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SHORT COMMUNICATION

EFFECTS OF INSTRUMENT-ASSISTED SOFT-TISSUE MOBILIZATION ON ANKLE RANGE OF MOTION AND TRICEPS SURAE PRESSURE PAIN SENSITIVITY

Corrie MYBURGH, MSc, PhD[1], Are HAMMERN, MSc[2], Peter MANNFJORD, MSc[3] and Eleanor BOYLE, BSc, MSc, PhD[1,4]

From the [1]Department of Sports and Clinical Biomechanics, University of Southern Denmark, Odense, Denmark
[2]Clinical Practice, Helsehuset Greaaker, Greåker, Norway
[3]Clinical Practice, and [4]Dalla Lana School of Public Health, University of Toronto, Toronto, Canada

Background: Within the practice of physical medicine, instrument-assisted soft-tissue mobilization (IASTM) is increasing in popularity. However, the intervention is still in its infancy and important clinical issues require elucidation; among these are the effects on asymptomatic individuals.
Methods: Twenty healthy males were allocated randomly to either 3 minutes of high-pressure IASTM or active self-stretch of the triceps surae muscles. Each individual served as his own control. Pre-post observations of active ankle range of motion, pressure-pain sensitivity and the occurrence of post-intervention petechial haemorrhage were made.
Results: A significant within-group increase in ankle range of motion was observed for both groups, but no significant between-group differences were noted. Pressure-pain sensitivity remained essentially unchanged. No petechiae were detected post-intervention.
Conclusion: Notwithstanding the limitations of this relatively small study and in relation to healthy individuals, IASTM increased active range of motion to the same extent as active self-stretch. Heavy-dose IASTM did not influence pain-pressure sensitivity and petechiae did not develop.

Key words: instrument-assisted soft-tissue mobilization; range of motion; pain; pain threshold; petechiae; petechial haemorrhage; physical medicine.

LAY ABSTRACT

The aim of this study was to observe whether treatment with a steel mobilization tool would relax muscles, reduce pain (by reducing sensitivity to pressure) and, if used aggressively, would result in superficial bleeding under the skin. Healthy men were asked to perform a calf stretch in one leg. Then 3 min of instrument-assisted soft-tissue mobilization was performed on their other calf using strong pressure. Relaxation was observed in both ankles after the intervention, indicating a similar degree of improved stretch. Surprisingly, pressure sensitivity did not change, indicating that the participants' bodies did not get used to the pressure. Finally, the instrument caused no superficial bleeding despite being applied with heavy pressure and over a long period of time.

Instrument-assisted soft-tissue mobilization (IASTM) is a non-invasive, physical intervention used to improve the functional status of myofascial structures (1, 2). Mechanistically, IASTM is thought to act as a force amplifier, facilitating a reduction in treatment time and practitioner effort, whilst attaining clinical effects equivalent to those of digital techniques such as deep friction massage and myofascial release (2–4).

The study of clinical effectiveness of IASTM has progressed to the point where at least one systematic review, focused on randomized intervention studies involving IASTM, has been published (3). According to the authors there is currently insufficient evidence to evaluate the clinical effectiveness of IASTM in modifying key objective outcomes such as pressure-pain threshold (PPT) or active range of motion (a-ROM) (3, 5–7). This paucity of evidence is of concern, as current IASTM practice trends have shifted towards so-called functional or dynamic treatments, in which emphasis is placed on exactly these parameters, as patients actively perform restricted/painful movements during treatment (4).

Similarly, no clear picture currently exists with respect to clinical side-effects, as exemplified by the appearance of petechiae (3, 8). Initially thought of as appropriate for this intervention, mechanical disruption of capillary endothelium has not been linked to beneficial clinical outcomes and is now considered a side-effect (2, 9).

Furthermore, and in relation to asymptomatic individuals, no norm values exist for PPT change or increases in a-ROM achievable in relation to IASTM (5, 10, 11). As a consequence it is challenging to differentiate among the responses applicable to healthy and affected individuals.

This study was a quasi-experiment aimed at contributing to the emerging evidence base in this area of soft-tissue management and to greater clarity in clinical practice. The aim of the study was to answer 3 questions in relation to asymptomatic individuals: (*i*) does IASTM increase a-ROM; (*ii*) does IASTM decrease pressure-pain sensitivity; and (*iii*) does high-dose IASTM necessarily result in the appearance of petechial haemorrhage?

METHODS

Design

A blinded randomized intervention study was devised, with participants serving as their own controls.

Sample

Twenty asymptomatic male volunteers were recruited from students in the faculty of health at the University of Southern Denmark. Although each participant served as their own control, the cohort was homogenized around age, height, body mass index (BMI) and weekly bouts of exercise in order to simplify standardization of the IASTM protocol. Participants were randomly allocated into receiving treatment with IASTM on either the left or right triceps surae, and the contralateral (non-IASTM) muscle was passively stretched and tested in a pre- and post-test fashion.

Blinding

Participants were clad in non-transparent stockings during examinations and therapists were not present during examinations, thus blinding both examiner and clinician. Participants were also instructed not to communicate with the research team beyond providing specific procedural feedback.

Outcomes

Active ROM was observed with the participant standing, facing and placing the hands on the wall. Individuals leaned towards the wall keeping the rear knee extended and the forward knee flexed, whilst being encouraged to stretch the rear leg as much as possible. The examiner measured a-ROM in the rear leg using a digital inclinometer (12).

PPT measurements were taken from standard points lateral to the tibial tuberosity and between the 2 heads of the gastrocnemius muscle using a digital algometer (13). The former served as a reference measure and the latter the test measure.

A post-intervention digital image was taken of the IASTM intervention site in order to visualize skin changes (14). Images were recorded at a standardized distance of 60 cm from the treatment table. All photographs were taken using the built-in flash in order to avoid the influence of the surrounding light sources.

Pilot procedure

To standardize a 'strong intervention dose', we determined the level of pressure experienced as 'uncomfortable' by participants, but which could be tolerated for a 3-min IASTM intervention. For this, 5 participants were used, who were not included in the main study. Whilst stroking, instrument pressure was systematically increased to the point where participants indicated the sensation to be 'uncomfortable', but tolerable. Through this process it was determined that a scale pressure value of between 4 and 5 kg should be maintained during the main intervention.

Interventions

Once a participant was randomly allocated one stocking was removed and IASTM performed on the triceps surae, followed by active stretch of the contralateral muscle. Participants were positioned lying prone with an analogue scale (KORONA, Sundern, Germany) beneath the leg being exposed to IASTM (**Fig. 1a**) . Care was taken to place sufficient cushioning between the scale and tibia to avoid experiencing discomfort from this contact point. The convex, sharp edge of the IASTM device (**Fig. 1a**) (15) was placed in contact with the gastrocnemius muscle at 45°, and upward strokes were applied in a range of between 4 and 5 kg. A lubricant consisting of coconut oil and beeswax was administered on the treatment surface to reduce friction to the skin prior to the intervention. Three minutes of IASTM was performed, using a metronome set to 90 beats per minute. Stretch was performed in the same fashion as a-ROM measurement, with the difference being that the stretch position was maintained for 3 min (**Fig. 1b**).
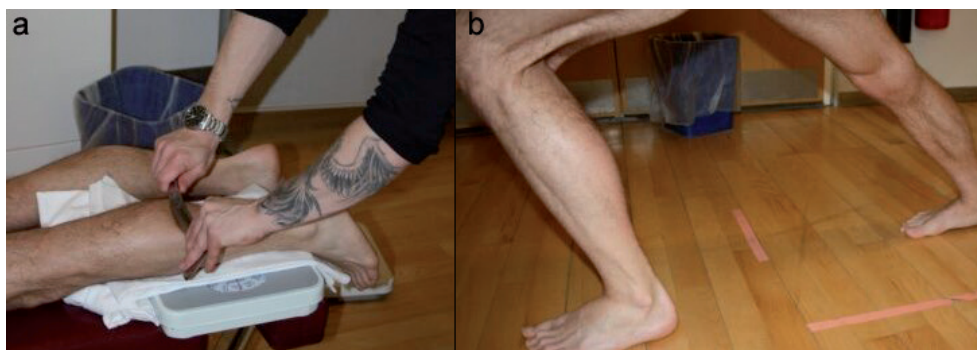
Fig. 1. Instrument-assisted soft-tissue mobilization (IASTM) and stretch intervention set-up.

Table I. Demographic characteristics of volunteers

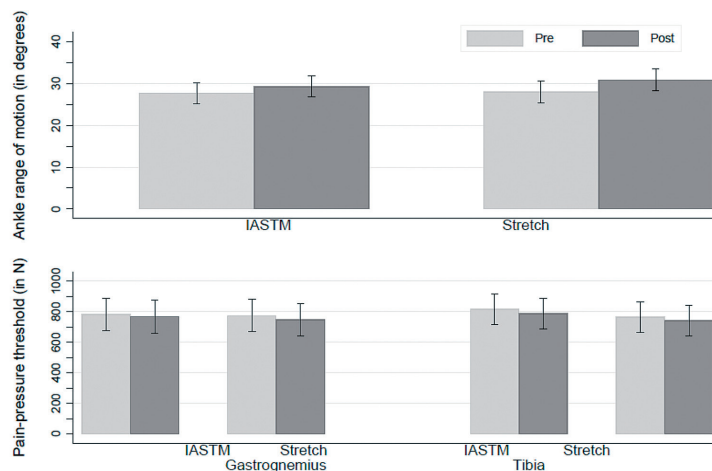| Characteristics	Stretch group Mean (95% CI)	IASTM group Mean (95% CI)
Age	24.3 (21.9, 26.7)	26.2 (24.2, 28.2)
Weight	84.1 (76.8, 91.4)	78.9 (70.7, 87.1)
Height	184.0 (180.4, 187.6)	182.8 (177.6, 188.0)
Body mass index (BMI)	24.8 (23.3, 26.3)	23.5 (22.2, 24.9)
Exercise/week (sessions)	3.2 (1.9, 4.5)	2.7 (1.4, 4.0)

The stockings were then replaced before post-measurement commenced.

Ethics

All participants gave informed consent, and ethical approval for this investigation was provided by the science and ethics committee of the region of Southern Denmark (17/34518, number 167).

Analysis

Simple descriptive analysis was conducted to summarize the characteristics of the participants. Furthermore, linear mixed models were calculated, to determine if there was a change in range of motion/pain sensitivity pre-post by group. The residuals of the fitted models were checked for normality. Simple effects contrasts were also calculated to determine if each group changed over time and if the pre/post values were different between groups.

Fig. 2. Rubor elicited in a typical instrument-assisted soft-tissue mobilization (IASTM) intervention volunteer (area circled).

RESULTS

The 2 groups of volunteers were demographically similar (see **Table I**). One volunteer was excluded due to a history of ankle trauma.

At pre-testing, both groups were comparable to each other with respect to a-ROM, PPT measured at the gastrocnemius and tibia, respectively (**Table II**).

Range of motion

There was a significant within-group improvement for both groups (stretching mean change = 2.8 and IASTM mean change = 1.7) (**Table II, Fig. 3**) . At post-test, the stretch group showed a slightly larger ROM than IASTM, but the difference was not statistically different (*p*-value = 0.06).

Pressure-pain sensitivity

No significant within-group change was observed for either the IASTM or stretch groups (**Table II, Fig. 3**) Furthermore no significant differences were observed between the 2 groups over time for PPT at the muscle or control sites (PPT gastrocnemius *p*-value = 0.568; PPT tibia *p*-value = 0.209).

Petechiae

Transient rubor developed during IASTM, but no petechiae were observed post-intervention **Fig. 2**).

Fig. 3. Ankle range of motion and pressure-pain sensitivity before and after instrument-assisted soft-tissue mobilization (IASTM) and active self-stretch.

Table II. Intra- and inter-group changes by range of motion and pressure-pain sensitivity for Instrument-assisted soft-tissue mobilization (IASTM) and active stretch

Outcome	Group	Pre-Mean (95% CI)	Post-Mean (95% CI)	Mean change, pre-post (95% CI)	*p*-value		Mean difference between groups (95% CI)	*p*-value
ROM	IASTM	27.7 (25.1, 30.2)	29.3 (26.7, 31.9)	1.7 (0.1, 3.2)	0.0393	Pre	0.4 (−1.2, 1.9)	0.6620
	Stretch	28.0 (25.4, 30.6)	30.8 (28.2, 33.4)	2.8 (1.2, 4.4)	0.0005	Post	1.5 (−0.1, 3.1)	0.0610
PPT (Gastrogn.)	IASTM	782.9 (676.2, 889.6)	767.7 (661.0, 874.4)	−15.2 (−79,1, 48.7)	0.6413	Pre	−8.1 (−72.0, 55.9)	0.8051
	Stretch	774.9 (668.1, 881.6)	749.1 (642.3, 855.8)	−25.8 (−89.7, 38.1)	0.4290	Post	−18.7 (−82.6, 45.3)	0.5675
PPT (Tibia)	IASTM	818.6 (718.5, 918.6)	790.1 (690.0, 890.2)	−28.5 (−100.4, 43.5)	0.4381	Pre	−51.4 (−123.3, 20.6)	0.1616
	Stretch	767.2 (667.1, 867.3)	744.1 (644.0, 844.1)	−23.2 (−95.1, 48.8)	0.5281	Post	−46.1 (−118.0, 25.9)	0.2094

95% CI: 95% confidence interval.

DISCUSSION

Based on these results, the following salient points should be considered regarding asymptomatic individuals: (*i*) IASTM is likely to improve a-ROM, when performed on associated skeletal muscle, (*ii*) IASTM, even when performed at high dose, does not reduce PPT sensitivity, and (*iii*) high-dose IASTM per se, is not the cause of petechial haemorrhage

Active range of motion

It is plausible that different mechanisms were involved in the increases in a-ROM observed in both groups; for IASTM the postulated mechanisms being acute improved movement between fascial layers and reduction in passive tissue stiffness (16) and for stretch, stress relaxation and creep of the musculotendinous unit (17). However, a mixture of these mechanisms is more likely. Nevertheless, the extent of a-ROM increase was of interest and in keeping with previous investigations (5, 9). For the clinician aiming to maximize a-ROM, both IASTM and stretch procedures should be carried out.

Pressure-pain sensitivity

During the application of IASTM it is expected that the patient will experience desensitization of involved tissues, through mechanoreceptor mediated pain inhibition, similar to that observed in deep friction massage (18) and as a result reduction in pain (19). We therefore hypothesized that PPT would increase post-IASTM. However, values did not change appreciably, certainly nowhere near the 100 kPa threshold for clinically meaningful change (20). It is therefore possible that the stimuli from the applied level of pressure used in the study (described as uncomfortable) may not compete with pain stimuli in the same way that stimuli from comfortable pressure hypothetically can. More specifically, the pressure used in the study was too close to painful for such an effect to occur. Furthermore, it may be critical to this outcome that the individuals should be experiencing pain at baseline, in order for the intervention to be desensitizing. The scope of this study; however, did not include trying to explain the underlying mechanisms of the investigated effects. For the practicing clinician, we suggest that, even though the patient reports a reduction in discomfort, the area treated with IASTM is not desensitized to pressure, and therefore caution should be used if further soft-tissue treatments are undertaken, so as not to cause unnecessary discomfort and/or reactive muscle guarding.

Petechiae occurrence

Although we used a pressure perceived as uncomfortable in this study, and a longer treatment time currently prevalent in clinical practice (more than 3 min) (2), no post-intervention petechiae were observed among our participants. This suggests that neither treatment time nor level of pressure is indicative of post-bruising in asymptomatic individuals over the triceps surae. It seems reasonable, therefore, that petechiae may be more related to local tissue factors, such as tone and condition (our participants were reasonably fit), as well as variations in skin sensitivity or IASTM instrument characteristics (21). Clinicians should therefore remain observant of tonic tissue overlying bony structures, as these are likely to exhibit petechiae more readily.

In conclusion, and remaining mindful of generalization limitations, this study indicated that high-dose IASTM intervention on the triceps surae resulted in an increase in ankle a-ROM, comparable to self-stretch, did not reduce PPT sensitivity, and did not routinely result in petechial haemorrhage. Further studies into the effects of IASTM on asymptomatic cohorts are required to inform future clinical practice and research.

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