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Investigating the Effects of The Percussive Therapy Device and Instrument-Assisted Soft Tissue Mobilization on Hamstring Tightness

Demet Biçki[1], Buse Keskin[2]

Abstract: The goal of this study is to research the impact the Percussive Therapy Device and Instrument-Assisted Soft Tissue Mobilization (IASTM) on hamstring tightness in individuals experiencing tangible hamstring muscle tightness.

Method: 40 healthy individuals aged between 18 - 60 with tangible hamstring muscle tightness (The Passive Straight Leg Raise ≤ 70°) were included in the study. They were randomly put into two equal groups using the randomization method. IASTM Group: N=20 Percussive Therapy Group: N=20. Hamstring muscle flexibility was measured with active knee extension and sit-reach tests in both interventions in pre- and post-treatment. Participants were treated by a therapist twice a week for a total of three weeks.

Findings: When the active knee extension angle flexibility and sit-reach tests were examined, the difference between pre- and post-treatments was ascertained to be statistically significant ($p<0.05$) in both studies. When the difference between the two groups was compared, the change in the IASTM group (3.66±2.05) was ascertained to be higher than the Percussive Therapy group (3.36±2.33), but this difference was statistically insignificant ($p>0,05$).

Conclusion: The study showed that both interventions had similar positive effects in a short time. As per the results of the study, we think that clinicians can switch from the traditional stretching protocol to more diverse interventions, i.e., IASTM, Percussive Therapy Device.

Keywords: Flexibility, massage gun, myofascial relaxation, soft tissue mobilization, vibration

[1] Aydın University, Department of Physiotherapy and Rehabilitation, İstanbul, Turkey, demetbicki@aydin.edu.tr

[2] Aydın University,Department of Physiotherapy and Rehabilitation, İstanbul, Turkey, busekeskin2@stu.aydin.edu.tr

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Introduction

In examining all the muscles in the body, the muscle group that is more likely to lose flexibility is the hamstring muscle (Turner et al., 1988, pp. 314-20). Loss of flexibility in the hamstring muscle has been shown to be the cause of 30% of injuries in the lower extremity (Hinman et al., 2013, pp. 45-55). The decrease in the flexibility of the hamstring muscle can cause postural disorders, lumbo-pelvic rhythm disorders and secondary accompanying musculoskeletal disorders, such as low back pain and patella-femoral pain syndrome (Aderonke et al., 2005, pp. 35-41). When the biomechanics of the hamstring muscle, which has insufficient flexibility, creates unbalanced forces in the lower extremity, movements that occur may become inefficient and overuse syndromes may occur (Gunn et al., 2019, pp. 15-23). Achieving and maintaining adequate range of motion in the musculoskeletal system is of great importance for athletes and non-athletes of all ages (Morton et al., 2011, pp. 3391-8). As can be seen, the loss of hamstring muscle flexibility can cause musculoskeletal problems by creating a chain effect throughout the body (Valenza et al., 2015, pp. 342-348).

Fascial restrictions are amongst the factors that affect muscle flexibility. While fascia can be limited by reasons such as trauma, sedentary life, disease and inflammation, it can cause increased pain and decreased flexibility (Warren et al., 2020, pp. 579-592).

Hamstring muscle injury accounts for 12% to 16% of all injuries. This injury is the most common contact-free injury. Moreover, the recurrence rate is 13% relatively high compared to other injuries (Carvalho et al., 2023). The high rate of repeated strain injuries in the hamstring muscle indicates that our current approach to the mechanism of injury and the risk of re-injury is insufficient (Opar et al., 2012, pp. 209-226). Some research has found that the injury rate of the hamstring muscle has increased or remained unchanged, suggesting that more effort is needed in prevention and rehabilitation research (Wan et al., 2021, pp. 222-229).

Physiotherapy and rehabilitation methods used for hamstring flexibility in literature can be listed as follows:

One of the treatment methods to increase muscular flexibility is clinical exercise (static stretching, dynamic stretching, PNF stretching, ballistic stretching). The most preferred method by physiotherapists is static and dynamic stretching because it is easy to apply (O' Sullivan et al., 2009, p. 37).

It is assumed that warming up tissue temperature will boost tissue flexibility and reduce the occurrence of injury (LaBella et al., 2011, pp. 1033-40). Thus, it is ascertained that diminishing internal friction reduces the energy cost of muscle contraction (Jarosch, 2011, pp. 2891-900).

Massage is another method widely preferred by physiotherapists because it is easily applied to the skin, subcutaneous tissue and muscles. Massage has a local impact in the area where it is applied, as well as the effects reflected in other parts of the body via the endocrine system, nervous system, lymph and blood circulation.

Another technique used to complement physiotherapy interventions is instrument-assisted soft tissue mobilization. In reviewing the literature, we notice it is one of the most researched methods (Baker et al., 2013, pp. 16-21). This method is an application that uses stainless steel instruments to target the remodeling of connective tissue by releasing the adhesions formed in the muscle and elicits a local inflammatory response. Several studies have been published documenting positive results in range of motion following instrument-assisted soft tissue mobilization (Loghmani et al., 2015, pp. 246-253). Doeringer et al. (2022), concluded there were positive improvements in hamstring tigthtness in a single session using the instrument-assisted soft tissue mobilization technique.

Nevertheless, the instrument assisted soft tissue mobilization technique has not been adequately researched due to differences in tools used and application times. Moreover, a gap exists in the literature due to the lack of studies comparing instrument-assisted soft tissue mobilization with popular interventions to improve hamstring tightness (Cheatham et al., 2016, pp. 200-211).

Another popular technique which has emerged recently is hand percussion massage therapy. It has become a frequently preferred technique, in order to accelerate recovery, increase flexibility and performance, in sports and therapeutic applications in particular. Nonetheless, few scientific studies proving such effects have been conducted to date (Kondrad et al., 2020, pp. 690-694).

The objective of this study is to examine the effects of percussive therapy device and instrument-assisted soft tissue mobilization on hamstring tightness in individuals experiencing tangible hamstring muscle tightness.

MATERIALS AND METHOD

This study was planned to investigate the effects of percussive therapy device and instrument-assisted soft tissue mobilization on hamstring tightness in individuals experiencing tangible hamstring muscle tightness. The study was carried out on 40 healthy volunteers, between December 2022 - March 2023, the necessary posture analyzes were conducted under the roof of FİZYOİST Healthy Living Center and the tangible tightness of the hamstring muscle was found.

The study was evaluated by Istanbul Aydın University Non-Interventional Clinical Research Ethics Committee with the decision dated 20/02/2023 and No. B.30.2.AYD.0.00.00-50.06.04/22 and deemed in compliance with medical ethics.

Individuals who agreed to participate in this study and met the inclusion criteria were randomly mustered into two equal groups. A percussive therapy device was applied to one of the two groups while instrument-assisted soft tissue mobilization was applied to the other. They were applied to both groups twice a week for a total of three weeks.

The participants were subject to appropriate goniometric measurements and sit-reach tests. These evaluations were performed during the pre- and post-treatment procedures. The obtained data was registered.

The following are the inclusion criteria;

Being between 18 - 60 years old, having a tangible shortening of the hamstring muscle, passive straight leg raise of ≤ 70°, applying to the area for the first time to improve hamstring tightness, and volunteering.

The exclusion criteria are:

Having a history of surgical operation(s) in any of the lower extremities, injury in the lower extremity in the last month, impaired balance and vision, receiving physical therapy from any region during the study period.

METHODS

After the purpose of the study and methods used were explained to those individuals who met the inclusion criteria, an Informed Consent Form was signed by the participants, whereas the intervention was started after the necessary evaluations and measurements were taken.

The following parameters were used in the evaluation:

Active Knee Extension Test

Hamstring muscle shortness can be determined by the Active Knee Extension test with the hip in the 90° flexion position. The leg to which the measurement will not be applied is extended in a straight extension, and the individual is stabilized on the bed with the help of a strap so that the pelvis passes over the spine and anterior superiors. While the hip is in 90° flexion, the knee is positioned on the step in 90° flexion in a position where the distal thigh touches the step (Gajdosik R., Lusin G., 1983). The measurement is taken with a goniometer, keeping the ankle in neutral and telling the subject to extend the knee.

Sit-Reach Test

This is a secondary evaluation criterion. The participant sits on the floor, in front of the assessment device, with his/her back and head against the wall, and stretches his/her feet onto the test platform with the soles in full contact and the knees in full extension. Feet are bare during the test. The platform on which the soles are placed corresponds to 26 cm. Stretching forward in a slow and controlled manner with expiration by placing both hands on top of each other without bending his knees, the participant maintains his/her position at the point of maximum reach for two seconds. If the measurement taken from the third fingertip falls below 26 cm, this value is subtracted from 26 cm, and if it goes beyond 26 cm, it is noted by adding over it. The test is repeated twice and the highest value is recorded. Less than 30 cm indicates loss of flexibility in the hamstring muscles.

Demographic Information

An evaluation form comprised of information such as; age, weight, height, smoking, dominant side, exercise habits was filled in for all individuals participating in the study.

Physical Therapy And Rehabilitation

Group 1 Percussive Therapy Device group was intervened by the researcher using Theragun Pro. (This device provides a percussion amplitude of 1750 (PPMs) with its soft coupling head.) After the warm-up exercise (static stretching 30 seconds/3 sets), the researcher applied the Theragun device for 2.5 minutes to both the right and left legs.

The therapist began applying the percussive therapy device from the medial side of the treated muscle (hamstring). This time it was continued from the proximal to the distal by drawing a semicircle from distal to proximal and then interfering with the lateral side of the muscle. The therapist continued to practice for 2.5 minutes. The application took 5 minutes in total, bilaterally. Thus, the percussive therapy device in the two hamstring muscles started from the medial side and ended on the lateral side. The therapist made the effort to apply the same pressure to the skin at all times.

The Group 2 IASTM group was intervened by the therapist using the IASTM tool. After the warm-up exercise (static stretching 30 seconds/3 sets), Vaseline was applied to the area to be treated (anywhere we could reach). Using the IASTM device, the therapist applied the surface sweep (30°) technique for 60 seconds, the fan (60°) technique for 60 seconds, and the deep sweep (60°) technique for 30 seconds. Bilaterally, the application lasted 5 minutes.

Statistical Analysis

Statistical analyzes were performed using the IBM SPSS 26 package program.

The assumption of normality in numerical variables was tested with the Shapiro-Wilk test by controlling the skewness and kurtosis values, whereas it was ascertained that the data showed a normal distribution. Parametric analysis methods were applied as per the normal distribution of the data. While an independent sample T-test was used for intergroup comparisons of numerical data, the Chi-Square and Fisher's Exact tests were used for intergroup comparisons of categorical data. A paired-sample T-test was used for in-group comparisons of numerical data. The $p<0.05$ level was considered statistically significant for the evaluation of all analyzes.

FINDINGS

40 people between the ages of 18-60 who accepted to be included in this study and who experienced tangible hamstring shortness as a result of posture analysis were randomly divided into two groups; 1. IASTM (Instrument-Assisted Soft Tissue Mobilization) and 2. Percussive Therapy Device (Theragun Pro).

Table 1. Distribution of Pre-Treatment Measurements by Groups

Pre-Treatment Measurements	IASTM Group (n=20)	Percussive Therapy Group (n=20)	(p)
	X ± Ss.	X ± Ss.	
Active Knee Extension (Right)	53.15 ± 8.58	50.65 ± 9.91	.399

Active Knee Extension (Left)	55.00 ± 8.75	51.90 ± 9.81	.298
Sit and Reach Test	11.14 ± 3.91	11.27 ± 3.78	.915

$p<0.05$; Independent Sample T-Test was used.

The results of the analysis performed to determine whether there is a difference according to the groups in the measurements of the patients included in the study are shown in Table 2.

There was no statistically significant difference between the averages of the active knee extension (right), active knee extension (left), sit-reach tests measured pre-treatment of both groups ($p>0.05$).

Table 2. Distribution of Post-Treatment Measurements by Groups

Post-Treatment Measurements	IASTM **Group (n=20)**	**Percussive Therapy Group (n=20)**	**(p)**
	X ± Ss.	**X ± Ss.**	
Active Knee Extension (Right)	58.50 ± 7.76	56.55 ± 8.62	.423
Active Knee Extension (Left)	59.05 ± 7.54	56.80 ± 9.36	.408
Sit and Reach Test	14.80 ± 3.07	14.63 ± 3.75	.873

$p<0.05$; Independent Sample T-Test was used.

There was no statistically significant difference between the mean of active knee extension (right), active knee extension (left), sit and reach test measured after the treatment of both groups ($p>0.05$).

Table 3. Comparison of Pre-Treatment and Post-Treatment Measurements

Measurements	**Groups**	**Pre-Treatment**	**Post-Treatment**	**(p)**	**Intra-Group Exchange**	**(p)**
		X ± Ss.	**X ± Ss.**		**X ± Ss.**	
Active Knee Extension (Right)	IASTM	53.15 ± 8.58	58.65 ± 7.76	**0.001^a**	5.50 ± 5.40	0.770^b
	Percussive Therapy Group	50.65 ± 9.91	56.55 ± 8.62	**0.001^a**	5.90 ± 2.78	
Active Knee Extension (Left)	IASTM	55.00 ± 8.75	59.05 ± 7.54	**0.001^a**	4.05 ± 2.50	0.276^b
	Percussive Therapy Group	51.90 ± 9.81	56.80 ± 9.36	**0.001^a**	4.90 ± 2.35	
Sit - Reach	IASTM	11.14 ± 3.91	14.80 ± 3.07	**0.001^a**	3.66 ± 2.05	0.664^b
	Percussive Therapy Group	11.27 ± 3.77	14.63 ± 3.75	**0.001^a**	3.36 ± 2.33	

$p<0.05$; a: Paired T-Test; b: Independent Sample T-Test

Comparison of Pre-Treatment and Post-Treatment Measurements

The results of the analyzes carried out between the groups in order to determine whether there is a difference within the group in the average measurements conducted before and after the treatment of patients included in the study and whether this difference is statistically significant are provided in Table 3.

In examining the active knee extension (right), it was observed that the average value of the IASTM group was 53.15±8.58 before treatment and 58.65±7.76 after treatment. The difference between before and after treatment was found to be statistically significant ($p<0.05$).

It was ascertained that the average value of the Percussive Therapy group was 50.65±9.91 before treatment and 56.55±8.62 after treatment, whereas the difference before and after treatment was found to be statistically significant ($p<0.05$).

When the difference between the two groups was compared, it was found that the change in the Percussive Therapy group (5.90±2.78) was higher than the IASTM group (5.50±5.40), but this difference was statistically insignificant ($p>0.05$).

In examining the active knee extension (left), it was observed that the average value of IASTM group was 55.00±8.75 before treatment and 59.05±8.62 after treatment. The difference before and after treatment was found to be statistically significant ($p<0.05$).

It was ascertained that the average value of the Percussive Therapy group was 51.90±9.81 before treatment and 56.80±9.36 after treatment. The difference before and after treatment was found to be statistically significant ($p<0.05$).

When the difference between the two groups was compared, it was found that the change in the Percussive Therapy group (4.90±2.35) was higher than that in the IASTM group (4.05±2.50), but this difference was statistically insignificant (p>0, 0). 05).

In examining sit and reach, it was observed that the average value of IASTM group was 11.14±3.91 before treatment and 14.80±3.07 after treatment. Tedavi öncesi ve sonrası farkın, istatistiksel olarak anlamlı olduğu belirlenmiştir (p<0,05). The difference before and after treatment was found to be statistically significant ($p<0.05$).

It was observed that the average value of the Percussive Therapy group was 11.27±3.77 before treatment and 14.63±3.75 after treatment. The difference before and after treatment was found to be statistically significant ($p<0.05$).

When the difference between the two groups was compared, it was found that the change in the IASTM group (3.66±2.05) was higher than the Percussive Therapy group (3.36±2.33), but this difference was statistically insignificant (p>0,). 05).

DISCUSSION

The study investigated and compared the impact of Instrument Assisted Soft Tissue Mobilization and Percussive Therapy Device in improving muscle flexibility in healthy individuals experiencing hamstring tightness. When the two interventions were compared with each other in the study, there was no statistically significant difference in the improvement in outcome measures ($p>0.05$). With this, when comparing between groups, significantly improved muscle flexibility in both interventions (IASTM and Percussive Therapy).

The improvement in muscle flexibility before and after Instrument-Assisted Soft Tissue Mobilization was consistent with other studies found in the literature.

Ahmad Osailan et al.(2021, pp. 200-206) researched and compared the effect of Instrument-Assisted Soft Tissue Mobilization and manual stretching in improving hip active range of motion, hamstring muscle torque, and hamstring muscle strength in a single session in young non-athletic subjects. In this study, too, there was no statistically significant difference in improvement in outcome measures when the two interventions were compared with each other. When the groups were compared amongst themselves, both interventions significantly improved the hip active range of motion.

There are many studies comparing the benefits of the IASTM technique, especially on hamstring flexibility, compared to other techniques. Gunn et al. (2019) compared the groups treated with IASTM and proprioceptive neuromuscular facilitation (PNF) and another, self-stretching, group. While the study showed a significant improvement in hip range of movement (compared to self-stretching) in the IASTM and PNF group, no comparison was made between the two groups.

In his study amongst footballers, Markovic (2015, pp. 690-696) compared the effects on hamstrings using IASTM, fascial abrasion technique and foam roll technique. The results were similar whereas there was no apparent significant difference between the groups.

Koumantakis et al. (2020, pp.96-104) compared IASTM with vibration and light hand massage in healthy and non-athletic youth. The study showed improvement in ROM similar to other studies, with no difference between groups.

In reviewing the literature, an opinion regarding the use of IASTM is that there is a mechanical advantage that allows the clinician to work more focused on muscles that have lost their flexibility by reducing the stress on their hands (Baker et al., 2013, pp. 16-21). Moreover, it is believed that IASTM allows the clinician to detect changes on the tissue and focus more on the areas where fibrosis occurs (Cheatham et al., 2016, pp. 200-211).

It can be thought that the effectiveness of the IASTM technique on ROM is due to facilitating and improving blood perfusion and reducing the symptoms caused by functional limitations due to the presence of scar and fibrosis (Black, 2010, pp. 14-21).

Mechanical percussion devices are a type of myofascial intervention that has frequently been used of late and is developing. Despite the popularity of these devices, little is known to guide clinical practice. In reviewing the research conducted until the present, there are very few studies published about them, thus creating a gap in the literature (Cheatham et al., 2021, pp. 766-77).

The significant improvements of vibration massage on hamstring muscle can be regarded as muscle spindle stimulation, increased stretch-reflex delay (Pope and DeFreitas, 2015) and decreased motor unit firing frequency of vibrating muscles (Barrera-Curiel et al., 2019).

In a study conducted by Behm and Wilke (2019, pp. 1173-1181), percussion massage therapy and foam rollers indicated similar results in stretching. They explained that the effect on fluid viscosity due to pressure and friction on the treated muscle, skin and fascia can create less resistance to movement in the muscle.

Therefore, it can be assumed that the increase in ROM of percussion massage therapy is probably because of a decrease in muscle stiffness (Konrad et al., 2020, pp. 690-694).

Comparing the different methodologies used to improve ROM in previous studies, IASTM and other approaches are equally effective, which concurs with the findings of the current study.

The results of this study are relevant to clinicians who wish to improve hamstring flexibility in seeking alternatives to typical stretching interventions. The present study aimed to show clinicians that a more diverse intervention could be made beyond the traditional stretching protocol. To the best of our knowledge, this is the first study that deals with the effects of IASTM and the Percussive Therapy device on hamstring flexibility. In conclusion, the study showed that both interventions had similar positive effects in a short time.

Admittedly, this study has some limitations. First, this study examined the short-term effects of the interventions administered. As all of our participants were healthy, it is difficult to generalize our results to individuals with pathological conditions. As the persons included were not athletes, it will also be difficult to generalize the findings of this study in regards to athletes. Future research should explore the effects of instrument-assisted soft tissue mobilization and percussive therapy device on hamstring tension in athletic humans. A study that incorporates a larger number of research participants, a control group, and comparing the long-term impact of interventions would be more helpful in determining the effectiveness of interventions.

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