

Effect of Instrument-Assisted Soft Tissue Mobilization on Ankle of Range of Motion and Balance in Older Women: A Preliminary Study

Han Wool Lee¹, Hyoung Jean Beak¹, Eun-Jung Yoon², Jooyoung Kim^{3*}

¹ Integrative Medicine, Graduate School of Integrated Medicine, CHA University, Pocheon, Korea

² Department of Physical Education, Korean National University of Education, Cheongju, Korea

³ Office of Academic Affairs, Konkuk University, Chungju, Korea

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ABSTRACT

OBJECTIVES This study aims to investigate the effects of instrument-assisted soft tissue mobilization (IASTM) on ankle range of motion (ROM) and balance in older women.

METHODS The 20 older women with a history of falls participated in the study, and the study subjects were randomly divided into the IASTM group (n=10) and control group (n=10).

RESULTS There were no significant interactions between group and time for ankle ROM and functional reach after 8 weeks of IASTM on older women ($P>0.05$). Meanwhile, there were significant interactions between group and time for one-leg standing and star excursion balance ($P<0.05$), and in particular, the IASTM group had greater improvements compared to the control group.

CONCLUSION In conclusion, the regular application of IASTM has been shown to improve the balance of older women with a history of falls.

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Introduction

There is an increased interest in health care with growth of the older population [1]. A major change with aging is ankle range of motion (ROM) restriction [2]. This change causes dysfunction in the older, which leads to unsteady gait and decreased balance, resulting in falls [3]. Falls are a serious problem in the older that can cause fractures and consequences that may lead to death [4,5]. The ankle is the first strategy to be used for dynamic postural control to keep balance on surfaces, and every movement of the ankle is highly related to maintaining balance during gait [6]. Therefore, ankle

ROM is essential to maintaining balance and preventing falls during gait in the older [2].

Of the interventions known to increase ROM, myofascial release techniques are currently widely used for rehabilitation of athletes and the general public [7,8]. Of the myofascial release techniques, instrument-assisted soft tissue mobilization (IASTM) treats soft tissue disorders using rigid instruments of various shapes and materials [9-12]. The use of instruments provides mechanical advantages by reducing stress on the clinician's hands and allowing for deeper penetration and more specific treatment [13]. In some studies, IASTM was reported to be effective in increasing ankle ROM and reducing ankle joint stiffness in healthy adults [14,15]. Also, when IASTM was applied to individuals with a history of chronic ankle

***Correspondence:** Jooyoung Kim, Office of Academic Affairs, Konkuk University, 268, Chungwon-daero, Chungju-si, Chungcheongbuk-do, 27478, Korea; Tel: +82-43-840-3212; E-mail: hirase1125@hanmail.net



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instability, increased ankle ROM and enhanced dynamic balance were observed [16].

However, so far, studies on IASTM have been mainly applied on healthy adults, athletes, or patients with chronic skeletomuscular disease [9,16-18], and the studies on the older are limited. In particular, older women have a higher rate of falls than older men [19,20], and reports suggest that older women with a history of falls may have increased anxiety due to fear of falling, which can restrict their daily activities [21]. Based on these facts, studies on methods to care for balance and ROM, the major factors for falls, in older women are needed. Therefore, this study aims to investigate the effects of IASTM on ankle ROM and balance in older women with a history of falls.

Methods

Subjects

Twenty older women aged 65 to 67 participated in this study. The sample size calculation was guided by previous studies [22]. The subjects have experienced falls in the past (within 3 years), and had limited dorsiflexion range of motion (less than 20 degrees). However, at the moment, they neither had musculoskeletal disorders (low back pain or lower limb arthritis), nor neurological damage related to balance (dizziness, vestibular dysfunction), nor orthostatic hypotension, nor pain in any part of the body. The subjects had cognitive abilities to understand explanations and instructions, and did not take any medication that can affect their balance. Subjects found with health risk factors or unable to properly participate in the study were excluded. The subjects were randomly divided into the ISATM group (n=10) and control group (n=10). Physical characteristics of the study subjects are described in <Table 1>.

Table 1. Physical characteristics of study subjects

Variable	IASTM (n = 10)	Control (n = 10)
Age (years)	65.7 ± 0.8	65.9 ± 1.1
Height (cm)	153.6 ± 5.6	151.6 ± 4.0
Weight (kg)	57.1 ± 6.2	59.2 ± 8.0

Values are Mean±SD. IASTM: instrument-assisted soft tissue mobilization; BMI: body mass index; There were no significant differences between groups.

Instrument-assisted soft tissue mobilization

IASTM was applied 3 times a week, for a total of 8 weeks. The tool called sweep stroke was used for IASTM (Bodywork Technique, Balancecord, Korea), and targeted all of the following soft tissues (Achilles tendon, gastrocnemii, soleus, and tibialis posterior muscles) each session <Figure 1>. Before applying IASTM, subjects lay on a bed in a prone position. Massage cream was applied to the soft tissues, and sweep stroke was applied for 30 seconds, slowly moving from the distal to the proximal end of the soft tissues [11]. The angle was kept at 45 degrees when using sweep stroke [9]. IASTM was applied only once for a total of 30 seconds. After applying IASTM, any remaining massage cream on soft tissues was wiped off with a towel, and subjects were allowed to rest. IASTM was applied by one certified expert with a certain amount of time of clinical experience. The control group did not receive IASTM.



Figure 1. Application of instrument-assisted soft tissue mobilization (IASTM)

Ankle ROM

Subjects were tested in supine position, and the knee was fixed to prevent it from bending. Measurements were taken using the international manual goniometer device, with the stationary arm of the goniometer aligned to the midline of the lateral malleolus and fibula head, and the movable arm placed parallel to the longitudinal axis of the fifth metatarsal bone [23]. Measurements were taken in triplicates for each ankle, and the average value was recorded and used.

Static and dynamic balance

Static balance was measured by the one-leg standing

test. Subjects were asked to face forward with both hands on their waist and one leg lifted with the knee bent 90 degrees. Time was measured until the raised foot touched the floor, supporting leg moved due to loss of balance, or the knee was unable to stay bent 90 degrees [24]. The test was performed with both eyes opened. The subjects performed the test on both left and right limbs, with three attempts on each limb. The average value was recorded and used. Dynamic balance was measured by star excursion balance test and functional reach test. For the star excursion balance test, the subjects stood facing forward with both hands on their waist. The subjects were asked to lift one knee up to a hip, then to stretch the leg to reach as far as possible. The distance from the farthest point reached by the tip of the toes to the original position was measured [25]. For the functional reach test, the subjects were instructed to flex the shoulder of one arm, with elbow fully extended, to 90 degrees. The subjects were told to reach forward as far as they could while keeping the arm level and parallel. The distance was measured from the end of the third metacarpophalangeal joint of the starting position to the final position [26]. The dynamic balance tests were performed on both left and right limbs, and the average value of three measurements was recorded and used. For safety reasons, the subjects were allowed to take enough time to rest between each measurement when measuring static and dynamic balance, and an assistant was beside each subject while taking the measurements.

Statistical analysis

All data in this study are described by mean and standard deviation (SD). Repeated measure ANOVA was used to analyze the interaction between groups (IASTM and control) and time (pre and post). Independent t-test was conducted

to find the difference between the groups when there was a significant interaction. SPSS program (version 18.0, IBM, Armonk, NY) was used for all statistical analysis. Statistical significance level was set to $\alpha < .05$.

Results

Change of ankle ROM

Changes in ankle ROM after 8 weeks of IASTM on older women have been described in <Table 2>. Ankle ROM increased in both left and right ankle after IASTM compared to pre-intervention, however, there was no significant interaction effect between group and time ($P > 0.05$).

Change of static balance

Changes in static balance, measured by one-leg standing, after 8 weeks of IASTM on older women have been presented in <Table 3>. For one-leg standing, measurements of both right and left limbs increased after IASTM, and there was a significant interaction effect between group and time (left: $P = 0.041$; right: $P = 0.014$). In particular, one-leg standing measurements of both left and right limb of the IASTM group were greater than the control group ($P < 0.05$).

Change of dynamic balance

Changes in dynamic balance, measured by star excursion balance, after 8 weeks of IASTM on older women have been described in <Table 4>. Star excursion balance improved after IASTM, and there were significant interaction effects between time and group for star excursion balance of both the left and right limbs (left: $P = 0.027$; right: $P = 0.009$). In particular, for the star excursion balance of the right limb, the IASTM group had greater improvements in static balance compared to the control group ($P < 0.05$). However, there was no significant

Table 2. Changes in ankle range of motion in older women after 8 weeks of IASTM

Variable	Group	Pre	Post	P
Ankle ROM (left, °)	IASTM (n = 10)	4.4 ± 2.0	6.0 ± 1.8	0.403
	Control (n=10)	3.8 ± 2.6	4.8 ± 2.2	
Ankle ROM (right, °)	IASTM (n = 10)	5.5 ± 2.2	7.1 ± 2.3	0.179
	Control (n = 10)	4.5 ± 1.9	5.3 ± 2.1	

Values are Mean±SD. IASTM: instrument-assisted soft tissue mobilization; ROM: range of motion.

Table 3. Changes in one-leg standing in older women after 8 weeks of IASTM

Variable	Group	Pre	Post	P
One-leg standing (left, sec)	IASTM (n = 10)	10.3 ± 7.2	15.0 ± 7.0 [#]	0.041*
	Control (n = 10)	10.9 ± 5.7	11.3 ± 4.7	
One-leg standing (right, sec)	IASTM (n = 10)	11.2 ± 8.2	15.2 ± 7.9 [#]	0.014*
	Control (n = 10)	12.1 ± 5.6	12.7 ± 4.7	

Values are Mean±SD. IASTM: instrument-assisted soft tissue mobilization; [#]Significant differences between groups; ***Interaction** effect between **group by time**.

Table 4. Changes in star excursion balance in older women after 8 weeks of IASTM

Variable	Group	Pre	Post	P
Star excursion balance (left, cm)	IASTM (n = 10)	15.4 ± 2.0	19.0 ± 3.9	0.027*
	Control (n = 10)	17.4 ± 7.7	17.9 ± 7.8	
Star excursion balance (right, cm)	IASTM (n = 10)	17.5 ± 8.4	21.9 ± 7.3 [#]	0.009*
	Control (n = 10)	18.4 ± 9.1	19.1 ± 9.6	

Values are Mean±SD. IASTM: instrument-assisted soft tissue mobilization; [#]Significant differences between groups; ***Interaction** effect between **group by time**.

Table 5. Changes in functional reach in older women after 8 weeks of IASTM

Variable	Group	Pre	Post	P
Functional reach (cm)	IASTM (n = 10)	27.3 ± 4.3	29.0 ± 3.3	0.468
	Control (n = 10)	28.9 ± 2.3	29.9 ± 2.2	

Values are Mean±SD. IASTM: instrument-assisted soft tissue mobilization.

interaction effect between group and time for dynamic balance of both the right and left limbs when measured by functional reach ($P > 0.05$, Table 5).

Discussion

The older need balance to perform daily tasks such as walking quickly and sit-to-stand [27]. However, due to changes to the sensorimotor and neuromuscular system of the ankle and restricted ankle ROM, the older have decreased performance in static and dynamic postural, and these changes may increase the risk of falls [3,28]. IASTM is a simple and practical method that uses rigid instruments to provide a mobilizing effect to soft tissue and help functional recovery [29].

This study aimed to investigate the effects of IASTM on

ankle ROM and balance in older women with a history of falls. From our knowledge, this is the first study on the effects of IASTM on older women. In this study, IASTM did not have any effects on ankle ROM in older women, however, there were significant improvements in static and dynamic balance. Of these results, the change in ankle ROM after IASTM is contrary to previous studies [14,15]. Prior studies have suggested that repetitive mechanical stimulation of the skin by IASTM reduces joint and muscle stiffness and changes stretch tolerance, and thus, can improve ankle ROM [14,15].

Differences in study subjects and methods are thought to be the reasons for these contradicting results. For both studies by Ikeda et al. [14] and Rowlett et al. [15], healthy adults, not the older, were selected as the study subjects. Ikeda et al. [14] and Rowlett et al. [15] both measured ankle ROM after a single session (2 or 5 min) of IASTM. Also, both studies

measured ankle ROM differently from this study, as Ikeda et al. [14] measured the isokinetic dynamometer, while Rowlett et al. [15] measured modified root position 1- knee extended (MRP1), modified root position 2- knee flexed (MRP2), and weight bearing lunge test (WBLT).

Meanwhile, the static and dynamic balance significantly increased after IASTM was applied on older women. This is similar to the results by Schaefer and Sandrey [16]. Schaefer and Sandrey [16] have reported 4 weeks of IASTM to increase dynamic balance, measured by star excursion balance test, in individuals with a history of chronic ankle instability. However, the subjects of the study by Schaefer and Sandrey [16] were physically active high school and college students, and IASTM was combined with dynamic-balance training. This is different from this study with a single intervention (only IASTM), and thus, the results should be interpreted with caution.

Although studies on IASTM and balance are limited, changes in mechanoreceptors may have contributed to the improvement in static and dynamic balance by IASTM. In general, mechanoreceptors around the foot are involved in changes in balance, and cutaneous mechanoreceptor afferents provide spatial and temporal information for foot and postural control [30]. These mechanoreceptors can change by myofascial release. Wikstrom et al. [31] have reported that myofascial release by manual, ball, or sensory brush in individuals with chronic ankle instability positively affects static postural-control, and have hypothesized the involvement of mechanoreceptors for these effects. However, this is only a hypothesis and there is not enough scientific evidence to support the changes in mechanoreceptors after myofascial release. Also, there were no measurements taken in this study related to this topic. Thus, further research is needed.

This study had several limitations. First, this research only studied older women, and thus, the effect of IASTM in older men also needs to be examined. In addition, this study only included older women with a history of falls within the past 3 years, limited dorsiflexion range of motion of less than 20 degrees, and no ankle pain. It is not yet known whether older women with different conditions, such as having ankle pain or chronic ankle instability, will have similar results to this study. Lastly, only ROM and balance were measured to evaluate

functional change in older women after IASTM. Effects on gait, which requires a combination of both factors, has not been studied. Gait of older women is directly related to falls [2]. Therefore, in future studies, equipment and indicators for gait analysis should be added to study functional changes in older women after IASTM.

Conclusions

In conclusion, the regular application of IASTM was found to improve the balance of older women with a history of falls. These findings may help trainers or therapists who are supporting functional rehabilitation in older women with a history of falls. However, since this is only a preliminary study, a larger study is needed to verify these results.

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Conflicts of Interest

The authors declare no conflict of interest.

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