The effects of an Instrument-Assisted Soft Tissue Mobilization (IASTM) protocol to improve shoulder range of motion for post-operative rotator cuff repair and debridement: a case report

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Abstract

Background and Purpose: It has been suggested that the use of Instrument-Assisted Soft Tissue Mobilization (IASTM) can be utilized to remove scar tissue from injury, improve blood flow, promote tissue healing, and increase range of motion (ROM). Improvements in ROM from the administration of IASTM were stated to be from the results of removing tissue adhesions and increasing muscle extensibility. However, there is a lack of literature examining the effects of IASTM on patients with a post-surgical status. The purpose of this case report is to evaluate the effects of IASTM on shoulder ROM in a patient with a post-operative rotator cuff repair and debridement.

Case Description: IASTM was initiated on the 14th therapy session for a duration of 8 weeks due continuously limited ROM, pain, diminished strength, and decreased left shoulder function. A protocol involving a warm up, IASTM, manual therapy, stretching, strengthening, and cryotherapy were initiated in that order to combat the deficits. Manual muscle testing (MMT), ROM measured by goniometry, Numeric Pain Rating Scale (NPRS), and the Upper Extremity Functional Index (UEFI) were collected prior to the IASTM protocol, on the 14th, 17th, 20th, and 23rd treatment session to asses for improvements in shoulder function.

Outcomes: The patient reported and demonstrated improvements in all objective measures at the end of an 8-week treatment. NPRS improved from 3/10 to 0/10. Shoulder flexion (flex) MMT from 3-/5 to 4-/5, shoulder abduction (abd) from 3-/5 to 4-/5, shoulder internal rotation (IR) from 3+/5 to 4+/5, shoulder external rotation (ER) from 3-/5 to 4-/5, and shoulder extension (ext) of 4+/5 to 5/5. Active shoulder flex increased from 109º to 135º, shoulder abd from 60º to 102º, IR from 38º to 75º, and ER from 20º to 44º. The UEFI raised a total of 13 points from 57/80 to 70/80 at the end of the protocol.

Discussion: The IASTM protocol as an intervention to increase shoulder mobility has already been demonstrated in other studies. However, the literature lacked evidence to support the use of IASTM for patients with a post-surgical status. The protocol implemented with IASTM may provide beneficial gains for pain, strength, shoulder active range of motion (AROM), and functional use of the shoulder for patients that are restricted in those areas as a result of a post-operative status.

Background and Purpose

The principles of IASTM originated from a traditional Chinese therapy known as “gua sha,” which referred to red spots (petechiae) that appeared over the skin of soft tissue as a result from scrapping of the skin with a metal instrument.[1] The theory behind this approach were to increase blood flow to the involved area to improve nutrients and oxygenation for soft tissue healing.[1] Although the names of the tools varied historically, the metal instruments used today consisted of different types of materials made from stainless steel.[1] Following an injury to soft tissue, a process of inflammation and proliferation will occur for the formation of new cells during tissue healing.[3] Throughout the healing process, the development of scar tissue and fibrosis can occur which can limit tissue extensibility and cause further adhesions that can limit gross ROM around a joint.[3] The loss of tissue extensibility and the formation of scar adhesions can diminish function and lead to pain.[3] In addition, scar tissue development can limit vital nutrients, blood supply, and oxygen perfusion to the injured area which can ultimately inhibit full physiological recovery.[3]

The use of IASTM can aid the clinician in identifying where the tissue adhesions are located by gently rubbing the edge of the metal instrument over the involved region.[2] The sensation of tissue adhesions or muscle tension within the soft tissue are characterized by "gritty, gravelly, and sandy" and those are the areas where treatment are indicated.[3,4] In addition, IASTM provides a mechanical advantage for the clinician because it provided the ability to generate an optimal amount of force to the soft tissue with minimal effort from the user.[4] Thus, less force is directed through the interphalangeal joints of the clinician compared to when manual soft tissue mobilization is administered.[3,4]

Several studies found that IASTM has an effect on pain following treatment to the local musculature surrounding the painful region. One of the explanations of pain is the occurrence of an acute soft tissue injury that initiated the cycle of inflammation.[3,4,3] Throughout this process, immune cells are recruited and pain is induced when substrates are secreted by the immune cells and stimulated nociceptive nerve endings.[4,5] Lee et al[4] reported a significant decrease in pain in 30 patients with chronic lumbar pain following treatment with IASTM for four weeks. Daniels and Morrell[5] found that use of IASTM once a week for six weeks, provided pain relief in youth football players diagnosed with plantar fasciitis. Another study by Howitt et al[6] demonstrated a reduction in pain after two weeks and a complete dissipation of pain after six weeks of IASTM for patients with tibialis posterior sprain. The results of these studies suggest that IASTM can be a valuable tool for pain relief and pain management.

Some studies reported that IASTM could significantly increase joint ROM following treatment of adhesive tissues surrounding the affected joint. Improvements in ROM from the administration of IASTM was a result of the removal of tissue adhesions and increasing tissue extensibility.[7] The mechanisms that drove the break-down of tissue adhesions originated from the friction generated by the metal instrument and that resulted in decreasing tissue viscosity, making the musculature softer.[9] A decrease in tissue viscosity contributed to the increased in ROM.[9] Baker et al[2] reported an increased in the sit and reach test by 5 cm and the active straight leg raise test by 7.5° in the hamstrings and triceps surae of men with lower extremity pain and tightness following IASTM for three times a week for one week. Another study conducted by Merkle et al demonstrated that two sessions of IASTM for three weeks increased the hamstring length of healthy collegiate baseball players.[8] An acute improvement in shoulder ROM into internal rotation by 11.1° was reported by Laudner et al[9] following a single treatment of IASTM. Though the outcomes varied among the literature, the results seemed to suggest that IASTM could facilitate improvements in ROM of the soft tissue.

From the literature review, there were many studies supporting the beneficial effects of IASTM on pain relief and improvements in ROM. Many of the subjects in the studies mentioned were young, athletic, healthy, or minimally impaired. To the author’s knowledge, there were not a sufficient amount of literature regarding the effects of IASTM on a patient who underwent a rotator cuff repair and a debridement. Therefore, the purpose of this case report is to describe the development and elucidate the effects of an IASTM protocol on a patient that is post-operative from a rotator cuff repair and a shoulder debridement.

Case Description: Patient History and Systems Review

The patient was a 58-year old male that was referred to physical therapy as a result of a four week post-operative left arthroscopic rotator cuff repair with a shoulder debridement secondary to a fall four weeks prior. His chief complaints were pain and stiffness of his left shoulder due to being immobilized by a sling as instructed by his physician. Since the procedure, he had a 3/10 pain that was characterized by a dull ache surrounding the incision site and it had been well managed through prescription medication. As a result of the procedure, the patient was unable to perform tasks associated with work as a chief financial officer because he could not effectively type on a computer with his sling on. In addition to being restricted at work, he struggled with activities of daily living (ADLs) including dressing, driving, washing, grooming, pushing/pulling, and overhead activities of his left shoulder. As a compensation strategy for transportation, he utilized he right upper extremity to drive. No remarkable findings were noted of other body systems including gastrointestinal, genitourinary, gynecological, and integumentary. However, the patient has a past medical history that includes hypertension and diabetes. He was on atorvastatin, azithromycin, fenofirbate, micronized, glipizide, losartan-hydrochlorothiazide, metformin, and metoprolol succinate to address those two comorbidities. The patient denied any numbness or tingling by the incision site or referring sensations down his left upper extremity. The UEFI was administered and the patient scored a 54/80. At the end of therapy, the patient's primary goal was to regain full use of his left upper extremity so he could return to a regular exercise routine at his local gym.

Clinical Impression #1

Another physical therapist conducted the initial evaluation of the first therapy session, but the patient was re-evaluated on the 14th visit by the author to determine candidacy for the IASTM protocol. Based on the documentation and a discussion with the prior therapist, the process of differential diagnosis was simplified by the post-operative status of the patient. From the information gathered during the patient interview, there were no red flags present that indicated a contraindication for physical therapy. As a result, the prior therapist decided to proceed with the physical examination that included a postural assessment, ROM of both upper extremities so the uninvolved extremity could be used as a reference for comparison, MMT of the right shoulder, and palpation of involved structures to identify tissue restrictions. In addition, an assessment of the cervical spine was also conducted as the prior therapist suspected the sling might impact posture and ROM in that joint.

Examination

Observation of body structure and posture without the sling in the sitting position demonstrated a mild forward head and rounded shoulders anteriorly. The conclusion to the postural assessment was made due to the external auditory meatus being located more anteriorly to the acromion process of the scapula. Manual assessment of the musculoskeletal system revealed significant limitations with AROM of his left shoulder in all directions along with pain during movement (Table 1). AROM of his right shoulder were all within normal ranges. The cervical spine AROM were assessed to be within functional limits and without pain, so the sling did not provide any additional restrictions to the patient. MMT of the left shoulder was deferred due to the post-surgical status of the patient. However, the results of MMT of the right shoulder in the directions flex, abd, IR, ER, and ext were graded a 5/5.

Assessment by palpation revealed tenderness and tightness of the left biceps brachii, posterior deltoid, and pectoralis minor. Assessment of the left glenohumeral (GH) joint presented as hypomobile in all directions using grades I-II mobilizations. Due to the limited mobility of his left GH joint, his bed mobility was independent, but with increased reliance on his right upper extremity to navigate himself on and off of the plinth.

Outcome Measures

The outcome measures used to capture change over time includes NPRS, ROM of the shoulder measured by goniometry, MMT and the UEFI patient questionnaire. These outcomes were chosen due to the established validity, reliability, and the known Minimally Clinically Important Difference (MCID) values. The NPRS has a MCID of 2.17 (95% CI).[10] It has an excellent test-retest reliability with r=0.95 and an excellent correlation between NPRS and the Visual Analog Scale (VAS) (r=0.94, 95% CI=0.93-0.95).[11,12] Goniometry was chosen to capture the changes in ROM in the shoulder over the course of the IASTM protocol. It has excellent intrarater reliability with an Intraclass Correlation Coefficients (ICC -3,k) for goniometry (≥0.94) and a concurrent validity (≥0.85).[13] The UEFI is a patient reported questionnaire that is used to quantify upper extremity function. It is applicable to this patient because it captured the functional ability and use of the involved upper extremity as he required it to meet his personal goals and work duties. The UEFI has a MCID of 8/80 and an excellent test-retest reliability (ICC=0.94).[14] MMT is a tool used by the therapist to obtain an accurate assessment on the strength of the shoulder.[15] MMT has an excellent inter-rater reliability by trained examiners with a ICC of 1.00 (95% CI 0.99-1.00).[17]

Table 1: Objective Measures of Pain, UEFI, MMT, and ROM

Session	Pain	UEFI	MMT		ROM	
			Left	Right	Left Shoulder AROM	Right Sh
Initial Evaluation	3/10	54/80	Flex: N/T Abd: N/T IR: N/T ER: N/T Ext:5-	Flex:5- Abd:5- IR:5- ER:5- Ext:5-	Flex:88* Abd:40* IR:34 ER:5*	F A
Re-Evaluation (9th visit)	5/10	57/80	Flex:3-* Abd:3-* IR:3-* ER:3-* Ext:4+	Flex:5- Abd:5- IR:5- ER:5- Ext:5-	Flex: 97* Abd: 47* IR: 37 ER: 11*	F A
Visit 14th (Initiation of IASTM)	4/10	57/80	Flex:3* Abd:3* IR:3* ER:3* Ext:4	Flex:5 Abd:5 IR:5 ER:5 Ext:5	Flex:109* Abd:60* IR:40* ER:20*	F A
(17th visit)	2/10	67/80	Flex:4* Abd:3* IR:4 ER:3* Ext:5	Flex:5 Abd:5 IR:5 ER:5 Ext:5	Flex:114 Abd:89* IR:44 ER:31*	F A
Visit 20th	2/10	N/A	N/T	N/T	Flex:117 Abd:90 IR:53 ER:36	F A
Visit 23rd	0/10	70/80	Flex: 4* Abd: 4* IR: 4 ER: 4* Ext:5	Flex: 5 Abd: 5 IR: 5 ER: 5 Ext: 5	Flex:135 Abd:102 IR:65 ER:44	F A

Flex = Flexion
Abd = Abduction
IR = Internal Rotation
ER = External Rotation
N/T = Not Tested
N/A = Not Available
* = with pain

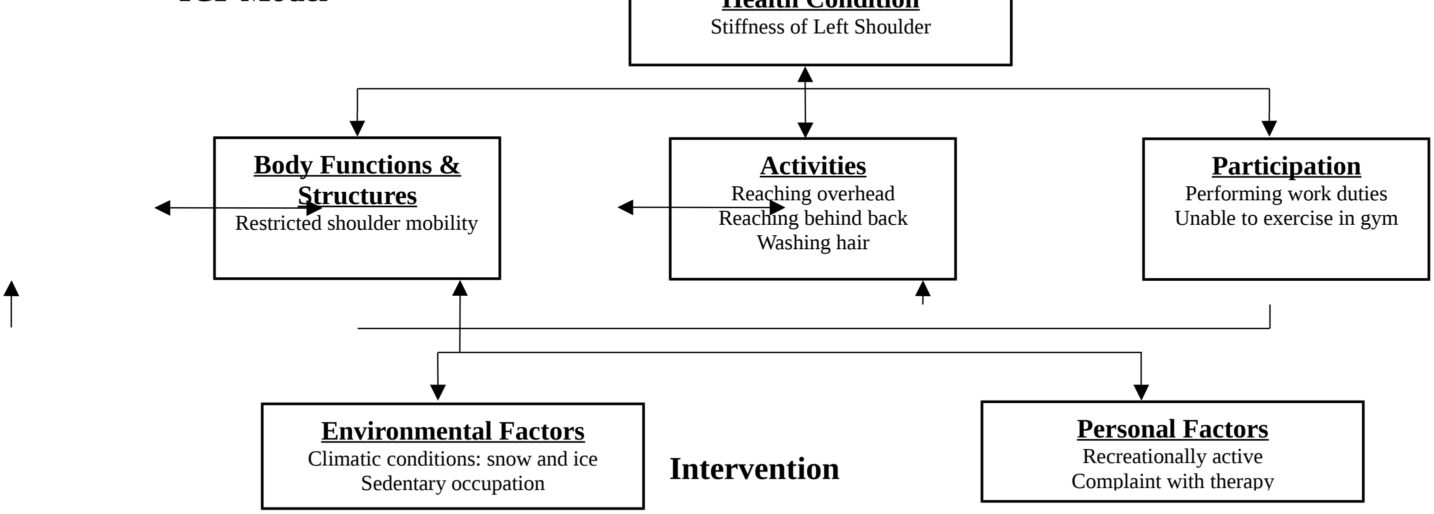
Clinical Impression #2

After completion of the physical examination, the previous therapist concluded that the patient presentation was aligned with the expectations of a post-operative status from a rotator cuff repair along with a debridement, and that he would benefit from physical therapy to address his limitations. The therapist devised a plan of care that included manual therapy and therapeutic exercise as part of his treatment plan to achieve his physical therapy goals based on the limitations.[16,17] Some noteworthy findings, included the significantly limited AROM of the left GH joint in all directions, stiffness and tenderness of the soft tissues around the joint, pain with active movement, and forward head and rounded shoulders. Although the therapist did not strength test the musculature of the left shoulder, it was suspected to be weak due to the traumatic process of surgery and immobilization for four weeks prior to the first therapy appointment.

As therapy progressed to the 14th visit, AROM of the left shoulder continued to be limited as illustrated by Table 1. The author suggested the use of IASTM to the previous therapist, which she thought the patient could benefit from. The author implemented an IASTM protocol based on previous positive outcomes from the literature. Since the patient continued to experience pain and restricted ROM, the author suspected the presence of significant scar tissue formation as a primary contributor. The culmination of scar tissue build up can prolong therapy and limit overhead motion.[18] Based on the current literature, IASTM can facilitate the removal of tissue adhesions and myofascial restrictions in non-surgical patients.[19]

Theoretically, the patient should be able to benefit from the effects of IASTM because it will promote fibroblast proliferation, collagen synthesis, maturation, and alignment through the initiation of an inflammatory response even though of the patient has a post-operative status.[20] If the IASTM protocol were to be successful, the author hypothesized that the improvements in ROM will stem from the removal of scar tissue adhesions and the decreased in pain from the facilitation of tissue healing.

ICF Model



Since the patient was treated by another physical therapist, his plan of care did not include IASTM up to the 13th treatment session. It was introduced at the 14th session because steady improvements in ROM were starting to plateau and additional ROM had not been consistently observed. Prior to the initiation of IASTM, the patient was receiving manual therapy that included soft tissue mobilizations and myofascial releases to the Biceps tendon, Deltoids, Supraspinatus, Infraspinatus, Teres Minor/Major, Latissimus Dorsi, and anterior/posterior capsule of the GH joint. In addition, PROM to end range with over pressure into flex, abd, and ER of the GH joint, joint mobilizations in anterior to posterior and inferior directions at the restricted range, scapular mobilizations in side-lying in all directions, and a passive Upper Trapezius stretch were implemented prior to the administration of the IASTM protocol.

The therapeutic effects of IASTM were explained to the patient prior to execution and the patient understood the potential adverse reactions that can occur such as bruising, petechiae, and soreness following treatment.[3] The patient was treated using the Functional and Kinetic Treatment with Rehab (FAKTR) F-2 tool (Appendix A-B) to the Pectoralis Major, Anterior Deltoid, and Biceps while the patient was in supine (Appendix C). The Latissimus Dorsi, Teres Minor/Major were treated in side-lying (Appendix D). Infraspinatus, Supraspinatus, Rhomboids, and Posterior Deltoid were treated in prone (Appendix E). The IASTM techniques were performed for 45 seconds parallel to the muscle fibers followed by 45 seconds perpendicular to the muscle fibers with the therapist holding the tool at 30º – 45º to the indicated muscle groups. As the FAKTR F-2 tool was applied, the patient was taken into repetitive passive shoulder abduction in the supine position and repetitive passive flexion in the side lying position. The pressure applied onto the involved regions were based on the tolerance of the patient, but the therapist utilized the NPRS and asked the patient to verbalize whether the pressure is >5/10 to avoid unnecessary discomfort. However, the goal was to maintain as much pressure the patient could tolerate since deeper pressure can promote a greater degree of fibroblast proliferation, which will improve the overall muscle extensibility of the involved regions.[21] The decision to apply IASTM to the muscles mentioned above was directed by the gritty sensations provided by the instrument.

The IASTM protocol (Table 2) that was followed was based on the Graston technique which starts with a warm-up, IASTM and manual therapy, stretching, strengthening, and followed by cryotherapy.[1] In addition, the patient received the usual course of manual therapy that was mentioned above after the administration of IASTM. The patient would start the therapy session on the Upper Body Ergometer (UBE) that included active reciprocal forward motion for three minutes followed by three minutes backward to improve blood flow to the upper extremities.[1,22] After warm-up, IASTM would be implemented as mentioned above followed by manual therapy to remove scar tissue and to facilitate the production of new collagen.[1,18] The patient would be instructed to perform his exercise program that included a series of stretching, strengthening, and neuromuscular re-education exercises to reinforce the benefits that were gained from IASTM.[1,23] At the end of his therapy session, he was to receive cryotherapy before he leaves or to apply ice onto the shoulder before the end of the day so he can prevent additional pain due to excessive inflammation from the IASTM. [1,6]

Table 2: Instrument-assisted soft tissue soft tissue mobilization (IASTM) protocol for soft tissue recovery[1]

Phases	**Parameters**
Warm-up	6 minutes on upper body ergometer
IASTM and manual therapy	30º – 45º parallel/perpendicular to the muscle fibers for 45 seconds
Stretching exercises	3 repetitions for 30 seconds
Strength training	High repetition with low load
Cryotherapy	10 minutes

Outcome

Changes in outcome measures were captured using the NPRS, UEFI, MMT, and ROM with a goniometer at initial evaluations, first re-evaluation, the 14th, 17th, 20th, and 23rd treatment sessions. Table 1 demonstrated the objective data recorded after administration of the IASTM protocol. MMT and goniometer data collection were based on the methods indicated in Reese and Hislop.[24,25] Pain scores were verbalized by the patient when asked to respond when a 0 indicates no pain and a 10 implied an immediate need for emergency medical attention. Lastly, the patient filled out the UEFI only on initial evaluation, re-evaluation, 14th, 17th and the 23rd therapy session. The patient was expected to lose shoulder ROM due to his surgical status and he was also expected to progress his ROM and strength as he was discharged from the sling per his physician order.[26] The changes in shoulder AROM in all directions can be observe after the initiations of IASTM at the 14th visit.

From the initiation of IASTM on the 14th visit to the day treatment stopped on the 23rd visit, the patient made significant improvements in AROM, pain, the UEFI patient questionnaire, and moderate improvements in MMT of his left shoulder. AROM in flex, abd, IR, and ER improved 26°, 42°, 25°, and 24°, respectively. The patient reported his pain score decreased from a 4/10 to a 0/10 at the end of the 23rd treatment and increased his UEFI score from a 57/80 to a 70/80. Although the difference in MMT grades were not immense, all previously tested muscle groups improved by one full grade. Both NPRS and the UEFI met the MCID of 2.17 and 8/80, respectively. [10,14]

Discussion

This case report described the effects of an IASTM protocol on a patient with a post-operative status from a shoulder rotator cuff repair and debridement. Currently, much of the research conducted with IASTM included soft tissue injuries that were not associated with any post-surgical status. To date, the author did not come across any research that included IASTM as an intervention to improve shoulder AROM after a rotator cuff repair and debridement. The rationale to implement the protocol described in this case report were based on positive outcomes from literature in the field of sports rehabilitation.[6,9,22,23,27,28] In addition, the author also suspected that the patient had a significant build-up of scar tissue that was limiting his shoulder ROM along with a type III scapular dyskinesia. The disrupted scapula-humeral rhythm was demonstrated by scapular hiking during AROM into shoulder flex and abd. As the author witnessed the dysfunction, it also contributed to the administration of IASTM on the periscapular muscles since it was possibly out of rhythm.

The IASTM protocol followed were divided into five phases that included a warm up, administration of IASTM and manual therapy, stretching, strengthening, and the use of cryotherapy at the end of each therapy session. The goal of the warm-up phase was to provide an environment where optimal changes can occur from the intervention as it increased blood flow, heating, and tissue plasticity to the target body part.[1] IASTM and manual therapy began shortly after the warm-up phase as the author identified the specific muscle to treat through the sensations of “gritty, gravelly, and sandy” provided by the instrument.[1,27] In phase three, the patient was instructed to perform all of his stretches prior to performing any strengthening exercises in an attempt to correct the shorten tissue and maintain any new ROM that was gained from the administered IASTM.[1,23] Improved extensibility should follow after stretching the tissue and the patient continued onto strengthen to realign dysfunctional collagen. [28] Lastly, the patient received cryotherapy prior to leaving the clinic as it was intended to reduce pain, manage excessive inflammation, and prevent secondary cell hypoxic injury.[29]

A number of limitations were present in this case report. Although the patient showed signs of improvements at the end of the IASTM protocol, it cannot be established that the protocol was more effective than traditional care since there was no control group. Thus, a causal relationship between the protocol and its effects cannot be demonstrated. Due to intrarater/ interrater reliability, goniometer measurement, and MMT grading and testing positions, the data collected by the other therapist did not utilize the methods indicated in Reese and Hislop on the initial evaluation, re-evaluation, and the 23rd treatment session.[24,25] In the last phase of the IASTM protocol, the patient did not always immediately received cryotherapy. There were multiple times where the patient had to return to work after therapy, but the patient stated he applied an ice pack to his left shoulder as instructed.

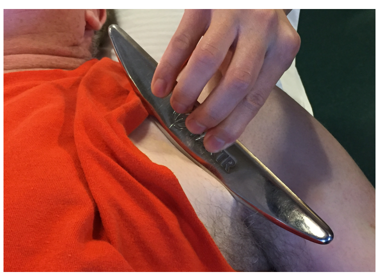
Conclusion

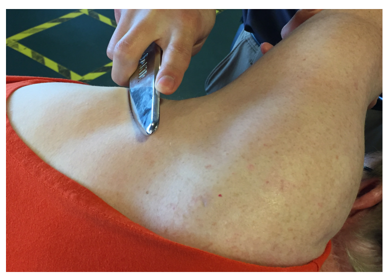
This case report demonstrated that an IASTM protocol has some relationship with improvements of shoulder AROM, MMT, pain, and a self-reported UEFI patient questionnaire after an arthroscopic rotator cuff repair along with a debridement in 8 weeks. Though the protocol was not strictly followed, the patient still met the MCID for NPRS and the UEFI. The current literature available on the effects of IASTM was not relevant to individuals with a post-operative status. To the author's knowledge, this is the first case report where an IASTM protocol was implemented for an arthroscopic rotator cuff repair along with a debridement. The results of this case report suggested that the implementation of the IASTM protocol could have initiated earlier in the rehabilitation process for even better outcomes. Thus, further research is required to establish a causal relationship between the IASTM protocol and its therapeutic effects and on individuals with other post-surgical procedures.

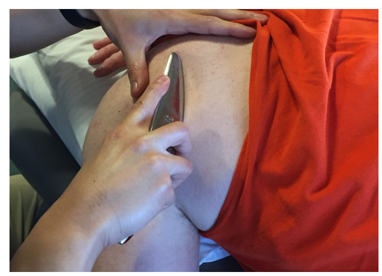
Appendix A and B

	
A. FAKTR F-2 Tool (Front)	B. FAKTR F-2 Tool (Back)

Appendix C, D, and E


C. Supine


D. Side-lying


E. Prone

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