the other posterior muscles responsible for controlling deceleration during horizontal adduction, such as the posterior deltoid, are not stretched.

As previously discussed, it is unclear whether muscular or capsular tightness is a greater contributor to GIRD in overhead athletes. Another explanation for our findings may be related to stretching of the posterior capsule. If the posterior capsule is better stretched in a position of horizontal adduction, rather than internal rotation, all motions (internal rotation and horizontal adduction ROM) restricted by capsular tightness would likely increase.

Presently, empirical data are limited to validate the use of MET. While improvements have been reported using MET on the cervical, thoracic, and lumbar spine,10,28,36,39,51 only 2 studies have investigated MET use in the extremities.14 Following a single application of MET to the hamstring muscles, Ballantyne et al1 observed a significant increase in passive knee extension. Smith and Fryer20 reported significant increases in hamstring flexibility following 2 applications of MET performed over a 2-week period. Several studies have demonstrated that contract-relax techniques similar to those used in present study are more effective than static stretching.10,30,32 Immediately following the interventions, maximal joint angle,30 ROM,16 and stretch tolerance31 were significantly greater after contract-relax stretching versus static stretching. Furthermore, performance of contract-relax techniques over a 30-day period produced significantly greater increases in plantar flexor, hip extensor, and hip adductor flexibility, compared to ballistic stretching.43
our findings, contract-relax techniques have also produced significantly greater increases in ROM compared to changes observed in control participants. Conversely, other investigators have reported no difference in flexibility gains between static and hold-relax stretching techniques when performed 4 times per week during a 6-week intervention.

Consistent with MET literature, our results support the use of a 5-second isometric contraction, which has been found to be more effective in improving cervical ROM than a 20-second isometric contraction. Our protocol also involved the application of a postisometric 30-second active-assisted stretch. A 30-second static stretch of the hamstring muscles, performed 5 times per week over 6 weeks, has been shown to be more effective than a 15-second stretch or no stretch, and no more effective than a 60-second stretch. Conversely, Smith and Fryer reported similar increases in hamstring flexibility following 2 applications of MET over a 2-week period, when using a 3-second and 30-second postisometric stretch; however, a no-stretch control group was not included in their study.

One limitation of this study is that the patient ultimately determined the amount of force created during the contraction phase of an MET. However, this is an inherent limitation of any contract-relax intervention. We controlled this as much as possible by clearly instructing the participant to use approximately 25% of maximum force, which was selected to allow for participant comfort and to minimize muscle guarding and potential risk of injury. Feland and Marin compared the use of isometric contractions performed at 20%, 60%, and 100% of maximum voluntary isometric contraction during contract-relax proprioceptive neuromuscular facilitation stretching and found no significant difference in changes in hamstring flexibility among the 3 effort levels. This supports our use of a 25% contraction and also indicates that participants who unknowingly perform a contraction at a higher or slightly lower percent maximum voluntary isometric contraction may still benefit from the treatment.

We attempted to minimize bias in the measurements of ROM by blinding the examiner who positioned the arm for all ROM measures. Additionally, the force applied by the examiner during the active-assisted stretch was not controlled. All stretches in this study were applied by a single examiner, but standardization of the force applied in future studies might serve to maintain consistency among participants.

The participants in the current study were healthy, asymptomatic overhead athletes. Further study is required to determine the effectiveness of MET application in individuals with symptoms that may be related to GIRD. Finally, we only observed the immediate effects of MET on joint ROM. Future investigations should study the effects of MET over multiple session applications to further validate its use and examine the duration of increased flexibility following both single and multiple sessions of treatment with MET.

CONCLUSION

Our findings indicate that a single application of MET for the GHJ horizontal abductors results in greater posttreatment GHJ horizontal adduction and internal rotation ROM immediately following treatment in asymptomatic collegiate baseball players. Alternatively, a single application of MET for the GHJ external rotators did not lead to a significant increase in horizontal adduction or internal rotation. Acute application of MET successfully improved GHJ posterior shoulder ROM in collegiate baseball players and may assist in the prevention and treatment of shoulder injuries associated with pathologic GIRD and posterior shoulder tightness.

KEY POINTS

FINDINGS: Immediate improvements in glenohumeral internal rotation and horizontal adduction range of motion were observed following an acute application of MET for the glenohumeral horizontal abductors in asymptomatic collegiate baseball players.

IMPLICATION: The use of MET for the glenohumeral horizontal abductors may assist in gaining posterior shoulder flexibility in baseball players and individuals prone to tightness of the posterior shoulder structures.

CAUTION: Our study examined the immediate effects of a single application of MET on soft tissue lengthening in the posterior shoulder. The effects of chronic application of MET for shoulder flexibility have yet to be examined.

ACKNOWLEDGEMENTS: The authors thank Amanda Somers, Rob Sipes, Dustin Holley, and Satoshi Kajiyama for their assistance with data collection.

REFERENCES
