Effects of Instrument Assisted Soft Tissue Mobilization on Range of Motion and Movement Patterns

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Abstract

Limited tissue mobility and loss of range of motion (ROM) contribute to changes in movement patterns. The purpose of the study was to determine the effect of instrument assisted soft tissue mobilization (IASTM) on tissue mobility and functional movement patterns. This study utilized a convenience sample (N=70) from an accredited regional university consisting of students, faculty, and staff. Each participant served as their own control using a test, re-test study design. Individual's ROM was pretested using a goniometer. Gait and center of pressure (COP) analysis was administered using Noraxon MyoMuscle insoles. Individuals either received IASTM treatment with HawkGrips or walked during the testing session. Post-tests were completed after each treatment. MANOVA results showed significance for bilateral knee flexion and ankle ROM between pre-and-posttest IASTM treatment. There was a statistically significant effect in ankle dorsiflexion and seven gait and COP components between pre-test IASTM and post-test walk. Statistically significant interaction effects were seen between post-test IASTM and post-test walk ankle in plantarflexion and seven gait and COP components. The findings of this study indicate that IASTM improves ROM and movement patterns. Those changes seem to support evidence finding that IASTM is more effective when combined with a stretching or mobility program (Thompson, et al, 2018). The effects on gait and center of pressure need further examination; this study shows support for further research using IASTM to treat other conditions with limited ROM and movement pattern dysfunction.

Introduction

Increases in soft tissue stiffness, called tissue restrictions, could be due to persistent muscle contraction or connective tissue adhesions that restrict shear plane movement[1]. All populations can be affected by conditions relating to tissue restriction. Individuals with conditions involving tissue restrictions often end up changing movement patterns to accommodate those restrictions or to avoid pain caused by the restrictions. These changes can cause more pain and a cascade of other issues if not treated properly[1]. The body is a kinetic chain, a system in which movement in one segment (or a lack thereof) affects the segments both proximal and distal to that segment[2]. Restrictions may be found throughout the body. One example of altered movement patterns due to restrictions may include the effect that decreased ankle dorsiflexion has on a decreased step length[3] and shortened stride length[4] leading to an increased cadence[5]. These gait changes may lead to difficulty walking and taking part in social activities that require increased pace of walking or running[6].

(IASTM) is a technique that is applied using specially designed instruments to provide a mobilizing effect to soft tissues including the skin, fascia, muscles, tendons, scar tissue, and myofascial adhesions by its various direct compressive stroke techniques[7, 8]. It is based on the principles of James Cyriax cross-friction massage[9]. The use of IASTM in the treatment of patients with various conditions has been beneficial in case studies. Although the current evidence is promising, empirical evidence is limited[7]. This study aims to add to the breadth of empirical evidence on the use of IASTM for tissue mobility. The results of this study may lend more credibility to the use of IASTM in the treatment of patients with various conditions where soft tissue mobility restriction or loss of ROM contributes to changes in movement patterns. The purpose of the study was to determine the effect of instrument assisted soft tissue mobilization (IASTM) on tissue mobility and functional movement patterns

Methodology

Participants

Seventy participants (Male-40, Female-30) (Mean age 23.57, (SD 8.15) were recruited. Participants ranged in age from 18 to 56 years of age. Participants ranged in height from 152.4 to 195.58 cm with an average height of 175.56 cm (SD 3.98). Weight ranged from 52.62 to 113.81 kg with an average of 81.42 kg (SD 43.44). Sixty-one participants were students; the remaining nine participants consisted of faculty and staff who volunteered for the study. Sixty-four were right dominant and the other six were left dominant.

	Minimum	Maximum	Mean	Std. Deviation
Weight	52.62 kg	1113.81 kg	81.42 kg	43.44
Height	152.4 cm	195.58 cm	175.56 cm	3.98
Age	18 yr	56 yr	23.57 yr	8.15

Table 1: Demonstrates the minimum, maximum, mean and standard deviation data for the weight, height and age of the participants.

Methodology Continued…

Methods

Seventy participants were volunteers recruited from a small regional university's student body, faculty and staff.

Exclusion criteria included:

- Acute spinal cord injury with neurological deficits
- Neurological disorders
- Acute lower extremity injury such as sprain or strain
- Acute lower extremity pain causing gait deviation
- Any type of lower extremity fracture within the past 12 months, lumbar disc pathology with radicular symptoms
- Use of blood thinning or clotting medications
- Known connective tissue disorders

Study design: crossover study that utilized two treatment protocols

- IASTM Treatment
- Walking

Measures for pre-test and post-test with each treatment protocol

- Ankle range of motion (dorsiflexion, plantarflexion, inversion, eversion)
- Knee range of motion (flexion, extension)
- Gait analysis
- Center of pressure analysis

Procedures

Participants in the study were asked to complete an informed consent form and then a questionnaire including the participant's medical and injury history.

After the initial ROM was measured using goniometry, gait and center of pressure (COP) analyses were conducted with the Noraxon MyoMuscle System using Ultium insoles placed in the participants shoes. There were four insole sizes of insoles. The size used was based on the size closest to the participant's shoe size. Once the insoles were in place, the Noraxon MyoMuscle software could be used. The sample rate was set to 2000 Hz EMG/200 Hz Motion. The insole mode was set at 4 zones Anterior/Posterior (500/1000 Hz). To calibrate the insoles, each participant performed a single leg balance on the left foot and then on the right foot while the system continued to calibrate. Once the calibration was complete, data was recorded while the participants walked with their normal pattern from a marked line to a wall 40 feet away. The software system collected measurements during the walking analysis.

Participants were then treated with IASTM techniques on their gastrocnemius/soleus complex and Achilles tendons on both lower extremities using HawkGrips tools. The IASTM techniques consisted of applying emollient on the skin surface to reduce friction followed by scanning the gastrocnemius/soleus complex and Achilles tendons using the HG8-Scanner tool for 15 strokes in each direction. Then the HG6-Large Multi-Curve and HG4-Small Multi-Curve were each used for 15 strokes in each direction. One lower extremity was treated at a time. The duration of the total treatment was measured and recorded followed by testing.

Three to seven days after the IASTM treatment and data collection, the participant returned for a second data collection using walking mobility. The same pre- and post-testing procedures were used. Participants were told to walk briskly for the same duration of time that their IASTM treatment had lasted at the previous session.

Sessions for each participant lasted less than one hour. Sessions were completed either by the primary researcher or by an undergraduate student researcher under the supervision of the primary researcher. The primary researcher is a licensed physical therapist and licensed and certified athletic trainer trained in IASTM.

Data Analysis

Statistical analysis was conducted using SPSS software. Descriptive analyses were conducted first to look for data characteristics, then MANOVA comparisons were conducted between Pre-IASTM Treatment and Post-IASTM Treatment, between Pre-IASTM Treatment and Pre-Walk Treatment, between Pre-IASTM Treatment and Post-Walk Treatment, between Post-IASTM Treatment and Pre-Walk Treatment, between Post-IASTM Treatment and Post-Walk Treatment and between Pre-Walk Treatment and Post-Walk Treatment.

	Frequency	Percent
Student	61	87.1
Non-Student	9	12.9
Right-Handed	64	91.4
Left-Handed	6	8.6
Male	40	57.1
Female	30	42.9
Athlete	49	70
Non-Athlete	21	30

Table 2: Demonstrates the frequency in number of students vs non-students, right-handed vs left-handed, male vs female and athlete vs non-athlete participants.

Results

IASTM treatment demonstrated significant improvement (Wilk's Lambda <0.001) when comparing Pre-IASTM Treatment to Post-IASTM Treatment. The changes were significant with increasing all ankle motions on both extremities and knee flexion on both extremities. Pre-IASTM Treatment to Pre-Walk Treatment and Pre-IASTM Treatment to Post-Walk Treatment demonstrated significantly increased ROM but only for ankle dorsiflexion bilaterally and right ankle inversion. Left ankle eversion ROM was significantly increased from Pre-IASTM Treatment to Post-Walk Treatment also. Post-IASTM Treatment to Pre-Walk Treatment and Post-IASTM Treatment to Post-Walk Treatment had significant improvement in plantarflexion on both extremities. Right knee flexion also significantly improved in Post-IASTM Treatment to Pre-Walk Treatment. Left step time significantly decreased between Pre-IASTM and Post-Walk (Wilk's Lambda <0.001).

When Wilk's Lambda with a significance level between 0.05 and 0.001 was selected, the significance for increased ankle ROM increased more broadly across the treatment group comparisons. In gait analysis, left stance duration (Wilk's Lambda 0.003), right step time (Wilk's Lambda 0.039), and stride time (Wilk's Lambda 0.008) all decreased significantly, while cadence (Wilk's Lambda 0.004) increased significantly. In COP analysis, analysis time decreased significantly, and COP average velocity increased significantly (Wilk's Lambda 0.003). The trend demonstrated the most changes occurred between Pre-IASTM and Post-Walk and between Post-IASTM and Post-Walk.

Variable	Pretest IASTM to Posttest IASTM	Pretest IASTM to Pretest Walk	Pretest IASTM to Posttest Walk	Posttest IASTM to Pretest Walk	Posttest IASTM to Posttest Walk	Pretest Walk to Posttest Walk	N
Left Dorsiflexion = <0.001 Lambda significance	<0.001	<0.001	<0.001	0.005	0.013	0.507	70
Right Dorsiflexion = <0.001 Lambda significance	<0.001	<0.001	<0.001	0.093	0.072	0.773	70
Left Plantarflexion = <0.001 Lambda significance	<0.001	0.018	0.007	<0.001	<0.001	0.302	70
Right Plantarflexion = <0.001 Lambda significance	<0.001	0.115	0.011	<0.001	<0.001	0.055	70
Left Inversion = <0.001 Lambda significance	<0.001	0.003	0.013	0.137	0.121	0.637	70
Right Inversion = <0.001 Lambda significance	<0.001	<0.001	<0.001	0.553	0.13	0.132	70
Left Eversion = <0.001 Lambda significance	<0.001	0.012	<0.001	0.007	0.426	0.021	70
Right Eversion = <0.001 Lambda significance	<0.001	0.277	0.068	0.043	0.37	0.188	70
Left Knee Flexion = <0.001 Lambda significance	<0.001	0.485	0.046	0.001	0.045	0.035	70
Right Knee Flexion = <0.001 Lambda significance	<0.001	0.211	0.001	<0.001	0.015	0.01	70
Left Knee Extension = Lambda not significant at 0.117	0.017	0.029	0.033	0.635	0.846	0.717	70

Table 3: Range of Motion MANOVA Significance

Variable	Pretest IASTM to Posttest IASTM	Pretest IASTM to Pretest Walk	Pretest IASTM to Posttest Walk	Posttest IASTM to Pretest Walk	Posttest IASTM to Posttest Walk	Pretest Walk to Posttest Walk	N
Load Response Left= Lambda not significant at 0.800	0.912	0.595	0.404	0.5	0.323	0.69	53
Load Response Right = Lambda not significant at 0.057	0.049	0.044	0.01	0.607	0.271	0.405	53
Pre-Swing Left = Lambda not significant at 0.077	0.052	0.042	0.015	0.582	0.32	0.526	53
Pre-Swing Right = Lambda not significant at 0.764	0.95	0.424	0.335	0.416	0.333	0.799	53
Stance Duration Left = Lambda significance was 0.003	0.254	0.036	0.001	0.108	0.003	0.058	53
Stance Duration Right = Lambda not significant at 0.096	0.224	0.264	0.039	0.662	0.135	0.107	53
Swing Duration Left = Lambda not significance at 0.068	0.292	0.278	0.013	0.733	0.051	0.058	53
Swing Duration Right = Lambda not significance at 0.216	0.527	0.177	0.042	0.273	0.054	0.157	53
Step Time Left = <0.001 Lambda significance	0.25	0.168	<0.001	0.625	0.006	0.002	53
Step Time Right = Lambda significance was 0.039	0.572	0.084	0.01	0.086	0.005	0.105	53
Stride Time = Lambda significance was 0.008	0.173	0.054	0.001	0.235	0.004	0.01	53
Cadence = Lambda significance was 0.004	0.146	0.044	<0.001	0.206	0.003	0.008	53
Analysis Time = Lambda significance was 0.003	0.864	0.127	0.002	0.209	0.007	0.079	53
COP Path Length = Lambda was not significant at 0.061	0.365	0.484	0.264	0.977	0.075	0.033	53
COP Average Velocity = Lambda significance was 0.003	0.086	0.003	<0.001	0.028	0.023	0.599	53
Length of Major Axis = Lambda not significant at 0.201	0.087	0.034	0.078	0.162	0.387	0.427	53
Angle Between Forward Major Axis = Lambda not significant at 0.178	0.419	0.286	0.283	0.696	0.1	0.036	53

Table 4: Gait and Center of Pressure MANOVA Significance

Conclusion

The findings of this study indicate that IASTM improves tissue mobility and increases ROM and facilitates improved movement patterns. ROM increased after IASTM treatment, with a high level of significance (p<0.001). There was also a significant impact on gait and COP indicating that there is an effect on movement patterns, but further research is needed. The larger sample size of this study supports that IASTM is a reliable treatment to improve tissue mobility to improve ROM. Those changes in movement patterns occurred between when a combination of IASTM and movement occurred (either between sessions or during the session with the walking treatment) which seems to support evidence finding that IASTM is more effective when combined with a stretching or mobility program[19]. This study shows data trends that support further research in using IASTM for other conditions in which increased ROM or tissue mobility would be helpful to allow movement patterns to be altered.

The limitations in this study included two equipment issues we encountered which led to us not being able to use the data from 17 of our participants for gait and COP analyses. Not having access to a true small pair of insoles for those who needed it and having a defective large insole meant that we were not able to have as large of a sample size in our gait and COP analyses, and the individuals with those two insole sizes were underrepresented in the study. We feel that this impacted our study's effect size although we do not feel that the areas that showed significance would have been any less significant with those 17 participants still being included.

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