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Therapeutic effects of instrument-assisted soft tissue mobilization and the use in athletic populations: a literature review

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Abstract

This literature review examines the mechanism and application of instrument-assisted soft tissue mobilization (IASTM) in athletic populations. IASTM is a treatment technique used for soft tissue pathologies. Experimental studies have been performed to determine the effects of IASTM on range of motion, pain, and inflammation in upper and lower extremities. Conflicting evidence exists for the effect of IASTM on the inflammatory reparative process of the body while more evidence exists in support of the technique's benefits on pain reduction and improvement in range of motion. Understanding the effects of IASTM on range of motion, pain, and inflammation may be useful in treating athletic-related pathologies. Further research should be conducted on a wider array of the population and in greater numbers. The effects should be further examined on a more diverse set of pathologies.

Therapeutic effects of instrument-assisted soft tissue mobilization and the use in athletic populations:

A literature review

Instrument-assisted soft tissue mobilization (IASTM) encompasses a broad range of techniques to treat soft tissue deficiencies. Tools used for IASTM produce micro-trauma to soft tissue for healing and restoring normal elasticity and function (Moon, Jung, Won, & Cho, 2017). Tools made of stainless steel varying in shapes and sizes are most commonly used. Treating soft tissue deficiencies requires specific strokes and pressures applied to the treatment area in an attempt to regain full function. Variations of IASTM exist differing in names and types of tools used.

The goals of the treatment are often to increase range of motion or decrease pain resulting from injury. IASTM may stimulate inflammation in an attempt to promote healing (Sevier and Stegink-Jansen, 2015). The effects of IASTM may provide an ideal environment for resolution of injury and promotion of functionality in sport. It is important to understand the effects of IASTM so it may be used effectively in treating soft tissue injury. With sufficient knowledge of how IASTM affects the body, it may become a staple for maintaining athletic performance and treating common pathologies in active populations.

Definition

Instrument assisted soft tissue mobilization defines a broad range of manual therapy techniques that aim to increase range of motion and decrease pain and inflammation in injured tissues. Many methods use metal tools to localize and treat soft tissue restrictions (Laudner, Compton, McLoda, and Walters, 2014). These soft tissue restrictions can lead to decreased range of motion and pain in the body.

The most common form of IASTM is the Graston Technique. This technique utilizes a set of six stainless steel tools varying in shape and size. Each tool has multiple beveled treatment surfaces. The array of tools caters to different structures and allow for varying intensities in treatment. Smaller sized tools may be used for smaller anatomical structures and with lighter intensity. Larger sized tools are used for large treatment areas and for use of greater treatment intensity. The use of tools allows more accurate treatment of soft tissue restrictions in tissues when compared to using basic massage methods with a clinician's bare hands. These restrictions include thickenings, adhesions, and scar tissue. (Laudner et al., 2014). The tools allow for identification of restricted tissues by way of the ease of glide of the tools over the skin (Coviello, Kakar, and Reynolds, 2017).

The Fascial Abrasion Technique is another method of IASTM. With this method, the tools consist of a handle and 20 treatment surfaces. The surfaces on the tool vary in size for specificity of treatment. Smaller edges are used for small areas like feet or hands while larger, beveled edges are used for larger muscle groups such as the quadriceps and hamstrings. A friction balm is used to create friction between the tool and skin. Application of a friction balm also allows smooth movement of tool over the treatment area. The soft tissue being treated is placed in a stretch position prior to application. The various edges and surfaces of the tools are used in feathering and sweeping motions across the tissue being treated. The direction of the motion varies throughout the duration of the treatment and a light and constant pressure is maintained by the clinician during the treatment. Treatment is most commonly performed on the entirety of a muscle with extra focus on smaller areas of increased tension. The Fascial Abrasion

Technique causes less irritation to the treatment area due to the angle at which the tool is used (approximately 45 degrees) allowing for longer treatment times when compared to other IASTM methods (Markovic, 2015).

Astym, another IASTM technique, aims to stimulate the regeneration of tissues and remove any scar tissue and fibrosis. The Astym tools are designed to amplify the tactile sensation of the underlying texture of the soft tissues to allow the clinician to indicate the location of the problem. When dysfunctional tissues are located, a series of pressures are applied to restart the reparative process so normal range of motion can occur along with the reduction of pain (Sevier and Stegink-Jansen, 2015).

Range of Motion

Restricted range of motion can lead to greater risk of injury (Markovic, 2015). Regaining and maintain full range of motion can increase functionality and performance in athletic populations. Factors such as muscle tightness (Kim, Jung, and Weon, 2014) or imbalances (Moon, Jung, Won, and Cho, 2017) can lead to decreased range of motion. Research has indicated the use of IASTM improving range of motion (ROM) in upper and lower extremities.

Many upper body sports require a great number of repetitive overhead motions. This stress over time may cause several changes in the shoulder that may lead to injury (Laudner et al., 2014). The body will often adapt to these changes. For example, sports that require repetitive overhead throwing, such as baseball, may causes changes in range of motion of the glenohumeral joint. To compensate for the increased stresses that are caused from overhead motions, throwing athletes may develop greater external rotation and decreased internal rotation and horizontal adduction in their throwing arm (Laudner et al., 2014). Throwing athletes may also develop posterior shoulder tightness due to a decrease in internal rotation and horizontal adduction range of motion. IASTM has been theorized as a solution to correct the issues caused by repetitive overhead motion.

The acute effects of instrument-assisted soft tissue mobilization on posterior shoulder range of motion has been examined in asymptomatic collegiate baseball players. Baseball players with no recent history of upper extremity injury in the past six months or history of surgeries in their throwing arm were defined as being asymptomatic and included in the study. One group received the IASTM treatment ($n = 17$) and the other group served as the control group ($n = 18$) and did not receive any treatment. All participants' passive glenohumeral horizontal adduction and internal rotation range of motion was measured before and after treatment was given to the experimental group. Measurements were taken using a digital inclinometer. This device gives readings of range angles in respect to vertical and horizontal reference. Greater improvements were found in the posttest measurements of the IASTM group when compared to the pretest measurements. The group receiving the IASTM treatment had significant improvements in horizontal adduction ($p < 0.001$ at $p = 0.001$) and internal rotation ($p < 0.001$ at $p = 0.001$) range of motion when compared to the group that received no intervention (Laudner et al., 2014). IASTM may be effective in acutely improving glenohumeral horizontal adduction and internal rotation in asymptomatic overhead athletes.

The effect of IASTM on lower extremity range of motion has been examined in a number of studies. The use of IASTM has been compared to self-treatment methods such as foam rolling and static stretching. These self-treatment methods are often more accessible and practical because they do not require the assistance of a clinician like IASTM methods. Comparing self-treatment methods and IASTM has been investigated to determine whether IASTM should be used more commonly in athletic populations to regain and maintain full range of motion.

Markovic (2015) examined this comparison on knee and hip range of motion in collegiate soccer players. A sample of 20 participants was assigned to one of two groups: Fascial abrasion technique (a variation of IASTM) group or foam rolling group. Each group included ten participants. The supine passive flexion test and straight leg raise were used to measure the effectiveness of each treatment. These measurements were taken before the treatment, immediately following the treatment, and 24 hours post-treatment. The fascial abrasion technique group received constant treatment on their hamstrings for approximately two minutes. The group receiving the foam rolling treatment was instructed to use a firm foam roller with kneading motions from the distal aspect of the hamstring to the proximal. Participants repeated this method for one minute, rested for 30 seconds, and repeated again for another minute. The results of the study revealed significant improvement ($p = 0.039$ at $p < 0.05$) in hip and knee range of motion in both groups immediately following treatment. However, only participants in the Fascial Abrasion Technique group showed the same significant improvements 24 hours following treatment.

The effects of the Graston technique in comparison to foam rolling have been studied as well (Kim et al., 2014). Participants claiming to have hamstring tightness were used for this comparison. To measure flexibility, participants were asked to lie supine on a table with their knee flexed at 90 degrees. They were then instructed to extend their knee until the point of tension was felt. This active knee extension test was then quantified using a goniometer. One group of participants received the Graston treatment while the other received the foam rolling treatment. The group receiving Graston received 30 sweeps resulting in approximately 30 seconds of treatment. The group receiving the foam rolling treatment were instructed to, using their body weight, roll the foam roller 30 times from the distal hamstrings to the proximal for approximately 60 seconds. Immediately following treatment, participants were administered the active knee extension test again. Both groups showed statistically significant increases in range of motion ($p = 0.05$ at $p < 0.05$). This study found foam rolling to be just as effective as the Graston Technique.

Moon et al. (2017) examined the effects of the effects of the Graston Technique on hamstring extensibility. When hamstrings feel tight, there is often a posterior tilt of the pelvis leading to non-specific low back pain. This muscle imbalance may be resolved with an increase of range of motion in the hip. This study used a non-athletic population of staff and students at a university reporting low back pain and tight hamstrings as participants. One group of participants received a Graston treatment to their hamstrings for approximately one minute. The other group received static stretching of their hamstrings for a total of 65 seconds. Increases in hamstring extensibility were quantified using a sit-and-reach test. The subjects receiving the Graston treatment ($p = 0.002$ at $p < 0.05$) had statistically significant improvements in their sit-and-reach test immediately following treatment when compared to the static stretching group ($p = 0.210$ at $p < 0.05$).

The efficacy of the Graston Technique in comparison to static stretching was examined further in a study done by Merkel, Han, Wughalter, and Chin (2016). Hamstring flexibility in collegiate baseball players was examined. Participants either received Graston, were assigned to the passive stretching group, or the control group. Hamstring flexibility of all participants was measured using a standard goniometer capable of measuring 360 degrees. The Graston Technique group received both passive stretching and an Graston treatment. The passive stretching group received the stretching treatment from a clinician. The control group simply had their flexibility measured. Measurements were taken one day before treatment and one day after the final treatment. Participants received treatment six days a week for a total of three weeks. Over the 20 day period, both the Graston treatment and static stretching were effective in increasing hamstring flexibility in participants ($p = 0.02$ at $p <0.05$). The addition of the Graston Technique did not provide any added increases when compared to the passive stretching group (Merkel et al., 2016). Since the group receiving the Graston treatment also received static stretching before their treatment, it is difficult to determine whether the Graston Technique had any effect.

Pain

A less researched topic relating to IASTM is its effect on pain. Many researchers have focused on the quantifiable effects of IASTM and range of motion, but little research exists on testing the effects of IASTM on pain. Some theories suggest IASTM decreases pain by means of the gate control theory. The gate control theory proposes that the perception of pain decreases when constant non-painful stimulus is applied to an area. This non-painful stimulus is often presented in the form of pressure. The non-painful stimulus “closes the gate” to painful stimulus resulting in decreased perception of the painful stimulus. With IASTM, more mechanical stress is applied to the body when compared to the use of bare hands. The increased neural activity may lead to a decreased perception of pain (Ge, Roth, and Sansone, 2016).

The effects of the Graston technique on mechanosensitive neurons has been tested on twenty-three middle-age (mean = 25 years old) adults. To assess the activity of mechanosensitive neurons and pain threshold, two measurements were taken. Two-point discrimination was tested using an electronic digital caliper. Participants are instructed to report feeling one or two points as the clinician adjusts the calipers. The measurement was taken three times to ensure accuracy. Pain threshold was measured using a digital dynamometer. Participants were instructed to report when pain was felt as the clinician gradually applied increased pressure to the treatment area. All participants received a ten-minute Graston treatment from a trained clinician after pre-test measurements were taken. Both pretest and posttest measurements were taken. At the conclusion of the study, a significant increase ($p < 0.001$ at $p = 0.001$) in the two-point discrimination test was found suggesting there was an increase in activity in the mechanosensitive neurons. No significant findings were found relating to an increase in pain threshold ($p = 0.44$ at $p = 0.001$) (Ge et al., 2016). These findings suggest the Graston technique changes the neural activity related to two-point discrimination, but has no effect on pain threshold.

The effect of IASTM on pain reduction of a weightlifter with subacromial pain syndrome has been examined (Coviello et al., 2017). Patients with subacromial pain syndrome often have posterior glenohumeral joint capsule tightness and abnormal scapular kinematics. An imbalance in musculature often results in decreased upward rotation and posterior tilt of the scapula. The use of IASTM may not only decrease tightness in the joint capsule, but may aid in pain reduction. The treatment was applied to the patient’s pectoral muscles and brachium with a gradual increase in pressure. Pain free active shoulder flexion was achieved post-treatment. This study suggested pain was decreased due to a reduction in soft-tissue adhesions limiting movement unlike the previous hypothesis of activation of the gate control theory (Coviello et al., 2017).

Astym treatment has been tested on the resolution of the pain associated with lateral elbow tendinopathy. Participants reporting chronic lateral elbow tendinopathy ($n = 113$) were used in the study. The participants received either a Astym treatment or eccentric exercise treatment. Both groups received the treatment assigned for four weeks. Data regarding pain, grip strength, and function were collected at baseline and after four, eight, twelve weeks, six months, and one year. The Astym treatment group received treatment from a clinician two times weekly for four weeks. The clinician performed Astym from the wrist to the deltoid on both sides of the arm. The eccentric exercise group were put through a stretching routine including all muscles originating on the lateral epicondyle as well as strengthening exercises that had a focus on the eccentric contraction. The stretching routine was performed three times daily for one repetition of thirty seconds. This group performed the strengthening exercises two times a week. They were instructed to perform two pain-free sets of fifteen repetitions and increasing to three sets as tolerated. Pain scores resolved completely for the group that received Astym ($p = 0.047$ at $p = 0.05$). This study suggests Astym therapy, a type of IASTM, may provide an option for treatment of pain associated with lateral elbow tendinopathy (Sevier and Stegink-Jansen, 2015).

Inflammation

Clinicians also indicate the use of IASTM for stimulating the body's inflammatory response. These hypotheses suggest that IASTM produces a localized micro-trauma that reinitiates the inflammation process and reparative system of the body. IASTM stimulates delivery of blood, nutrients, and fibroblasts to the affected area leading to healing of the tissue (Laudner et al., 2014). Greater pressures lead to greater fibroblast proliferation (Coviello et al., 2017). IASTM methods have been developed to stimulate the regeneration of soft tissues and resorption of inappropriate scar tissue/fibrosis (Sevier and Stegink-Jansen, 2015).

The effects of IASTM on inflammation have been examined in a study on human plantar flexors. Many characteristics of the plantar flexors of eleven male participants were examined. Measurements of the pro-inflammatory cytokine and anti-inflammatory myokine interleukin 6 (IL-6) and tumor necrosis factor alpha (TNF-alpha) cytokine were taken. Both are found in the body during the acute inflammation process. The measurements of the cytokines were taken before treatment, 24 hours post-treatment, 48 hours post-treatment, and 72 hours post-treatment. No significant changes in IL-6 and TNF-alpha were found. This study did not find evidence of an effect of IASTM on the inflammation and reparative process of the human body (Vardiman et al., 2015).

Therapeutic application in athletic populations

Active participants in athletic competition often endure great stresses on the body. Negative adaptations of the body or injury may occur due to these stresses. Decreased range of motion and increased pain may occur in the tissues. In theory, IASTM may be an effective tool in minimizing the negative impacts of athletic participation by increasing range of motion, decreasing pain, and stimulating inflammation to aid in injury recovery.

Upper and lower extremity restrictions are often found as adaptations to increased stress on the body. These adaptations often do not result in beneficial changes to the body. Maintaining and correcting functionality in sport is ideal for optimal performance and well-being of the athlete.

Full range of motion in the upper and lower extremities is important for full function and decreased risk of injury in sport. With limitations in range of motion, the body may compensate or adapt to these changes. For example, Laudner et al. (2014), expressed the changes that occur in a collegiate baseball player's shoulder range of motion due to the repetitive throwing they must perform. The excessive overhead motion required for the sport causes adaptations in shoulder horizontal adduction, internal rotation, and external rotation. These adaptations may be more advantageous in the realm of the sport, but are not ideal for normal function of the glenohumeral joint. Markovic (2015) expressed the importance of maintaining normal range of motion in the hip for the prevention of injury in collegiate soccer players.

If IASTM can be proven to have positive effects on range of motion, it can be an effective and non-invasive treatment for the correction of insufficient range of motion in athletes. The application of IASTM may provide a more effective solution for improving flexibility and range of motion when compared to methods like static stretching or self-myofascial release techniques.

In sport, acute and chronic pain is often reported due to the stresses athletic activity places on the body. Different theories offer suggestions on how IASTM may affect pain perception. The gate control theory is proposed (Coviello et al., 2017). The pressure and forces applied during a treatment session of IASTM may reduce pain perception. Pain may also be influenced by the activity of mechanosensitive neurons (Ge et al., 2016). Another hypothesis suggests pain may be resolved by correcting the underlying tightness in the soft tissue (Sevier and Stagnik-Jansen, 2015). No matter the mechanism in which IASTM may improve pain perception, it may be useful in the maintenance of athletic performance.

Pain often limits an athlete's ability to compete in their sport at the highest intensity. Feeling pain is often associated with injury, so withdrawing when pain is felt is a common response. Reducing pain caused by an existing pathology may be accomplished with the use of

IASTM. As further research continues, participants in athletic competition may be able to continue to compete in sport due to a resolution in pain perception.

Injured tissue can often cause loss in range of motion and increases in pain. Finding a way to heal the tissue can eliminate the effects following. Healing injured tissues and preventing the risk of other negative impacts of sport can aid in maintaining performance and decreasing the risk of future injury. Currently, research does not seem to support the use of IASTM as a means to heal the tissue by stimulating the body's reparative process.

Range of motion, pain, and inflammation have a symptomatic relationship. This relationship demonstrated by pain may be caused by a lack of range of motion and a lack of range of motion may be caused by pain perception. Conclusive research findings have suggested the use of IASTM may be indicated in the treatment of athletic injury and maintenance of athletic performance.

Conclusion

The studies presented in this review have limitations that prevent definite answers on the effect of IASTM on range of motion, pain, and reparative process of the body. There is conflicting evidence about the effectiveness of IASTM. Some findings reveal significant effects of IASTM on range of motion, pain. While other studies reveal no effect on the body's inflammatory reparative process. All studies in this reviewcontained small sample sizes. Although results for the use of IASTM may be statistically significant for range of motion improvement and pain resolution, it is hard to generalize the results to the entire active patient population. Data from larger sample sizes should be collected, so the results may be generalized to a larger population. The studies reviewed provided insightful information, the studies examined cannot provide definite evidence for or against the effectiveness of IASTM and its use in athletic settings. The lack of evidence for the effect of IASTM on inflammation does not allow for implications of its use in athletic settings.

Some studies reviewed found significant improvements in range of motion in both the upper and lower extremities suggesting IASTM should be indicated in the treatment of individuals with limited range of motion, and also provided evidence indicating IASTM is no more effective than widely available treatment options like stretching and self-myofascial release techniques.

Although IASTM has been shown to reduce pain in most cases, the mechanism as to how pain is reduced is still not known. Further research should be conducted to examine this mechanism. The current research is helpful in showing how IASTM may affect pain perception, but it is still hard to determine its true effects on the body.

Current research suggests IASTM has some positive effect on range of motion and pain, but no effect has been shown to inflammation. There may be a multidirectional relationship between all factors that indicate the use of IASTM. Deciphering how these effects work together may provide more definite evidence of the effectiveness of IASTM. Most studies focus on one effect only. To truly determine whether IASTM is an effective treatment method, studies analyzing all effects in a collective matter should be done.

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