Comparing the Immediate and Sustained Effects of Instrument-Assisted Soft Tissue Mobilization on Ankle Dorsiflexion

Original Research

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Abstract

Introduction: Ankle dorsiflexion plays a crucial role in maintaining proper biomechanics and preventing overuse injuries. This study aimed to evaluate the efficacy of Instrument-Assisted Soft Tissue Mobilization (IASTM) compared to static stretching in improving ankle dorsiflexion range of motion (ROM) during weight-bearing activities, and to assess whether these effects persist over time.

Methods: A total of 30 participants reporting restricted dorsiflexion were divided into two groups: 14 participants underwent IASTM treatment, and 16 performed static stretching exercises. Dorsiflexion was assessed using the half kneeling ankle dorsiflexion range of motion test at six-time intervals, including pre-intervention and post-intervention at 15-minute intervals up to 60 minutes. The IASTM group received a 5-minute treatment targeting the triceps surae using the HG8 instrument, while the stretching group completed static stretches on a 45-degree slant board.

Results: Statistical analysis using repeated measures ANOVA revealed no significant differences between the two intervention groups in terms of dorsiflexion improvement over time. However, significant improvements were noted within the stretching group when comparing pre- and post-intervention measurements, though no lasting effects were observed at subsequent time intervals. The control leg showed no significant changes for either group.

Conclusions: In conclusion, while both static stretching and IASTM provide marginal improvements in ankle dorsiflexion, neither intervention demonstrated statistically significant superiority. Further research with more comprehensive protocols is needed to determine long-term efficacy in clinical populations.

Key Words: Graston Technique, range of motion, injury prevention

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Introduction

Ankle dorsiflexion, the movement of the foot toward the shin, is essential for gait, squatting, and many athletic movements. Limitations in dorsiflexion can shift loading patterns to the forefoot and alter biomechanics throughout the kinetic chain, contributing to conditions such as metatarsalgia, plantar fasciitis, and Achilles tendinopathy.[1] When restricted, compensatory movements higher up the kinetic chain can lead to knee, hip, or back pain, impacting both daily activities and athletic performance.[1]

Instrument-assisted soft tissue mobilization (IASTM) is a manual therapy technique that uses specialized tools to detect and treat soft tissue dysfunction. Methods like the Graston Technique aim to improve range of motion (ROM), reduce pain, and enhance tissue healing through controlled microtrauma and increased local circulation.[2-4] Compared to manual soft tissue therapy, IASTM allows for more targeted and consistent pressure application, potentially reducing therapist fatigue and increasing treatment specificity.[4] While several studies have shown positive effects of IASTM on pain and mobility, especially in athletic populations,[5-7] the evidence base remains varied. Some research reports short-term improvements in ROM and function, while others cite methodological limitations, such as small sample sizes, heterogeneous outcome measures, or limited follow-up.[6-7] More critically, few studies[2-7] have isolated the effects of IASTM on ankle dorsiflexion specifically or compared it to well-established interventions like static stretching.

Given the significant role of ankle dorsiflexion in functional movement and the growing body of evidence supporting the use of IASTM for improving mobility and reducing pain, this study aims to evaluate the effects of static stretching and IASTM on ankle dorsiflexion ROM and whether these effects persist over time.

Scientific Methods

Participants

A total of 30 recreationally active adults were recruited and randomly assigned to one of two intervention groups: the Instrument-Assisted Soft Tissue Mobilization (IASTM) group (n = 14, mean age = 22.5 years) or the static stretching group (n = 16, mean age = 24 years). All participants self-reported experiencing tightness or limited dorsiflexion in at least one ankle. Recruitment was conducted via campus-wide advertisements. Prior to participation, all individuals completed a health screening survey to confirm they met the inclusion criteria: (1) aged 18–35 years, (2) physically active for at least 3 days per week, and (3) free from current lower extremity injuries or pain. Exclusion criteria were based on standard contraindications for IASTM.[2] Participants were assigned to treatment groups based on a blinded scheduling process. They received a link to sign up for data collection sessions without knowledge of which intervention (IASTM or stretching) would be administered during their selected time slot. This approach helped minimize selection bias and maintained allocation concealment. The study was approved by the University of the Incarnate Word institutional review board, and all participants provided informed consent prior to enrollment.

Protocol

Participants in the IASTM group received treatment while seated at the edge of a treatment table. A certified athletic trainer trained in the technique applied a Graston Technique emollient (Graston Technique LLC, Indianapolis, IN) to the posterior lower leg. The HG8 instrument (HawkGrips, Conshohocken, PA) was used to apply moderate pressure using sweeping strokes across the gastrocnemius muscle at an angle of 30° to 45°. The treatment duration was five minutes, consistent with prior literature on IASTM dosage.[9]

Participants in the static stretching group performed a standing stretch targeting the triceps surae muscle group (gastrocnemius, soleus, and plantaris) using a 45-degree slant board. Each stretch was performed with the knee extended and the heel in contact with the board to ensure maximum dorsiflexion. Participants completed three sets, holding each stretch for 45 seconds with a 60-second rest between sets.

Ankle dorsiflexion range of motion (ROM) was measured using a digital leveling application during a standardized weight-bearing lunge test. Participants assumed a half-kneeling position with the front leg being assessed. The device was positioned just below the tibial tuberosity to measure dorsiflexion angle in degrees. This method has been previously validated for reliability and accuracy in assessing functional dorsiflexion ROM.[8] To control for limb dominance and potential systemic effects, both ankles were assessed at all time points.

Measurements were collected at five time points: pre-intervention, immediately post-intervention, and at 15-minute intervals for 45 minutes total. All measurements were taken by the same trained examiner to ensure consistency and reduce variability. The examiner was not blinded by the intervention.

Statistical Analysis

All statistical analyses were conducted using SPSS (version 29; IBM Corp, Armonk, NY). A 2 (IASTM and Stretching) x 6 (pre- and post-intervention at immediate, 15-minute, 30-minute, 45-minute, and 60-minute intervals) repeated measures analysis of variance (ANOVA) was employed to compare the dependent variables. The dependent variable assessed was the half kneeling ankle dorsiflexion range of motion measurement. Three trials were conducted, with the highest degree measurement recorded for analysis. Pairwise comparisons between the different time intervals were performed. The alpha level was predetermined at $P < .05$.

Results

The means and standard deviations for all dependent variables are reported in Table 1. A 2 (intervention) x 6 (time) repeated measures ANOVA revealed no statistically significant main effect difference between interventions (IASTM vs Stretching) for half kneeling ankle dorsiflexion range of motion measurement (P > 0.05). There were statistically significant differences for stretching when comparing pre-intervention to each post-intervention measurement (P < 0.05). The control leg displayed no differences for either intervention or between any time interval (P > 0.05). There were no other statistically significant differences (P > 0.05).

Table 1: Means and standard deviations for intervention by time.

Time	IASTM	Stretching	Non-Intervention Leg	Effect Size (IASTM)	Effect Szie (Stretch)
Pre	38.64±5.33	37.63±9.9*	40.73±7.75	.42	.46
Post 0	42.71±5.89	43.13±7.31	41.60±7.65	.09	.15
Post 15-min	40.78±5.86	42.43±6.15	40.90±7.35	.17	.22
Post 30-min	41.36±6.23	43.13±6.23	42.13±6.49	.25	.26
Post 45-min	41.78±5.97	43.00±6.85	42.60±6.78	.21	.27
Post 60-min	42.14±6.06	42.94±7.94	42.70±7.45	.12	.11

Stretching Intervention was statistically significant when compared from pre-intervention compared to each post-intervention noted with *. "Pre" - pre-intervention; "Post 0" - post-intervention immediately after treatment; "Post 15-min" - 15 minutes post-interventions; "Post 30-min" - 30 minutes post-interventions; "Post 45-min" - 45 minutes post-interventions; "Post 60-min" - 60 minutes post-interventions; IASTM - treated leg; Stretching - Treated leg; 0.00±0.00 – Mean ± Standard Deviation.

Discussion

This study evaluated the effects of static stretching and instrumented-assisted soft tissue mobilization (IASTM) for improving dorsiflexion range of motion (ROM) and assessed whether these changes persisted over time. Contrary to our hypothesis, neither intervention resulted in a statistically significant improvement in dorsiflexion compared to the control limb. While static stretching demonstrated slightly greater improvements than IASTM, the differences were minimal and not statistically significant.

Both interventions showed increases in dorsiflexion ROM compared to baseline across all time intervals; however, while static stretching reached statistical significance, the improvement in the IASTM group did not. Additionally, the static stretching intervention group achieved the minimal detectable change (MDC), while the IASTM fell just short of this threshold.[8] These findings are consistent with previous research indicating that static stretching may yield immediate improvements in ROM, though the long-term effects remain variable.[12]

Although ROM gains were small, improved dorsiflexion may have short-term practical implications. Enhancements in ROM may help mitigate compensatory movement patterns in the lower extremities, particularly during running and jumping activities. Restricted ankle dorsiflexion range of motion is associated with decreased hip and knee flexion, as well as increased knee abduction movements during landing from a jump.[10] Additionally, compensatory patterns have been found in walking and running gait due to decreased dorsiflexion range of motion, including a shortened stride and early heel-off time.[11] Even marginal improvements in dorsiflexion could support better joint loading patterns, reduce soft tissue strain, and enhance neuromuscular control, which may reduce injury risk in athletic populations. For rehabilitation patients, small increases in ankle mobility may translate to earlier return to functional tasks such as squatting, ascending stairs, or maintaining balance during gait. These findings suggest that modest gains in ROM, even if not statistically significant, could have clinical relevance in specific populations or movement contexts.

While previous studies have documented beneficial effects of IASTM in individuals with soft tissue restrictions or pathology, the current study included a young, non-pathological population whose dorsiflexion values were already within or near normal limits.[1,4] This may have contributed to a ceiling effect, limiting observable improvements. Furthermore, the IASTM protocol used in this study was simplified compared to more comprehensive regimes, such as the full Graston protocol, which typically includes warm-up, IASTM, stretching and functional exercises.[7,9] As Bush et al.[9] and Palmer et al.[7] observed, combining soft tissue mobilization with dynamic movement strategies may be more effective in producing meaningful gains in ROM than manual therapy alone.[7,9]

Additionally, methodological considerations such as the use of the untreated leg as the control rather than a separate control group may have introduced potential crossover or systemic effects. Rowlett et al.[12] employed a randomized control design and observed significant improvements in dorsiflexion ROM following both IASTM and static stretching interventions, suggesting that a more rigorous control structure may influence outcomes.[12] Future studies may benefit from including sham interventions or a no-treatment control group to better isolate treatment effects.

These findings contribute to a growing body of literature evaluating the clinical utility of IASTM and static stretching. While the current study does not support strong conclusions regarding the superiority of either method, it does highlight the need for individualized treatment planning and further investigation. It may be more appropriate to view these findings as indicative of potential short-term changes in ROM in active individuals, rather than prescriptive recommendations. In clinical settings, the choice between IASTM and stretching should consider the individual's condition, ROM limitations, functional goals, and personal preferences.

Limitations of this study include the small sample size, homogeneous participant characteristics, and the absence of long-term follow-up. Pre-intervention dorsiflexion values were close to normative ranges, which may have contributed to a ceiling effect, thereby limiting the ability to detect significant changes following the interventions. The findings may not be generalized to clinical populations with impaired ROM or musculoskeletal dysfunction. Future research should explore the effects of multi-modal interventions, varied dosages, and broader populations over extended durations.

Conclusions

In summary, while static stretching demonstrated statistically significant short-term improvements in dorsiflexion and IASTM showed small gains, neither intervention yielded lasting changes beyond 60 minutes in a healthy, recreationally active sample. These findings may contribute to a broader understanding of mobility interventions and their relative impact on non-clinical populations. However, further research is warranted to establish clinical relevance and efficacy across diverse populations and functional outcomes.

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