INFLUENCE OF INSTRUMENT ASSISTED SOFT TISSUE TECHNIQUES VERSUS ACTIVE SOFT TISSUE THERAPIES ON LATENT TRIGGER POINT OF UPPER TRAPEZIUS MUSCLE: RANDOMIZED CLINICAL STUDY

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ABSTRACT

Background: Myofascial pain syndrome is common problem; Soft tissue mobilization is a type of manual therapy frequently used by clinicians to address the pain and dysfunction associated with it.

Objectives: To compare the effects of active soft tissue therapies versus instrument assisted soft tissue techniques in chronic neck pain patients with latent trigger point of upper trapezius muscle.

Methods: Design of the study was randomized clinical study. Forty-five female chronic neck pain patients with latent myofascial trigger points in the upper trapezius muscle were randomly assigned into equal groups of 15 subjects. Group (A) received stretching exercise and active soft tissue therapy, group (B) received stretching exercise and IASTM and group (C) received stretching exercise only. Pain pressure threshold and cervical ranges of motions were obtained before and after treatment in each group.

Results: Mixed MANOVA revealed that there was a significant interaction of treatment and time (F [14, 72] = 8.97, p = .001). There was a significant main effect of time (F [7, 36] = 699.15 p = .001). There was a significant main effect of treatment (F [14, 72] = 5.34, p = .001). Within-group comparison revealed a significant increase in PPT and cervical ROM in the three groups post treatment compared with that pretreatment (p < .001). Between groups comparisons pretreatment revealed a no significant difference in all parameters (p > .05). Comparison between groups post treatment revealed a significant increase in PPT and cervical flexion, extension, lateral flexion and rotation toward affected and non-affected side of group A and B compared with that of group C (p < .01). While there was no significant difference in in PPT and all cervical ROM between group A and B post treatment (p > .05).

Conclusion: The current study does not support the efficacy of IASTM in increasing pain pressure threshold and range of motion in chronic neck pain patients with latent trigger point of upper trapezius muscle when compared with other treatments.

Keywords: Instrument Assisted, Soft Tissue, Manual Therapy, Trigger Point.
I. INTRODUCTION

Myofascial pain syndrome (MPS) is defined as pain that comes from myofascial trigger points in skeletal muscle. It is prevalent in regional musculoskeletal pain syndromes, either alone or in combination with other pain generators. The appropriate evaluation and treatment of myofascial pain is an important part of musculoskeletal rehabilitation. The trigger points (TPs) are classified as active or latent: The active trigger points manifests as referred pain even during rest, and the latent type defined as “clinically quiescent with respect to spontaneous pain; it is painful only when palpated. Latent myofascial trigger points (MTrPs) may have all the other clinical characteristics of an active MTrP and always has a taut band that increases muscle tension and restricts range of motion. Manual therapy is a commonly used treatment for MPS as it has been considered one of the most effective techniques for the inactivation of MTrPs. Passive and active methods have been used as a clinical tool for the treatment of muscle dysfunction. Soft tissue mobilization (STM) is a massage-based modality that can be administered by hand alone or with rigid devices.

Instrument assisted soft tissue mobilization (IASTM) is a popular treatment for myofascial restriction based upon the rationale introduced by James Cyriax. Unlike the Cyriax approach utilizing digital cross friction, IASTM is applied using specially designed instruments to provide a mobilizing effect to soft tissue (e.g., scar tissue, myofascial adhesion) to decrease pain and improve range of motion (ROM) and function. The use of the instrument is thought to provide a mechanical advantage for the clinician by allowing deeper penetration and more specific treatment, while also reducing imposed stress on the hands. Using instruments for soft tissue mobilization is theorized to increase vibration sense by the clinician and patient. The increased perception of vibration may facilitate the clinician's ability to detect altered tissue properties (e.g., identify tissue adhesions) while facilitating the patient's awareness of altered sensations within the treated tissues. No studies have directly compared the outcomes of active soft tissue therapies and IASTM in chronic neck pain patients with latent trigger point of upper trapezius muscle. Therefore, the purpose of this study was to determine the efficacy of IASTM compared to active release technique in the treatment of chronic neck pain patients with latent trigger point of upper trapezius muscle.

II. METHODS

Design

A randomized single-blind controlled clinical trial was conducted at El Sahel Teaching Hospital, Cairo, Egypt.

Participants

Fifty six female subjects with chronic mechanical neck pain referred by their physician to physical therapy were screened for eligibility criteria; the volunteers were female because gender differences may have influenced the results as the difference among sex in terms of pain threshold. Participants were screened for signs of verteobasilar insufficiency and underwent manual screening for upper cervical spine ligamentous instability. Participants were examined for the presence of latent TrPs in the upper trapezius muscle by a clinician with more than 15 years of experience in the management of TrPs. Therapist determines the most sensitive latent TP in the left or right upper trapezius by evaluating the level of sensitivity using hand palpation and algometer. Participants were included if they had a minimum of 1 palpable nodule in the upper trapezius muscle and hypersensitive tender spot in a taut band in response to 2.5 kg/cm2 of pressure, and were excluded if they had any contraindication to manual therapy or IASTM (osteoarthritis, spinal fracture or infection, neoplastic disorders, anticoagulant medication), active TP or jump sign, and Myofascial pain therapy within the month before the study. The participating patients understood the study purpose and associated information and provided their written consent to participation.

The selected participants were then randomly allocated to 3 groups by researcher not involved in the recruitment and/or treatment of patients. Using a lottery draw: each participant received a sealed envelope containing one of the letters A, B, or C, those who received letters A, B, and C became members of active, IASTM and stretching groups, respectively.

The study protocol was approved by the ethical committee of faculty of physical therapy—Cairo University (NO: P.T. REC/012/002113) and was registered on Pan African Clinical Trial Registry (PACTR) registration number was PACTR20190748249. This study was registered retrospectively due to lack of awareness about the mandatory prospective registration of clinical trials and lack of local registry.
Outcome Measures
The primary outcome measures included pressure pain threshold. It was assessed with a digital pressure algometer, FDX® (Wagner instrument, Greenwich, advanced digital algometer with RS232). Auto calibration was done before data collection commenced. The pressure pain threshold measurement for the trapezius was performed at the center of the upper trapezius, at a position 2–3 fingers below the center of the spine of scapula. The investigator placed the digital pressure algometer on a site to be examined and pressed against the tester in a vertical direction while increasing the force at a constant rate of 1 kg/cm² (Figure 1). The investigator instructed the subjects to express pain either by saying “ouch” or raising their hands when only slight pain was felt. 15

Figure 1. The investigator placed the digital pressure algometer on a site to be examined

The secondary outcome measures included cervical range of motions, which was assessed with Deluxe Cervical Range of Motion Instrument; Model #12–1,156 (Fabrication Enterprises, White Plains, NY).

Cervical range of motions was determined in 3 planes of movement. It was measured in a standardized sitting position to remove errors and movement compensation.16,17 Place the cervical range of motions device (CROM) on their head like a pair of glasses. The CROM attaches to the subject's head and contains two gravity goniometers and one compass goniometer. Sagittal and frontal plane gravity goniometers measure flexion-extension and lateral flexion respectively. Rotation is measured by the compass goniometer in conjunction with a magnetic yoke.18 Pressure pain threshold and active cervical range of motions were assessed at baseline and post intervention by an assessor blinded to the treatment allocation group.

Procedure
Stretching exercise and Active Soft Tissue Therapy (Group A): Patient sat on a chair. The therapist stood behind the participant and held one hand over head as the support, with the thumb of the other hand scan to detect the painful area of the latent TP of the upper trapezius muscle along the fibers. Then, pressure was applied by the thumb and the participant was asked to simultaneously actively change the muscle from shorted position to elongated state (ipsilateral side flexion of the cervical to the opposite side). This technique was repeated 3–5 times per session, and each repetition was maintained for 40–60 s till release is felt, with a 15-second rest interval. 15,19 Three times passive stretching of the upper trapezius muscle was also performed for 45 s for each side.

Stretching exercise and IASTM (Group B): IASTM tool as show in (Figure 2). Patient lied prone; the treatment was applied for approximately 20-seconds in a direction parallel to the muscle fibers with the instrument at a 45º angle. Followed immediately by treating the muscles in a direction perpendicular to the muscle fibers with the instrument at a 45º angle for an additional 20-second, resulting in a total treatment time of approximately 40 s. This technique was applied 3–5 times per session with 20 s rest between each time. 20 Three times passive stretching of the upper trapezius muscle was also performed for 45 s for each side.
Figure 2. IASTM Tool

Stretching exercise only (Group C): three times passive stretching of the upper trapezius muscle (Cervical flexion, contralateral side flexion, and ipsilateral rotation) was also performed for 45 s for each side.

Data Analysis

Descriptive statistics and ANOVA test were conducted for comparison of subject characteristics between groups. Normal distribution of data was checked using the Shapiro–Wilk test for all variables. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. Mixed MANOVA was performed to compare within and between groups effects on PPT and cervical ROM. Post-hoc tests using the Bonferroni correction were carried out for subsequent multiple comparisons. The level of significance for all statistical tests was set at p < .05. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL).

III. RESULTS

Fifty-six female's patients with chronic neck pain were screened for eligibility criteria. Only forty-five one, Age ranged from 25–50 years, satisfied the eligibility criteria, agreed to participate, and were randomized into equal groups of 15 subjects. Consort flow diagram shown in Figure 3.
Subject Characteristics

Table 1 showed the subject characteristics of the group A, B and C. There was no significant difference between groups in age, weight, height and BMI (p > .05).

Table 1. Basic characteristics of participants

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>28.7 ±4.4</td>
<td>30.3 ±4.2</td>
<td>27.4 ±4.3</td>
<td>0.20</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>69.5 ±10.97</td>
<td>69.5 ±13.9</td>
<td>67 ±11.1</td>
<td>0.81</td>
</tr>
<tr>
<td>Height (cm²)</td>
<td>162.0 ±8.2</td>
<td>165.5 ±8.6</td>
<td>163.0 ±6.8</td>
<td>0.46</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>26.4 ±3.3</td>
<td>25.4 ±4.9</td>
<td>25.16 ±3.9</td>
<td>0.67</td>
</tr>
</tbody>
</table>

α, Mean; SD, Standard deviation; p-value, probability value

Effect of Treatment on PPT and Cervical ROM

Mixed MANOVA revealed that there was a significant interaction of treatment and time (F [14, 72] = 8.97, p = .001). There was a significant main effect of time (F [7, 36] = 699.15 p = .001). There was a significant main effect of treatment (F [14, 72] =5.34, p = .001).

Table 2 showed descriptive statistics of PPT and cervical ROM and the significant level of comparison between groups as well as significant level of comparison between before and after treatment in each group.

Within Group Comparison
Within-group comparison revealed a significant increase in PPT and cervical ROM in the three groups post treatment compared with that pretreatment (p < .001). (Table 2).

**Between Group Comparisons**

Between groups comparison pretreatment revealed a non-significant difference in all parameters (p > 0.05). Comparison between groups post treatment revealed a significant increase in PPT and cervical flexion, extension, lateral flexion and rotation toward affected and nonaffected side of group A and B compared with that of group C (p<0.01). There was no significant difference in in PPT and all cervical ROM between group A and B post treatment (p>0.05; Table 2).

**Table 2.** Mean PPT and cervical ROM pre and post treatment of group A, B and C:

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
<th>p-value</th>
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</thead>
<tbody>
<tr>
<td><strong>PPT (kg/cm²)</strong></td>
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<td></td>
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<tr>
<td>Before treatment</td>
<td>1.4 ± 0.1</td>
<td>1.39 ± 0.18</td>
<td>1.3 ± 0.17</td>
<td>1</td>
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<tr>
<td>After treatment</td>
<td>2.5 ± 0.2</td>
<td>2.66 ± 0.2</td>
<td>2.1 ± 0.17</td>
<td>0.09</td>
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<tr>
<td>p = 0.001</td>
<td>p = 0.001</td>
<td>p = 0.001</td>
<td>p = 0.001</td>
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<tr>
<td><strong>Cervical ROM (deg)</strong></td>
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<tr>
<td><strong>Flexion</strong></td>
<td></td>
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<tr>
<td>Before treatment</td>
<td>39.1 ± 5.1</td>
<td>41 ± 5.8</td>
<td>41 ± 4.2</td>
<td>0.9</td>
</tr>
<tr>
<td>After treatment</td>
<td>53.4 ± 2.7</td>
<td>53 ± 3.7</td>
<td>49 ± 2.5</td>
<td>0.001</td>
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<tr>
<td>p = 0.001</td>
<td>p = 0.001</td>
<td>p = 0.001</td>
<td>p = 0.001</td>
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<tr>
<td><strong>Extension</strong></td>
<td></td>
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<tr>
<td>Before treatment</td>
<td>63.6 ± 5.8</td>
<td>63.5 ± 3.8</td>
<td>61.9 ± 2.5</td>
<td>1</td>
</tr>
<tr>
<td>After treatment</td>
<td>72.6 ± 3.5</td>
<td>73.1 ± 3.2</td>
<td>68.8 ± 1.97</td>
<td>0.003</td>
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<tr>
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<td>p = 0.001</td>
<td>p = 0.001</td>
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<tr>
<td><strong>Lateral flexion toward affected side</strong></td>
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<tr>
<td>Before treatment</td>
<td>24.9 ± 4.6</td>
<td>24.5 ± 4.1</td>
<td>25.3 ± 4.1</td>
<td>1</td>
</tr>
<tr>
<td>After treatment</td>
<td>41.2 ± 2.5</td>
<td>41.1 ± 3.2</td>
<td>36.6 ± 3.04</td>
<td>0.001</td>
</tr>
<tr>
<td>p = 0.001</td>
<td>p = 0.001</td>
<td>p = 0.001</td>
<td>p = 0.001</td>
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<tr>
<td><strong>Lateral flexion toward non affected side</strong></td>
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</tr>
<tr>
<td>Before treatment</td>
<td>30.9 ± 3.6</td>
<td>29.7 ± 3.3</td>
<td>28.9 ± 2.6</td>
<td>0.92</td>
</tr>
<tr>
<td>After treatment</td>
<td>42.5 ± 2.3</td>
<td>41.1 ± 2.3</td>
<td>36.8 ± 2.8</td>
<td>0.34</td>
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<tr>
<td>p = 0.001</td>
<td>p = 0.001</td>
<td>p = 0.001</td>
<td>p = 0.001</td>
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<tr>
<td><strong>Rotation toward affected side</strong></td>
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<tr>
<td>Before treatment</td>
<td>64.7 ± 3.4</td>
<td>63.4 ± 3.1</td>
<td>63.7 ± 2.7</td>
<td>0.79</td>
</tr>
<tr>
<td>After treatment</td>
<td>73.7 ± 2.8</td>
<td>75 ± 3.2</td>
<td>70.2 ± 1.2</td>
<td>0.55</td>
</tr>
<tr>
<td>p = 0.001</td>
<td>p = 0.001</td>
<td>p = 0.001</td>
<td>p = 0.001</td>
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<tr>
<td><strong>Rotation toward non affected side</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Before treatment</td>
<td>68 ± 3.2</td>
<td>68.5 ± 2.4</td>
<td>67.3 ± 2.2</td>
<td>1</td>
</tr>
<tr>
<td>After treatment</td>
<td>75.9 ± 1.9</td>
<td>77.5 ± 2.6</td>
<td>72.1 ± 2.8</td>
<td>0.24</td>
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<tr>
<td>p = 0.001</td>
<td>p = 0.001</td>
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</table>

§, Mean; SD, Standard deviation; p-value, probability value

**IV. DISCUSSIONS**

The results of this study showed significant improvement in pain and all cervical ROM after active soft tissue therapies and IASTM as well. But there were no significant difference was observed between the effects of active groups and IASTM group in pain and cervical range of motion in subjects with chronic neck pain with latent trigger point of upper trapezius muscle. This come in contrary with the work of Cheatham et al.,2016 who concludes that literature measuring the effects of IASTM is still emerging and non-significant results which challenges the efficacy of IASTM as a treatment for common musculoskeletal pathology. Also a systematic review by Nazari et al.,2019 does not support the use of IASTM to improve pain, function, or range of motion in individuals without extremity or spinal conditions or those with varied pathologies. Although IASTM technique in this study was determined to have better benefit than that in active therapy but this did not reach to statistical difference with other treatment. This is possibly because of the easy position; IASTM is a simple and practical technique. Because the surface of the instrument minimizes the force used by the practitioner, but maximizes the force delivered to the tissues, it is possible to stimulate points of adhesion. Located in deep areas, Hayes et al.2007 found that the levels of discomfort and fatigue experienced by therapists who treated...
patients with IASTM were significantly lower than the levels in therapists treating their patients using the metal end of a reflex hammer.\textsuperscript{28}

Moreover, IASTM has another advantage of being able to produce positive effects in a much shorter period than friction massage.\textsuperscript{10} In consistency with the positive effect of using passive or active treatment in this study, Kojidi et al. (2016) concluded that 90 seconds of passive treatment or 20 seconds of active treatment for female patients with myofascial TPs in the upper trapezius muscle was significantly decreased the sensitivity of myofascial TPs, increased flexibility of muscle fibers, and improved the ROM.\textsuperscript{14} After performing the IASTM, pain significantly decreased in this study and this comes in agreement with the work of Howitt et al., 2006; Daniels & Morrell, 2012; Howitt et al.,2009; Lee et al., 2016 White, 2011.\textsuperscript{5, 29-32} Our results also demonstrated that after performing the IASTM, ROM significantly increased and this comes in agreement with the work of many investigators.\textsuperscript{9,20, 33,34} The improvement in the IASTM group may be due to IASTM as it improves the extensibility of soft tissues by treating their restrictions\textsuperscript{35}, and when heat is generated from friction by the instrument, the viscosity of the tissue decreases, making it softer.\textsuperscript{36} Physiologically, a decrease in the viscosity of tissue improves ROM.\textsuperscript{26} On the other hand, significant changes in ROM as a result of IASTM can also be explained by hypotheses related to the nervous system.\textsuperscript{37} It is also based upon the rationale for deep friction massage and cross fiber massage as proposed by Cyriax.\textsuperscript{31} Although it is believed that IASTM improves ROM via the mechanisms described in these hypotheses occurring independently or as a combination, scientific proof to support such claims is still lacking.\textsuperscript{38} In spite of these positive results regarding using IASTM, there was no significant difference in PPT and all cervical ROM between it and other treatment in this study.

**Strength and Limitations**

The advantage of using IASTM over other soft tissue mobilization is that metal surface of the instruments does not compress the tissues, as do the fat pads of the finger, so that deeper restrictions can be accessed and treated.\textsuperscript{39} IASTM is a procedure that is rapidly growing in popularity due to its effectiveness and efficiency while remaining non-invasive.\textsuperscript{31}

The present study had several limitations. First, it only investigated changes in pain and ROM after IASTM application while, it did not measure the muscles activity. Second, the duration of intervention was short. Usually, longer intervention periods are used because the most significant progress may be made after at least 6 weeks.\textsuperscript{24, 33} The participants were all females. So further studies are recommended to include both men and women. It is also recommended that future studies include participants with active TPs. Future studies show the differences between the different types of instrument assisted soft-tissue treatment are recommended. There are lacks of a universal description for the term IASTM. Researchers have used the name IASTM and other names such as but not limited to: instrument assisted soft-tissue treatment, instrument assisted cross fiber massage, instrument assisted neuromobilization, ASTYMR, and Graston\textsuperscript{4} treatment. A large number of researchers have used the term Graston\textsuperscript{8} to describe the intervention but appear to not follow the specific Graston-recommended treatment protocol which includes examination, warm-up, IASTM treatment, post treatment stretching, strengthening, and ice.\textsuperscript{30}

**Acknowledgment:** None.

**Conflict of Interest**

The authors certify that they have no financial affiliations or involvement with any commercial organization that has a direct financial interest in any matter or materials discussed in this manuscript.

**Authors’ Contribution**

Dina Othman: was responsible for analysis and interpretation of data.

Noha Elserty: was responsible for conception, design of the study and acquisition of data.

All authors are responsible for collecting data, writing, editing and revising the manuscript.

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