The Comparison of Instrument-Assisted Soft Tissue Mobilization and Self-Stretch Measures to Increase Shoulder Range of Motion in Overhead Athletes: A Critically Appraised Topic

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Clinical Scenario: Shoulder range of motion (ROM) in throwing athletes relies on a balance of mobility and stability to maintain proper function and health that, if disrupted, can lead to shoulder injury. There have been several studies that address the relationship between ROM deficits and overhead injuries; however, it may be unclear to clinicians which interventions are most effective for increasing ROM in the glenohumeral joints of overhead athletes. **Clinical Question:** In overhead athletes who have deficient shoulder ROM, is instrument-assisted soft tissue mobilization (IASTM) more effective at acutely increasing ROM over the course of a patient's treatment when compared with self-stretching? **Summary of Key Findings:** A thorough literature review yielded 3 studies relevant to the clinical question, and all 3 studies were included. Two articles found a significant increase in acute ROM when compared with a self-stretch measure. All 3 articles showed increases in internal rotation and horizontal adduction, and 1 study reported an increase in total arc of shoulder ROM. **Clinical Bottom Line:** There is moderate evidence to support the use of IASTM to acutely increase ROM in the glenohumeral joint of overhead athletes. Clinicians should be aware of the variability with recommended treatment times; however, positive results have been seen with treatments lasting 5 to 6 minutes per treatment region. There is no consensus for treatment intensity, and certain IASTM tools require certification. **Strength of Recommendation:** Grade B evidence exists that IASTM is more effective at increasing shoulder ROM (ie, internal rotation, horizontal adduction, external rotation, total arc of motion) in overhead athletes than self-stretching measures.

Keywords: rehabilitation, manual therapy, shoulder mobility, Graston technique

Clinical Scenario

Shoulder range of motion (ROM) in throwing athletes relies on a balance of mobility and stability to maintain proper function and health. Prior research has reported that deficits in internal rotation greater than 20°, decreases in total arc of motion greater than 5° when compared with the contralateral side, and decreases in horizontal adduction greater than 16° have all been identified as factors that could lead to throwing-related injuries.¹ Because of the increased risk of injury associated with ROM deficits, it is important for clinicians to be cognizant of how to most effectively treat these issues. Laudner et al² reported that the results related to interventions intending to increase shoulder ROM have not been consistent and have not been able to indicate a standard of best practice for clinicians. To date, published studies on this topic have included various control measures (eg, no intervention, static self-stretching measures, and TheraBand warm-up measures), study procedures, and ROM measurements (eg, internal rotation, horizontal adduction).¹⁻³

Current research identifies a few soft tissue therapy techniques for treating pain and increasing ROM including myofascial release, active release technique, and instrument-assisted soft tissue mobilization (IASTM).⁴ All of these techniques are backed by similar

theoretical bases and utilize application procedures that involve multiple treatment directions to treat fascial disfigurement.⁴ One key differentiating factor that sets IASTM apart is the utilization of a tool or instrument that provides the clinician with a mechanical advantage. These instruments help to provide clinicians with the ability to apply a greater amount of force to the tissues while minimizing stress to the clinician's own hands and joints.⁴ McMurray et al⁴ states that IASTM can be used for immediate improvements in ROM and can have a positive impact on degraded tissue.⁴ Another potential advantage of IASTM is that it may produce improvements in ROM and function in shorter individual treatment periods than other methods of manual therapy. There have been several studies that address the relationship between ROM deficits and overhead injuries; however, it is unclear which interventions are most effective for restoring ROM to normative ranges.¹⁻³

Clinical Question

In overhead athletes who have deficient shoulder ROM, is IASTM more effective at acutely increasing ROM over the course of a patient's treatment when compared with self-stretching?

Summary of Search, Best Evidence Appraised, and Key Findings

- The literature was searched for studies that investigated IASTM versus self-stretching measures to increase shoulder

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- ROM and yielded 3 possible studies (all randomized control trials)¹⁻³ related to the clinical question.
- All 3 studies¹⁻³ met the inclusion criteria and were included for critical appraisal.
 - Two studies^{1,2} reported utilization of IASTM significantly increased acute gains in ROM when compared with self-stretching measures alone.
 - All 3 studies¹⁻³ reported a significant increase in internal rotation and horizontal adduction in the experimental group.
 - One study¹ reported an increase in total arc of shoulder ROM in the experimental group and suggested that utilization of IASTM may help to prevent further loss of ROM.

Clinical Bottom Line

There is moderate evidence to support the use of IASTM to acutely increase ROM in the glenohumeral joint of overhead athletes.¹⁻³ IASTM is indicated for the acute treatment for ROM deficiencies in patients with a lack in soft tissue extensibility.⁴ Treatment length varies across the literature, but positive results have been produced with treatment lengths lasting approximately 5 to 6 minutes per treatment region.⁴ There is currently no consensus for specific treatment pressure recommendations with IASTM. The amount of intensity used by the clinician should be based on presentation of the patient’s condition, pain tolerance of the patient, and clinical judgment throughout the course of treatment.⁴ Clinicians should also be aware that certain IASTM treatment tools require certification to use.⁴ There is a need for more quality research on this topic to expand the breadth of knowledge regarding IASTM techniques and strategies in overhead athletes. However, the findings of this critically appraised topic suggest that IASTM is a viable treatment option that can be used in clinical practice to attain acute gains in shoulder ROM for overhead athletes.

Strength of Recommendation

Grade B evidence exists that IASTM is more effective at increasing shoulder ROM (ie, internal rotation, horizontal adduction, external rotation, total arc of motion) in overhead athletes than self-stretching measures.

Search Strategy

Terms Used to Guide Search Strategy

- Patient/Client group: overhead athletes AND deficient ROM
- Intervention (or Assessment): IASTM
- Comparison: self-stretching
- Outcome(s): increase ROM
- Time: over the treatment period

Sources of Evidence Searched

- Cochrane Library
- MEDLINE
- Google Scholar

- Additional resources obtained via review of reference lists and hand search

Inclusion and Exclusion Criteria

Inclusion Criteria

- Level 3 evidence or higher
- Studies that investigated self-stretching and ROM measures in overhead athletes
- Studies that investigated IASTM in overhead athletes
- Limited to the past 10 years (2007–2016)
- Limited to English language
- Studies that included asymptomatic athletes with deficient shoulder ROM

Exclusion Criteria

- Studies that did not address ROM deficiencies in the shoulder
- Studies that did not include self-stretch or IASTM treatment interventions for the shoulder
- Studies that looked at unrelated outcomes in the shoulder (eg, power, strength, pain)

Results of Search

Three relevant studies¹⁻³ were located and categorized as shown in Table 1 (based on levels of evidence⁵).

Best Evidence

The studies in Table 2 were identified as the best evidence and selected for inclusion in this critically appraised topic. These studies were selected because they were considered level 3 evidence or higher and investigated the effectiveness of self-stretching and IASTM in increasing shoulder ROM.

Implications for Practice, Education, and Future Research

The literature has shown that the repetitive movements inherent in overhead athletics can cause microtrauma to soft tissue, resulting in changes in ROM.⁶ This trauma alters the physical properties of collagenous tissue and can cause scarring and fibrosis.⁶ IASTM is indicated for use in patients where this type of damage has occurred.^{4,6} It has been shown to break down scar tissue, release adhesions, promote new collagen synthesis, increase tissue remodeling, resolve pain caused by soft tissue extensibility issues, and facilitate a faster return to normal ROM than natural healing

Table 1 Summary of Study Designs of Articles Retrieved

Level of evidence	Study design	Number located	References
1b	Randomized controlled trial	3	Bailey et al ¹ Laudner et al ² Heinecke et al ³

Table 2 Characteristics of Included Studies

	Bailey et al ¹	Laudner et al ²	Heinecke et al ³
Study design	Single-blinded randomized control trial	Single-blinded randomized control trial	Single-blinded randomized control trial
Participants	<p>A total of 60 asymptomatic baseball players with ROM deficits.</p> <p>Inclusion criteria: (1) male baseball players, (2) 15 y or older, (3) pitchers and position players, (4) current participant in organized baseball teams, (5) ROM deficits were on dominant throwing arm, and (6) deficit needed 15° or greater, when compared with nondominant arm.</p> <p>Exclusion criteria: (1) recent shoulder pain that resulted in time lost from participation, (2) history of surgery on either shoulder, and (3) significant pain or disability on subjective outcome surveys.</p> <p>Patients were identified through standard screening process. Random assignment into one of the 2 intervention groups.</p> <p>Intervention groups: (1) IASTM and self-stretch and (2) self-stretch alone.</p> <p>Of the 276 athletes screened, 126 qualified and 60 were enrolled (21.7%).</p>	<p>A total of 35 college baseball players.</p> <p>Inclusion criteria: (1) member of a National Collegiate Athletic Association Division 1 baseball team, (2) no upper-extremity injury in the last 6 mo, (3) no upper-extremity surgery in the throwing arm, and (4) ROM restrictions were not required for inclusion.</p> <p>Exclusion criteria: None given.</p>	<p>A total of 14 college overhead athletes.</p> <p>Inclusion criteria: (1) student-athletes between the age of 18 and 22 y and (2) participants in overhead athletics were included.</p> <p>Exclusion criteria: (1) shoulder injury within the last 6 mo and (2) had shoulder surgery within the past year.</p> <p>Of the 122 individuals who were recruited, 15 volunteered.</p> <p>One athlete lost contact during the course of the study.</p> <p>Patients were active participants on baseball, softball, and volleyball teams.</p>
Intervention investigated	<p>Patients were allocated to one of the 2 groups and were supervised by one of the 2 physical therapists.</p> <p>Each treatment lasted 4 min. (Control group had 1 self-stretch treatment session, totaling 4 min. Intervention group had a self-stretch treatment and IASTM session, totaling 8 min of treatment.)</p> <p>Participants were supine, 90° of shoulder abduction, and 90° of elbow flexion. A towel roll was used to maintain humeral position.</p> <p>Scapula was manually stabilized by examiner, and the second examiner measured ROM with digital inclinometer.</p> <p>Internal rotation, external rotation, and horizontal adduction were measured passively.</p> <p>Patients in the self-stretch group performed the sleeper stretch and the cross-body adduction stretch.</p> <p>Each stretch was performed for 1 min for 2 repetitions with a 30-s rest period in between.</p> <p>For the IASTM group, they performed sleeper and cross-body adduction stretch for 1 min for 2 repetitions with a 30-s rest period alongside IASTM.</p> <p>Patients were prone with shoulder abducted to 90° and 90° of flexion.</p>	<p>Blinded randomized study designed where patients were assigned to 2 groups (IASTM and a control group receiving no treatment intervention).</p> <p>Patients attended 1 testing session where all measurements were performed.</p> <p>Clinicians used digital inclinometer to measure passive internal rotation and horizontal adduction.</p> <p>Reference line was positioned along the midline of the device to ensure proper alignment with anatomic landmarks.</p> <p>Intervention measure was performed with Graston Tools® and Techniques® (Indianapolis, IN).</p> <p>Two clinicians performed the preintervention and postintervention measurements. These clinicians were not involved in the treatment sessions.</p> <p>A third clinician administered the test or control measures to eliminate any biases during measurement.</p> <p>Patients were fully clothed for preintervention and postintervention measurements to hide any markings left by the treatment and removed their shirts for IASTM administration.</p> <p>Patients were supine for all ROM measurements with shoulder flexed to 90°, elbow flexed to 90°, and arm placed so that there was neutral rotation.</p>	<p>Participants were stratified based on gender and were randomly assigned to a treatment group (warm-up + IASTM) or a control group (warm-up + dynamic strength and exercise program).</p> <p>Graston Technique® was used as the treatment intervention.</p> <p>TheraBand® (Akron, OH) was used for dynamic stretching and exercise program.</p> <p>Prior to randomization, patients were measured with a goniometer bilaterally for external rotation, internal rotation, and horizontal adduction.</p> <p>Apley's scratch test was also measured bilaterally in 3 different positions to measure shoulder mobility.</p> <p>After a 3-min warm-up, control group performed a dynamic stretching and exercise routines, while the treatment group received IASTM.</p> <p>The intervention was applied with patients in a prone position and the application areas exposed.</p> <p>Testing was performed 2 times per week for 4 consecutive weeks.</p> <p>Patients were given a 2-d rest period between the first and second treatment of each week.</p>

(continued)

Table 2 (continued)

	Bailey et al ¹	Laudner et al ²	Heinecke et al ³
	Emollient was applied to the axillary border, and 2 min of treatment was administered to a frequency of 45 Hz. Treatment angle was consistent at a 45° angle to the skin surface in the direction of the parallel and perpendicular fibers of the infraspinatus muscle.	For horizontal adduction, the inclinometer was placed along the ventral shaft of the humerus, and ROM was measured based on an axis aligned perpendicular to the examination table. For internal rotation measurements, the inclinometer was aligned with the shaft of the ulna, and the same perpendicular axis was used.	
Outcome measure(s)	(1) Shoulder ROM measured by inclinometer. (2) Humeral torsion assessed with musculoskeletal ultrasound. (3) Electromagnetic tracking system used to assess anterior–posterior glenohumeral joint translation.	(1) Shoulder horizontal adduction and internal rotation ROM were measured using an inclinometer.	(1) Shoulder horizontal adduction, internal rotation, and external rotation were measured bilaterally using a goniometer. (2) Apley's scratch test was utilized bilaterally to assess shoulder mobility before and after the test.
Main findings	Posterior rotator cuff stiffness was measured using musculoskeletal ultrasound, and there was decreased stiffness in the group receiving IASTM (−0.46 (0.09) vs −0.16 (0.09) kPa; $P = .002$). There were no significant changes in anterior–posterior translation in either the intervention or the control groups ($P = .41$). There was a significant increase in total arc ROM (8° (6°); $P = .01$), internal rotation (5° (2°); $P = .01$), and horizontal adduction (7° (2°); $P = .004$) in the IASTM + stretching group compared with the stretching only group.	There was a significant increase in glenohumeral horizontal adduction between the intervention group (11.1° increase) and the control group (0.1° decrease); $P < .001$. There was a significant increase in internal rotation between the intervention group (4.8° increase) and the control group (0.1° decrease); $P < .001$.	There was an increase from the beginning of the study to the midpoint in right internal rotation (beginning: 50.96 (13.33); midpoint: 56.76 (12.75)), left horizontal adduction (beginning: 105.69 (24.43); midpoint: 127.46 (10.58)), and second position of Apley's scratch test to the right shoulder (beginning: −4.63 (4.83); midpoint: 4.07 (4.19)); $\alpha = .05$. There was a significant improvement from the midpoint of the study to the conclusion of the study in right horizontal adduction (midpoint: 125.63 (12.75); conclusion: 113.77 (14.71)) and left horizontal adduction (midpoint: 127.46 (10.58); conclusion: 135.90 (10.02)). Right internal rotation (beginning: 50.96 (13.33); conclusion: 57.09 (8.08)), left horizontal adduction (beginning: 105.69 (24.43); conclusion: 135.90 (10.02)), and right Apley's scratch position 2 (beginning: −4.63 (4.83); conclusion: −4.77 (4.52)) showed significant improvement from beginning to the conclusion of the study.
Level of evidence	1b	1b	1b
Validity score ^a	19	20	15
Conclusion	Posterior rotator cuff stiffness is associated with acute resolution in ROM deficits, where acute decreases in posterior rotator cuff stiffness showed gains in internal rotation, total ROM, and horizontal adduction. Through the use of IASTM and stretching, the treatment showed increases in changes of the posterior cuff tightness, which lead to increases in ROM. These findings can be used as a guide for clinicians in diagnosing what the problem associated with deficient ROM is, and showing that the use of IASTM + self-stretching can show positive changes in posterior cuff stiffness, which can lead to increases in ROM at the shoulder.	The use of IASTM on the posterior shoulder has shown to be effective in increasing glenohumeral horizontal adduction and internal rotation ROM. IASTM can be an effective method of increasing ROM at the glenohumeral joint, especially in the dominant arm of the asymptomatic college baseball players.	The use of dynamic stretching and strengthening with Graston Technique® has shown increases acutely in ROM and smaller losses in Apley's Scratch Test; however, the findings were insignificant when compared with the control group. There is a need for further research in the application of the Graston Technique® overtime to improve ROM.

Abbreviations: IASTM, instrument-assisted soft tissue mobilization; ROM, range of motion.

^aDetermine with the Downs and Black checklist.

alone.⁶ Clinicians should note that treatment is contraindicated with the presence of open wounds, thrombophlebitis, uncontrolled hypertension, kidney dysfunction, hematoma, and myositis ossificans.⁴ Precautions include patient tolerance, skin conditions, and the use of certain medications.⁴ It should also be understood that treatment can cause hyperemia with petechiae formation.⁴ Once a patient has been cleared of contraindications, IASTM is indicated in clinical practice for managing pain, increasing ROM, and improving shoulder function.⁴

Of the 3 studies appraised, 2 studies^{1,2} resulted in acute increases in internal rotation and horizontal adduction between groups. Additionally, 1 study found acute increases in external rotation and total arc of motion between groups.¹ Although significant differences were reported between time points in the third study,³ there were no between-group significant differences regarding long-term increases in internal rotation, external rotation, horizontal adduction, and shoulder mobility measured by Apley's scratch test.

Each of the studies¹⁻³ had different study procedures. Bailey et al¹ looked at increases in internal rotation, external rotation, horizontal adduction, and glenohumeral total arc of motion.¹ The treatment group performed 4 minutes of supervised self-stretching and received 4 minutes of IASTM.¹ The control group performed 4 minutes of supervised self-stretching and received no IASTM treatment.¹ The study also only looked at the acute effects of IASTM after a single treatment and did not discuss all of the specifics of the IASTM or self-stretching parameters.¹

Laudner et al² explored internal rotation and horizontal adduction measurements after a single treatment and did not include a self-stretching measure.² These treatments were performed according to Graston Technique® guidelines, which involved 20-second treatments perpendicular to the muscle fibers and 20 seconds of treatment parallel to the muscle fibers.² Treatment was applied to the posterior deltoid, latissimus dorsi, teres major, teres minor, and infraspinatus.² The primary goal of this study was to explore treatment for posterior shoulder tightness.²

Heinecke et al³ assessed internal rotation, external rotation, horizontal adduction, and shoulder mobility measured by Apley's scratch test.³ This study looked at the potential effects of IASTM on shoulder mobility and ROM over time. Treatments utilized the Graston Technique® recommendations and included two 30-second treatments at the infraspinatus fossa, the supraspinous fossa, and the medial border of the scapula, followed by 45-second treatment around the borders of the scapula.³ Patients were treated and measured bilaterally.³ Clinical results were reported as "left" and "right" shoulders,³ rather than dominant and nondominant shoulders.

The literature suggests that IASTM is effective in increasing acute shoulder ROM in overhead athletes with asymptomatic ROM deficiency. The lack of a standardized IASTM treatment protocol in current research presents a limitation for clinicians who wish to utilize it in clinical practice. The 3 studies that were appraised in this critically appraised topic all utilized different treatment parameters (duration, frequency, and intensity).¹⁻³ In previous research, treatments have shown positive results produced by treatments times varying from 40 seconds to 18 minutes.⁴

McMurray et al⁴ reported that treatment sessions usually last approximately 5 to 6 minutes per treatment region.⁴ Because of the lack of a consensus regarding treatment intensity or frequency, clinicians should follow the guidelines for treatment as recommended by IASTM certification courses and available training resources until further research can indicate specific guidelines. During the treatment sessions, the pressure that is given to the patient through the instrument is variable because it depends on how patient presents to the clinician.⁴ Treatment sessions are usually performed on patients who have chronic issues, as it reactivates the inflammatory process.⁴ Certification is only required by a few companies to use their IASTM tools in clinical practice.⁴ Clinicians are free to perform IASTM without special certification as long as the tools that they are utilizing do not have a certification requirement.

Future research should focus on the uniformity of measurements and treatment parameters in addition to a more in-depth exploration of the effects of IASTM over time. In order to be able to provide education and sound clinical recommendations for optimal treatment, further research must be performed regarding the effects of various IASTM parameters. Clinicians who are looking to use evidence-based practice would benefit from a body of evidence that utilizes consistent treatment protocols, provides sufficient clarity of the control measures, and specifies details of the study that will prove clinically beneficial (ie, specification of dominant and non-dominant measures). This critically appraised topic should be reviewed in 2 years or when additional best evidence becomes available to determine whether additional best evidence has been published that may change the clinical bottom line for the research question posed in this review.

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