Improving Ankle Range of Motion with the Use of Instrument Assisted Soft Tissue Mobilization: A Validation Case Study

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ABSTRACT

The purpose of this case validation study was to examine the effects of Instrument-Assisted Soft Tissue Mobilization (IASTM) on the ankle. The patient population consisted of nine participants (2 females, 7 males, age = 16± 2 years) from a suburban high school in Illinois. Each patient completed an IASTM treatment program, incorporating the Graston Technique® (GT). The program was completed over a three-week period with 2 sessions occurring each week, for a total of 6 sessions. Data collection of ankle dorsiflexion range of motion (DFROM) occurred after the completion of the GT. This was assessed by performing the weight-bearing lunge test at the start and end of each treatment day. Results demonstrated that ankle DFROM did improve by the last session. The findings from this case validation study suggest that the use of GT is an effective intervention for increasing joint DFROM.

Key Phrases
Manual techniques, clinician-rated outcomes, secondary schools patient population

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INTRODUCTION

We selected a systemic review[1] regarding the use of instrument-assisted soft tissue mobilization (IASTM). The authors completed a literature search from the years 2000 through 2016, using the following databases: Academic Search Premier, Alt Healthwatch, CINAHL, Cochrane Library, MEDLINE, NLM PubMed, Physical Education Index, PEDro, SPORTDiscus, and the Web of Science. The studies were evaluated and included if they met the following criteria: (1) the study was a randomized controlled trial, (2) range of motion (ROM), pain, strength, or patient-reported function was measured pre-intervention and post-intervention, (3) studies were written in English, (4) human patients were assessed, and (5) IASTM was compared with a control group (no IASTM). Thirteen of the initial 1,279 studies were included in the review and of these, 6 examined the upper extremities, 6 examined the lower extremities and 1 examined the thoracic spine. Six studies assessed outcomes in uninjured patients and the remaining studies assessed outcomes in injured patients. The review concluded that IASTM improves ROM in uninjured individuals as well as pain and patient-reported function for certain injuries.

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OBJECTIVE

The purpose of the validation case study was to examine whether the use of the Graston Technique® (GT) improves ankle dorsiflexion range of motion (DFROM) in secondary school (grades 9-12) participants from a variety of athletic programs.

PATIENT POPULATION

The setting was a secondary school in suburban Illinois. Female and male athletes from football, volleyball, and basketball programs were recruited to participate. Nine participants (2 females, 7 males, age = 16± 2 years) completed the GT treatment. Participants were included in the treatment program if they had 10 cm or less of ankle DFROM while performing the weight-bearing lunge test (WBLT) and were in a school sponsored athletic program. Less than 10 cm of DFROM while performing the WBLT has been cited as an indicator of ankle equinus.[2] Participants were excluded from the treatment program if their DFROM was greater than 10 cm.[2] Participants were also asked if they had any previous history of ankle injuries. If the ankle injury was on the right ankle they were excluded from the study (**Figure 1**). However, if the ankle injury was on the left ankle and their right ankle DFROM was less than 10 cm while performing the WBLT, they were included in the study.

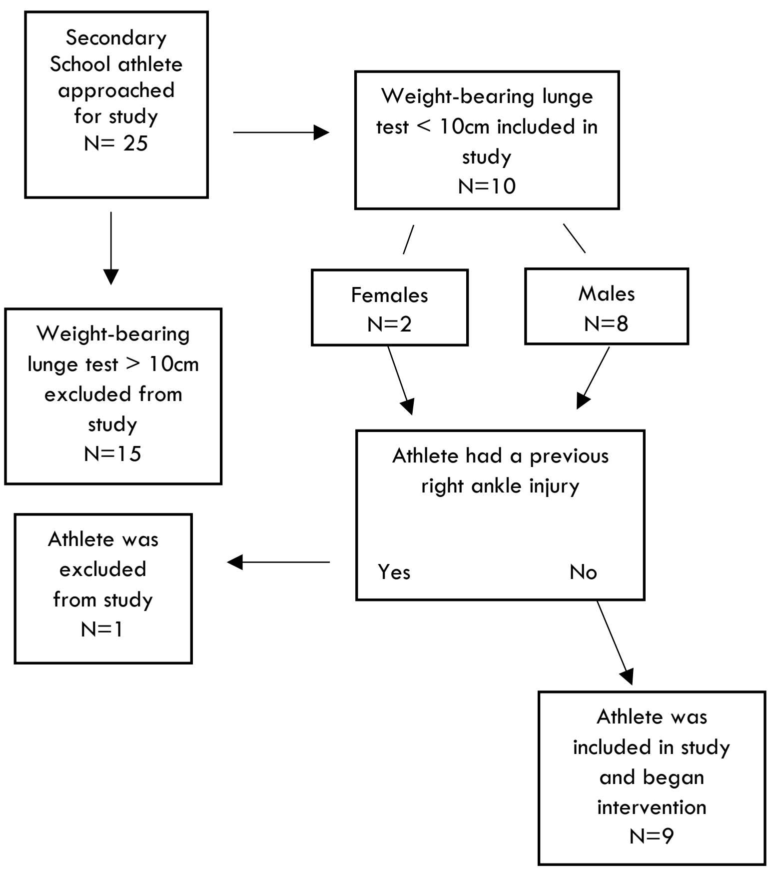

Figure 1. Participant Flow Chart

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INTERVENTION

In this study, GT was performed by the primary investigator, who was certified in the technique, while being supervised by the head athletic trainer. The treatment protocol was based on previous work of GT on chronic ankle instability to increase ankle DFROM.[3] This program was initiated in the middle of the fall sports season and consisted of a 3-week phase for each participant. The 3-week phase required participants to complete 6 sessions, twice per week for approximately 10 minutes total per session. There was a minimum of 48 hours between each session of GT. Participants received treatment one hour before the start of their athletic practice time. This gave each participant enough time to receive treatment before heading to practice.

Before the start of each treatment session, each participant performed the WBLT[4] for ankle DFROM with all measurements taken on the right ankle. For this study, the right leg was chosen because all participants were right leg dominant and was used most often as their leading or kicking foot within the participants associated sports. Documentation of their dominant leg was asked before measurements. All measurement were taken using a tape measurer in centimeters. The tape measurer in this study acted as our measuring tool instead of a goniometer. Research shows that using either a goniometer or tape measure when measuring ankle DRFOM are both reliable tools.[4] The WBLT was performed in a kneeling position with the heel in contact with the ground, the knee in line with the second toe. The great toe was placed at 10 cm away from the wall (**Figure 2**). Participants were asked to lunge forward touching their knee to the wall, without removing their heel from the ground. If the participants were not able to touch, their knee to the wall or the heel was removed from the ground, their foot was moved forward 1 cm until the participant was able to touch the wall with their knee without lifting their heel from the ground. This measurement was then recorded. The participants then completed a warmup on a stationary bike for five minutes before the GT was applied. It is recommended that participants either use a modality or perform an active warm-up prior to GT administration.[5] The GT was then performed at four different locations, all on the right ankle, for a total of 8 minutes (2 minutes each site)[1] (**Table 1**). The four locations were the full length of the Achilles tendon, the gastrocnemius/soleus, the dorsum of the foot, the fibularis longus and the flexor digitorum longus. Three GT instruments were selected (GT2, GT3, GT4) to treat the restricted areas in the fascia, muscle, tendon, or ligaments both in a prone position (**Figures 3, 4**) and in a supine position (**Figures 5, 6**). Restrictions were acknowledged as soft tissue lesions and fascial restrictions.[14] Instruments GT2 and GT4 were used primarily to sweep and fan each specific location, whereas GT3 was used for performing fanning, brushing, and j-stroke when a restricted area was found.[3] The WBLT[4] was then re-assessed at the end of each treatment session.

Table 1. Graston Instrument Assisted Soft Tissue Mobilization

Graston Instruments	Patient Position	Strokes And Anatomical Area
GT 4, knob of GT 2 and GT 3 (Figure 3,4)	Prone, foot over end of table	Sweep plantar fascia and gastrocnemius/ soleus
GT 4, knob of GT 2 and GT 3 (Figure 5, 6)	Supine, foot over end of table	Sweep dorsum of foot and anterior tibialis Frame medial and lateral malleoli

STATISTICAL ANALYSIS

A two-way repeated measures analysis of variance (ANOVA) was used to examine differences in each ankle DFROM measure over time and weeks. Post hoc comparisons were completed using paired samples t-

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test to examine pairwise differences within each week and from baseline through week 3. Hedges' *g* effect size (ESs) with 95% confidence intervals (CIs) were calculated for our post-hoc comparisons. A positive ES indicated an increase in ankle DFROM after the application of GT while a negative ES indicated a decrease in ankle DFROM. A weak ES is considered $< .40$, while a moderate ES is .41 to .69.[8] A strong ES is considered $> .59$.[8] Significance level for all analyses was set at $p \leq .05$. Statistical analysis was completed using SPSS (version 27, SPSS Inc., Chicago, IL), and Excel 2016 (Microsoft Inc., Redmond, WA).

Figure 2. Weight-Bearing Lung Test Measurement

Figure 3. GT2 Achilles Tendon and Fibula

Figure 4. GT3 Gastrocnemius/Soleus and Achilles tendon

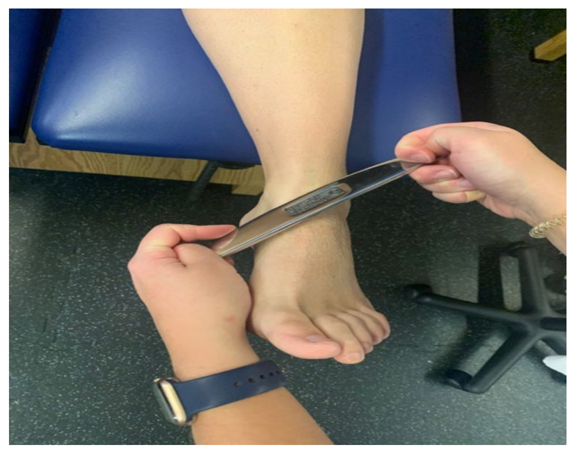

Figure 5. GT4 Anterior tibialis and dorsum of the foot

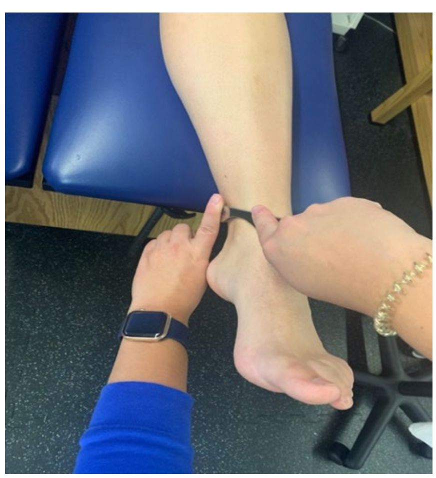

Figure 6. GT2 Medial and Lateral Malleoli-Knob of GT2

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MAIN FINDINGS

During the three-week intervention, no injuries were sustained and there were no changes in the number of participants. A significant time main effect was found for right ankle DFROM ($p < 0.001$) with the WBLT. All participants except one improved in ankle DFROM from day-to-day and week-to-week (**Table 2**). Post hoc analysis identified a significant change in ankle DFROM from pre-to-post of week 1 ($p = .001$), pre-to-post of week 2 $p < .001$, to pre-to-post week 3 ($p = .001$). The results indicated that there was an improvement with right ankle DFROM within each week. The significant results were associated with medium to large effect sizes (0.58-4.12) (**Table 3**).

Table 2. Means (±Standard Deviations) for Ankle Dorsiflexion, Numbers Represent Degrees

	W 1/D 1	W 1/D 2	W 2/D 1	W 2/D 2	W 3/D 1	W 3/D 2
Right Ankle	4.74 ±5.42	7.10 ±4.80	10.91 ±5.33	15.60 ±4.32	21.2 ±5.53	24.4 ±5.63

Table 3. Effects Size with Associated Confidence Intervals

	P-Value	Effect Size	Lower Bound	Upper Bound
Pre-Post Wk1	0.001	0.55	-0.39	1.49
Pre-Post Wk2	<0.001	1.45	0.41	2.49
Pre-Post Wk3	0.001	1.02	0.03	2.01
PreWk1-Post Wk3	<0.001	3.91	2.28	5.54

DISCUSSION

The results from this study suggest that the application of GT alone may have an acute improvement on ankle DFROM. Similar improvements have been found in other studies which also evaluated the effects of GT on ankle DFROM.[8-10] Literature[11] has established normal range for ankle DFROM as 0-16.5 degrees for non-weight bearing measurement and 7.1-34.7 degrees during weight-bearing measurement. Traditionally, less than 10 degrees of ankle DFROM has been cited as a noticeable deficit.[2] Decreased DFROM can alter motor control and cause a lack of neuromuscular control. This deficit can also lead to a higher risk of injury of the lower limb in athletes, especially in the ankle, knee and hip region.[11] Therefore, improvement of ankle dorsiflexion may assist in lower extremity injury prevention.

One category of therapeutic interventions that can be used to increase DFROM is manual therapy, specifically GT.[15] There are many other reported benefits with GT, some of which have shown to increase the fibroblast response in healing to produce more collagen with the controlled movement of the instruments.[12] The theory behind the GT benefits is that the technique improves the extensibility of the tissues by treating the tissue restrictions, along with decreasing inflammation after an acute injury.[14] When heat is created from friction by the instrument, the viscosity of the tissue decreases, making it more pliable.[15] Physiologically, a decrease in the viscosity of tissue improves ROM.[16] Changes in ROM as a result of GT may also be explained with the hypothesis that the mechanical stress applied on the muscle fascia can cause the fascia to become stimulated.[14] This change in stimulation alters the proprioceptive input sent to the central nervous system, which in turn changes the tension in the tissue.[17]

In a cross comparison of studies, Palmer et al.[8] found improvements with ankle DFROM when GT was combined with stretching. In our study, the GT group received a total of ten minutes for the GT treatment from the proximal gastrocnemius to the metatarsal heads. Palmer et al.[8] completed a comprehensive treatment that focused on the anterior and posterior structures of the foot and the ankle, noting that these

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locations of GT have a greater influence on ankle dorsiflexion. Similarly, Stanek et al.[9] through the use of the WBLT, identified DFROM improvements after the application of a single session of GT at two different locations, the Achilles tendon and the soleus/gastrocnemius region. Rowlett et al.[8] also identified significant improvements in DFROM with a single session of GT when ROM was measured using the WBLT. Rowlett et al.[10] also found that both GT and stretching appear to have a greater effect on the muscle flexibility than just GT alone. Overall, these studies found an acute increase in DFROM after completing one application of GT. [8-10]

Implementing a GT program in a secondary school setting may be challenging if the athletic trainer does not have GT instruments, as one must be certified[14] in the technique and have the financial means to attain the tools. However, implementing a general IASTM intervention, instead of specifically GT, may be more feasible as there is a wider variety of instruments and courses from which one can choose. Specifically, general IASTM tools may be more reasonable in terms of cost, access, and certification standards. In this current study, we focused on 10-minute treatment sessions which was time efficient. Similarly, other studies[8-10] attained acute results with DFROM when performing short treatment sessions that were done 1-2x/week with a minimum of 48 hours in between each session. It is recommended that GT treatment sessions have a minimum of 48 hours in between each session to allow the tissues to heal.[19] Following the use of GT, other treatments may be used in conjunction.[3,8,10] These treatments may include exercise such as stretching and strengthening, to aid in the tissue healing.[20] Rowlett et al.[10] also found that both GT and stretching appear to have a greater effect on the muscle flexibility than just GT alone. Nevertheless, including supplemental therapy or exercise can require more time commitment from the participant, coach, and the athletic trainer, and time itself is considered a limitation of prevention programs.[21] Since higher compliance rates can positively affect outcomes for the participants, it is important to create a supervised and efficient prevention program.[22,23] In this study, we chose to implement the program before the start of practice as pre-practice treatment sessions were already established throughout all sports. Furthermore, the participants gained the supplemental benefits of exercise as the participants could immediately begin warm-up drills and sport-specific activities post-GT treatment. However, each participant may have different degrees of DFROM along with various histories of previous ankle injuries that may bring additional symptoms that must be addressed. Therefore, athletic trainers should evaluate the needs of the patient when deciding complimentary treatments for GT.

Additionally, there are limitations within this study that needs to be addressed. First, having a small sample size may influence the results when examining the effects of GT on DFROM. Future studies will benefit from obtaining a larger sample size when completing a case validation study. The participants were recruited from a convenience sample within the traditional fall and winter athletics seasons. The athletic demands of the represented sports vary greatly, and therefore may have influenced inclusion and exclusion factors. Future case validation studies may benefit from investigating the effects of the intervention on individuals participating in other sports.

CLINICAL BOTTOM LINE

The findings from this case validation study concur with the guiding systematic review that the use of IASTM and GT is an effective intervention for increasing joint ROM at the ankle[1] when assessing ROM with the WBLT. Healthy ankle ROM is an important part of an injury prevention program, and GT may be an effective way of improving functional limitations. Athletic trainers should examine their patient population to determine the feasibility of using IASTM as a treatment.

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