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Effects of three different application angles of instrument-assisted soft-tissue mobilization on hamstring surface thermal responses

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Letter from the author:

Dear Editor of the Journal of Physical Therapy Science

We are submitting a manuscript for consideration of publication in Journal of Physical Therapy Science. The manuscript is entitled "Effects of three different application angles of instrument-assisted soft-tissue mobilization on hamstring surface thermal responses"

It has not been published elsewhere and that it has not been submitted simultaneously for publication elsewhere.

Original article

Title: Effects of three different application angles of instrument-assisted soft-tissue mobilization on hamstring surface thermal responses

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Abstract

[Purpose] This study aimed to examine the thermal skin responses (thermal buildup and retention rate) to instrument-assisted soft tissue mobilization (IASTM) procedures applied on hamstrings at different angles.

[Participants and methods]Thirty university students (age: 20 ± 4 years, weight: 70.61 ± 9.11 kg, height: 168.5 ± 7.5 cm) received three sessions (one per week) of 10-min Ergon® IASTM treatment on their dominant limbs' hamstrings at 20°, 60°, and 90° application angles. The skin temperature was measured with a thermometer immediately before and after treatment, and every minute thereafter until it returned to the baseline value.

[Results] IASTM resulted in a significant increase in skin temperature irrespective of the application angle. The thermal retention rate produced by the treatment at a 90°angle was significantly higher than that produced by the 20°application angle (78.9 vs. 64.53 min). No significant differences were observed between the 60° and 90°angle applications (72.5 vs. 78.9 min).

[Conclusion] IASTM application at different angles can increase and retain the hamstring's skin temperature for a long time, creating the conditions for a persistent local increase of metabolism and reduction of muscle tone.

Key words: Instrument-assisted soft tissue mobilization (IASTM), Hamstrings, Skin temperature

INTRODUCTION

Soft tissue techniques are a fundamental therapeutic approach aimed at improving the functionality of the human body. A soft tissue technique is defined as a therapeutic procedure that results in a targeted mobilization of soft tissue, affecting both the superficial and the deep tissues of the body[1)]. The term encompasses a wide variety of techniques developed to improve blood and lymph circulation, reduce painful muscle spasms, induce myofascial release, and mobilize muscles, tendons, and ligaments.

Additional therapeutic adaptations of soft tissue techniques include oxygen consumption and nutrient absorption improvement, soft tissue elasticity restoration, and ultimately, local and referred myofascial pain elimination[2,3)]. Soft tissue techniques include several types of manipulations, ranging from classical to cross-friction massage and muscle energy, passive or active release, and myofascial release techniques. These techniques are performed with the therapist's hands or with specialized equipment. An innovative therapeutic approach is the mobilization of soft tissues with specialized equipment, known as instrument-assisted soft tissue mobilization (IASTM)[2)].

IASTM techniques are based on the use of specialized tools made of stainless steel, aiming at myofascial mobilization, painful contracture and adhesion release, and separation of pathological cross-links between tissues. Additional goals of these therapeutic interventions are to achieve better nutrition by increasing blood flow to and from the treated area, improving lymphatic circulation and venous return, increasing cellular activity (including fibroblasts and mast cells), and raising skin temperature[4)].

The effect of soft tissue techniques on skin temperature rise is an important parameter, as it is directly associated with increased blood circulation and metabolism in the underlying tissues. The aforementioned thermal adaptations of the skin following IASTM have been fully elucidated by physiological adaptations induced by soft tissue compression and friction and enhanced microcirculation in the treated area[5)]. However, while there is some evidence that classical hand massage is associated with skin temperature rise, research on the thermal adjustments after IASTM treatment is limited, with only one study showing that IASTM can significantly increase the calf skin temperature in healthy participants[6)]. Moreover, no surveys have taken into account critical application factors of these techniques, which can significantly affect their thermal effect. These factors include the intensity of application, the constructional peculiarities of the tools in terms of their edges and angles, and perhaps most importantly, the angle of application of the therapeutic strokes. The latter is crucial, as it affects both the application intensity and the sliding–compression of the fascial layers. In particular, as the angle of the IASTM application increases, the intensity of the manipulations also increases, as the axis of the applied pressure intensity is close or adjacent to the tool's contact angle, thereby increasing the compression of the treated area and the fascia. Conversely, at a narrower angle, the direction of the applied force is far from the tool's point of contact with the skin, thereby reducing the strain on the treated tissues. In addition, a narrower angle biomechanically enhances the sliding and not the compression of the fascia.

The purpose of this study was to improve our knowledge of the effects of different IASTM application angles on skin temperature. To that end, we evaluated the effects of three different IASTM application angles on hamstring skin temperature rise and retention.

PARTICIPANTS AND METHODS

The study sample consisted of 30 university students (17 female and 13 male), aged 20 ± 4, with a body weight of 70.61 ± 9.11 kg and a body height of 168.5 ± 7.5 cm. Participants with a body mass index >24 were excluded, as a high concentration of fat in the measured area may affect the skin's thermal behavior. All participants were informed about the objectives and procedures of the study and signed consent forms for voluntary participation. Approval for the study was obtained from the Health and Human Sciences Ethics Committee of the University of Patras, Greece (12311-3/6/2019).

The study was conducted at the Laboratory of Human Evaluation and Rehabilitation of the Physiotherapy Department of the University of Patras. The temperature in the study area remained at 25°C throughout the investigation. The participants were asked to refrain from consuming food or drinks and performing strenuous physical activity one hour before the start of each treatment session. The research process included a 10-min application of Ergon® IASTM techniques at three different angles on the dominant limb's hamstring area (using the non-dominant limb as control) and the evaluation of the skin's thermal adaptations before and after each intervention. The skin temperature was recorded at three assessment points of the hamstring: in the middle of the hamstring and 5 cm above and below the middle point.

Participants received three treatments (one per week), which included the application of Ergon technique strokes at 20°, 60°, and 90° angles, thus forming three respective groups. The order of attendance was randomized using a computer-generated randomization chart. The participants were blinded to the order of attendance. The application was performed using ametronome (at 50 BPM) so that the tools passing through the hamstrings marked points at the same speed and frequency and with constant and uniform pressure.

The temperature of the selected points in the posterior femur was measured immediately before and after treatment, and every minute thereafter until it returned to pretreatment levels. The control limb's temperature was measured every 5 min. A manual wireless infrared thermometer (Thermofocus® 01500A3, Tecnimed, Varese, Italy) was used to measure the skin temperature. This surface thermometer has a measurement accuracy of ±0.3°C between 20 and 42.5°C, with an improved accuracy of ±0.2°C between 36 and 39°C[7].

Differences between pre- and post treatment hamstring temperature values were assessed with a paired t-test. One-way analysis of variance (ANOVA) was used for the comparative evaluation of the effects of the three treatment interventions on the retention time of the increased temperature at the treated lower limb. The average of the 3 temperature assessment points was used in the analysis and the significance level was set to p=0.05.

RESULTS

Table 1 presents the descriptive data on the increase of the hamstring skin temperature immediately after the application of the Ergon IASTM technique at different angles (20°, 60°, and 90°), as well as the retention time of the increased temperature per angle.

"Insert Table 1 near here."

The paired t-test analyses for comparisons before and after the application showed a significant difference ($p < 0.05$) in hamstring surface temperature increase on the intervention side in all groups (20°, 60°, and 90°). On the contrary, there was no significant difference ($p > 0.05$) in surface temperature variation on the control (non-dominant) side.

The application of the Ergon IASTM technique with an application angle of 90° led to a significantly longer retention of the surface temperature ($p < 0.05$) compared to the 20°angle but not compared to the 60° angle. More specifically, the treatment at a 90°angle significantly increased the surface temperature, which remained elevated above baseline levels for almost 79 minutes compared to 64,5 and 72,5 minutes of elevated temperature observed with application angles of 20°and 60°, respectively. No significant difference in the retention time of elevated surface temperature was observed between the 20 and 60 degrees applications.

DISCUSSION

IASTM techniques constitute an innovative approach that is gaining ground in modern therapeutics thanks to its efficacy in the myofascial release and overall correction of the human body. However, despite the critical evidence in the literature on the usefulness of such techniques in improving patients' health, important application parameters remain unstudied and unsupported. The only parameter that was slightly evaluated in one study is the direction of the therapeutic strokes. The study's authors reported that the therapeutic IASTM strokes aimed at increasing the range of motion of specific joints should have a direction of application toward the treated joint[8]. However, no study has evaluated the physiological effects of applying IASTM techniques at different application angles. To narrow this research gap, we examined the effectiveness of the Ergon IASTM technique applied at three different angles (20°, 60°, and 90°) in increasing and maintaining hamstring skin temperature.

Our findings suggest a significant skin temperature increase of 1–1.5°C on average immediately after a10-min application irrespective of the angle. In addition, our results indicate a remarkable maintenance of elevated temperatures, which may last more than one hour. The longest retention of surface temperature is achieved at the most aggressive application angle of 90°, with a significant difference from the minimal application angle of 20°, which is much lighter and softer. This is an expected finding, as with minimal application angles, the axis of pressure and intensity of manipulation is applied away from the therapeutic tool's point of contact with the skin, as opposed to applications at 90°, where the axis of pressure passes through the tool and is directly related to its contact point. This increases the loading of the underlying tissues, which explains the physiological responses observed. The fact that there is no significant difference in temperature rise and retention between the 20° and 60° and between the 60° and 90°application angles (the time difference was approximately 8 and 6 min, respectively) is also an important finding, which demonstrates the importance of myofascial layer sliding as opposed to compression. In contrast to wider angles, which compress the myofascial structures, narrower application angles enhance the sliding of the fascia, which explains the insignificant difference.

These significant skin thermal adaptations, and in particular the remarkable temperature retention above the baseline for a considerably long period, are particularly important from a clinical point of view, as elevated skin temperature is directly linked to increased blood circulation and metabolism of the underlying tissues in the treated area[6)]. Given that an increase of 1°C in tissue temperature can help reduce mild inflammation and increase the metabolic rate by approximately 13%[9)], a normal physiological adaptation may contribute to the alleviation of pain and muscle spasms, reducing resistance to stretch, increasing collagen elasticity, and potentially improving the healing process of tissues. Elevated tissue temperatures are also directly related to increased vessel permeability, oxygen supply, and enzyme activity[10)].

As our findings cannot be compared with others since no other relevant design research has been conducted to date, they should be evaluated under the weight of our study's own limitations. The most important limitation is that its research design was based not on random but on convenience sampling. Besides, participants were healthy with no pathologies (inflammations),which may affect the skin's thermal responses. The number of participants may also be considered small; however, this limitation is offset by the fact that there was significant homogeneity in the participants' basic physical characteristics.

Despite its limitations, the clinical value of this study's findings is particularly important. We provide evidence that Ergon IASTM techniques can increase and, more importantly, maintain the hamstring's skin temperature for a considerable period, thus resulting in beneficial physiological reactions and adaptations. We also provide evidence that no aggressive and therefore potentially injurious applications (such as those at a 90° angle) are needed to produce significant temperature adaptations in body surface tissues. This finding, if supported by future studies, can alter the practice of relevant applications and prevent aggressive manipulations, which particularly strain human soft tissues.

In conclusion, it seems that the application of IASTM techniques at different angles, ranging from narrow to wide, thus varying the intensity of the therapeutic strokes, can lead to significant hamstring skin thermal adjustments, irrespective of the angle of application. Although the more aggressive application at 90° leads to longer maintenance of increased skin temperature than the narrower application angles, these adjustments are not significant enough to justify the choice of such aggressive therapeutic approaches. In any case, further research is needed to support the findings of this study and to improve the therapeutic approaches to human soft tissues.

Conflict of Interest: None.

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Table 1. Descriptive data on the increase and retention of skin temperature immediately after the application of the Ergon IASTM technique at different angles.

	Treated side		Non-treated side		Treated side
Application Angle	Pre-treatment temperature (°C)	Post-treatment temperature (°C)	Pre-treatment temperature (°C)	Post-treatment temperature (°C)	Temperature retention time (min)
20°	35.19 ±0.54	36.28 ±0.47	35.04 ±0.5	34.98 ±0.58	64.53 ±16.93
60°	35.25 ±0.47	36.3 ±0.25	35.11 ±0.51	35.13 ±0.57	72.5 ±14.14
90°	35.26 ±0.48	36.28 ±0.31	35.15 ±0.5	35.10 ±0.54	78.86 ±18.92

Values represent Means ± SD.