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Comparison of The Effectiveness of Instrument-Assisted Soft Tissue Mobilization Technique, Ultrasound therapy, or Deep Friction Massage on Fast Recovery and Accelerating Tissue Healing in Groin Strain

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ABSTRACT

Background: Instrument-assisted soft tissue mobilization technique (IASTM), Ultrasound therapy (US), and Deep Friction Massage (DFM) offered to manage adductor muscles for facilitating the fast recovery and promoting tissue healing. Few studies are available about the effects of IASTM, how far the effectiveness of ultrasound on the functional recovery is still under debate. Deep friction massage is known to be used to promote muscle fiber arrangement. Methods: 46participants divided randomly into four groups; (I) control group, no agent used (n=10), (II) instrument-assisted soft tissue mobilization technique (n=12). (III) Ultrasound therapy (n=12) (IV) Deep friction massage (n=12). 15 sessions delivered to all participants over five weeks, day after day. Analysis: Numerical Pain Scale, Inclinometer, dynamometer, and ultrasound imaging used to measure pain severity, pain-free abduction passive range of motion, maximum pain-free adductor contraction, and tissue healing respectively. Baseline measurements were done before any intervention, and measures after the 1st week, 3rd week, and at the end of the therapeutic intervention. Repeated measures MANOVA used to compare within and between groups. Result: IASTM and US show a significant effect on Pain, recovery (ROM {P<0.031, P <0.018} – Strength {P <0.026, P <0.041}), and proper healing (P <0.049, P <0.021). Initially, ultrasound was effective in reducing pain intensity and accelerating healing but, IASTM is more effective in gaining recovery. DFM only has a tissue healing effect (P <0.039). Conclusion: IASTM is the most effective method regarding fast recovery and proper tissue healing in groin strain unless the pain is not a big issue.

Keywords: *Adductor strain, Instrument-Assisted Soft Tissue Mobilization, Muscle healing.*

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INTRODUCTION

Adductor strain is a common injury in athletes; this injury is ranked the second most common injury after a hamstring strain, and it causes pain and movement limitation within the affected muscle group. [1] While the healing process of the muscle fibers progresses, the function of the tissue decreases, as long as healing lasts as long as functional restrictions

exist. [2] There are three stages of muscle healing; Destruction, Repair, and Remolding stage.

Healing should be guided carefully and should be enhanced as much as possible to reassure proper healing. [3]Many physical therapy agents, either mechanical like Deep Friction Massage (DFM) and Ultrasound therapy (US) or electrical like Laser and Electrical Stimulation (ES) are available to facilitate the healing process of the injuries, aiming to gain a fast recovery. [4]

DFM is usually used to help in the rearrangement of fibers during the healing process, especially in the remodeling stage. [5] Ultrasound is known to be used in the inflammatory phase, but the extent of its effect on functional outcomes is still under debate. [6, 7] A laser is known to have a significant impact in decreasing pain, promoting healing, and encouraging cell reproduction within injured soft tissue, but the cost-effectiveness and the availability are considered burdens when deciding to use it. [8-10]

All the previously-mentioned modalities focus on enhancing healing of the injury and trying to help the patient recover without any or fewer complications, but there is no mention of their impact on the healing timeframe.

Instrument-assisted soft tissue mobilization technique (IASTM) is a modality used to address musculoskeletal pathology-related impairments. [11] A decrease in pain intensity of sports injuries, an improvement in joint range of motion, and an enhancement of soft tissue functions due to using IASTM had been reported. [12]

IASTM is a practical and straightforward technique. Its surface minimizes the force used by the therapist and maximizes the energy being delivered to the injured tissue. [13] Furthermore, IASTM is capable of producing healing in a much shorter time than friction massage. [14] Following an injury, it is can also help speed up healing if applied clinically and produce the triumphant return to daily activities and sports. [8]

Only a few studies are available about the impact of IASTM. This report tries to point out the effectiveness of using IASTM to manage such a case aiming to facilitate a quicker repair process.

PATIENT HISTORY AND SYSTEMS REVIEW

46 subjects their age ranged from 19 to 37 years old enrolled in this controlled study. Participants divided randomly into four groups; (I) control group, no agent used (n=10), (II) instrument-assisted soft tissue mobilization technique (n=12). (III) Ultrasound therapy (n=12) (IV) Deep friction massage (n=12).

15 sessions delivered to all participants over five weeks, day after day (no session on Friday), all of them received a standard protocol of active range of motion exercise, gentle stretch, progressive resistive exercises, and home exercise program (HEP). This study was approved by the guidelines of the local ethics committee.

Examination and Clinical assessment

Patients initially were seen in an outpatient physical therapy department of Cairo University Hospitals. Once the patient was received, an initial traditional evaluation was done. During the initial assessment, the following systems were reviewed. Neurologically, she is entirely intact; screening was done by light touch and 2-point discrimination, and she reported no sensory loss compared with the other side. At initial assessment, the integumentary system was assessed visually and by palpation and showed moderate ecchymosis, edema noted and seen over the superior medial border of the left thigh. By palpation over this area, a point of severe tenderness was reported with a feeling of hardness. The patient responds negatively to all inquiries about any previous orthopedic injuries, corticosteroids injection or skin allergies.

Pain severity was measured by the Numerical Pain Rating Scale (NPRS) ***(Figure 1)*** which gave a real impression of the experienced pain and considered to be a useful instrument for evaluating the pain over time and providing an indication when the patient feels cured. [15] In soft tissue injuries with similar cases, NPRS was found to be the most reliable method for the measurement of acute pain; a significant correlation between NPRS and pain relief, patient satisfaction, Faces Pain Scale-Revised (FPS-R) was found in a study conducted on patients whose age as old as my patient. Also, its validity was reported. [16] MCID found to be 2 points, and that is reasonable and statistically satis-

factory. [17] The scale was illustrated graphically to the patient for self-completion.

Pain-free passive hip abduction range of motion was measured using a digital inclinometer (9 in. Digital Level, HUSKY Inc., USA) **(Figure 2)**, this method had been shown to have high ICC level (inter or intra-rater). [18] A digital inclinometer was found to be a valid and reliable tool in measuring joint ROM, and it is more accurate in measuring hip abduction than a standard goniometer with (ICC = 0.9). [19] From a supine lying position, the patient was instructed to abduct her right lower limb as much as she could, once she began to feel pain, she should immediately stop, and the measurement recorded.

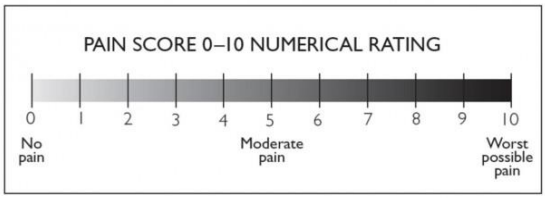

Figure 1: Numerical Pain Rating Scale (Used with Permission)

Figure 2: Digital Inclinometer.

The maximum pain-free isometric contraction of hip adduction was measured by Hand-Held Dynamometer (HHD) (Lafayette Model 01165, USA). This is an ergonomic hand-held device (Figure 3) for objective quantifies of the muscle strength. Although the most common method for evaluating muscle strength is manual muscle test (MMT), [20] but the interrater reliability for HHD was excellent (0.80–0.96); (SEM percentage = 7.0% – 22.0%), (MDC = 3.6 for 13.2 - 52.4 Nm). [21] Patient was instructed to adduct her right lower limb isometrically against the HHD while she was laid on her back and her hip in a neutral position. For both ROM and HHD, an average for three attempts had been recorded. Measures of the initial assessment are summarized below **(Table 1)**.

Figure 3: Hand-Held Dynamometer

Muscle injuries can be classified into extrinsic, due to contusion or penetrating wound, or intrinsic, due to sudden elongation of the muscle containing primarily type II fiber leading to a tear. [22] Ultrasonographic examination (US) imaging can classify the intrinsic muscle injury into three grades. Grade 01, less than 5% of muscle injured and involvement of a few muscle fibers; Grade 02, partial lesion occurred and up to 50% of the tissue torn, and the damage occupies up to ¾ of the involved fibers; Grade 03, more than 50% of the muscle involved and more than ¾ of the fibers ruptured. [23] The US is not a suitable diagnostic modality for classifying extrinsic muscle injuries.

Table 1: Summary of the initial assessment

	NPRS	Abd. ROM	Add. isometric contraction	Injury Classification
Injured.	8/10	18^0	21.6 N (2.2 Kg)	Grade 02: 45 % of the fiber
Sound.	0/10	52^0	52.5 N (5.35 Kg)	Normal Appearance

The US was used to image and describe the healing process from an anatomical point of view over time. The existence of accumulated blood, the appearance of muscle fibers and any calcification may exist are the parameters examined.

Intervention

The local ethics committee approved this study, the treatment was conducted after the acceptance received, and by their guidelines. Treatment began the following day (4^{th}day of injury). Twelve treatments were done to the patient over 30 days in addition to a Standard protocol of active range of motion exercise, gentle stretch, and weight-free resistive exercises.

The home exercise program (HEP) was advised to control the prognosis and maintain the achieved result. HEP contain stretching exercise for 5 min. (Squatting, frog leg and abdominals stretch from prone lying) and strengthening for 10 min. (Ball squeeze by both knees, with a fastened tube to the ankle; hip adduction away from a wall, controlled leg backward from a full hip extension, push against a ball on a wall with the leg turned out).

There are a lot of traditional modalities used to manage such a case. These modalities include; therapeutic ultrasound (US), deep friction massage (DFM) and LASER. Even though the US has no significant effect on muscle regeneration, it is still recommended and used. [24] DFM usually used to enhance the process of healing and increase the flow of nutrients and blood around the affected area, but up till now no strong evidence-based data about its effect in cases of a groin pull and most common indications of its use are lateral epicondylitis or lateral knee pain. [25] LASER is usually recommended in cases of skeletal muscle injuries but the inflammatory phase. [26] During the remodeling phase, LASER has a significant effect on extracellular matrix (ECM) and angiogenesis with no significant impact on tissuerearrangement. [27]

For the application of instrumented mobilization, M2T-Blade was used **(Figure 04a, b)** which was made from 100% Surgical Grade Stainless Steel (Made in Canada). It is the only double beveled (35° and 55°) available on the market. During the first two weeks, a downward force applied approximately equal to 350 - 500g as this force was previously used but on animal models. [28] A training for the desired pressure was done at a folded sheet over a digital flat scale before the actual appliance, to ensure the delivery of the required pressure within limits of the mentioned parameters. This force was kinesthetically determined to be used clinically to treat ligaments of comparable tissue depth. [29] One-way stroking (from inferior to superior) at a frequency of 80 strokes per minute was applied for 5 minutes at the beginning of the treatment session and after for 3 minutes after 30 minutes of therapeutic exercise. During the seventh treatment, a force approximately equal to 500 - 750 g was applied for 3 minutes at the beginning of the treatment session and 90 seconds at the end of the clinical setting. The patient was advised to utilize ice massage upon returning home to reduce any skin hyperemia.

Figure 4a

Figure 4b

OUTCOME

An objective assessment was done and data obtained by using valid and reliable tools, as reported by recent literature. The initial assessment was completed at the first visit as mentionedReevaluationwas done after two and four weeks from the initiation of treatment.

Pain significantly decreased after two weeks of treatment, and by the end of the fourth week, the patient reported only mild discomfort with quick movements. By the first reevaluation, pain-free passive ROM of hip abduction increased 30.7 % (160); and by the second reevaluation, the range increased 54.7 % from the initial assessment (almost achieved 90 % of the available range for the contralateral side). Pain-free maximum isometric contraction of hip adductors increased by 28.3 % at the first reevaluation with the comparison to the strength of the contralateral limb. By the end of the fourth week, maximum contraction increased by 50.2 % from the initial assessment, achieving 92.3 % of the maximum isometric contraction of the contralateral limb by the end of the fourth week.

Grade II muscle injury requires at least 5 – 8 weeks to show what is shown by the diagnostic US after four weeks. [30] **(Table 2)** summarizes the outcome measures of re-evaluation.

IASTM and US therapy show a significant effect on Pain, fast recovery (ROM – Strength), and proper tissue healing. Initially, the US was effective in reducing pain intensity and accelerating tissue healing, but by the end, IASTM is more effective in gaining functional recovery. DFM fail to achieve any significant effect regarding pain and functional recovery, but proper tissue healing had a significant statically psychometric parameter.

Table 2: Summary of re-evaluation follow-up

	Initial Assessment.	**After two weeks**	**After four weeks.**
NPRS	8/10	4/10	2/10
Abd. ROM	18^0	34^0	47^0
Add. contraction	21.6 N (2.2 Kg)	36.5 N (3.7 Kg)	48 N (4.9 Kg)
Injury Classification	Grade 02: 45 % of the fiber	Grade 02: 20 % of the fiber	Grade 01: 4 % of the fiber

DISCUSSION

Once any muscle has been injured, three stages of healing should occur. Stage I (degeneration/inflammation); rupture and necrosis of the myofibers exist and a hematoma forms and the inflammatory reaction is initiated {3 – 4 days}, Stage II (Regeneration phase); phagocytosis of damaged tissue, followed by myofiber regeneration {3 – 4 weeks}, stage III (Remolding); recovery of muscle functional capacity due to maturation of regenerated myofibers {5 – 7 weeks}. [31]

DFM failed to have a significant effect on pain or quicken the recovery in cases like epicondylitis and lateral knee pain. [24] A comparison of DFM with placebo ointment, US, and phonophoresis shows insufficient evidence to support its use in the future. [32] IASTM succeeded to decrease the pain intensity within a shorter time than usually expected.

Rantanen et al. 1999 found that using US after injury increases the period of rapid fibroblast proliferation from 3 - 4 days average to 7 - 10 days whereas capillarization was still unaffected. [23] Diagnostic ultrasound performed after two weeks showed that the second stage had begun. This showed that the muscular tissue started the second stage of healing a week earlier than the known time frame.

Even though the laser is very useful in enhancing tissue proliferation, it had a short-term effect only and failed to achieve speeding up the healing process. [8] Diagnostic ultrasound was performed after four weeks and showed the beginning of the remolding stage. This demonstrated that muscular tissue began two weeks earlier than the standard time frame.

RECOMMENDATION AND CONCLUSION

A more objective tool for showing the myofibrils should be used rather than the diagnostic ultrasonography to clarify the histological changes that may have occurred over time within the injured muscle throughout the healing process. Metabolic imaging may be very beneficial for tracking the process of healing, but it is not feasible everywhere and very expensive.

By the end, as an external mechanical agent, IASTM succeeded to lead the proper healing of the tissue within less time than the known. The statistical result was satisfactory; it showed a significant improvement in pain, ROM, and the ability of the muscle to contract without restriction due to a wrench.

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