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Original Article

Physical Medicine and Rehabilitation Section

Effect of Matrix Rhythm Therapy on Subjects with Asymptomatic Hamstring Tightness: A Quasi-experimental Study

VARUN CHANDRAKANT NAIK[1], VANSHI PAREKH[2], SHIVANI PATIL[3]

ABSTRACT

Introduction: Hamstring tightness is a decreased range of motion at the knee with an associated feeling of restriction in the posterior thigh. The hamstrings are a group of muscles that control hip and knee joint mobility as well as pelvis and spine alignment. Because hamstring tightness impacts body posture and causes musculoskeletal pain, finding a new effective approach to restore hamstring flexibility is critical. Matrix rhythm therapy is a class IIA medical device that enhances an increase in microcirculation and tissue flexibility and elasticity.

Aim: To determine the immediate effect of Matrix Rhythm Therapy (MaRhyThe©) on an individual with asymptomatic hamstring tightness between the age group of 18-25 years on an active knee extension test and Ultrasonography (USG).

Materials and Methods: This quasi-experimental single session study was conducted in KAHER Institute of Physiotherapy (tertiary care hospital), Belagavi, Karnataka, India, from November 2020 to January 2021. A total of 63 people were screened for the study out of which 30 were included (17 female and 13 male) and were recruited using the Active Knee Extension (AKE) test and ultrasonographic assessment. The age criterion was 18-25 years. MaRhyThe© was given for only one session of 60 minutes on both legs (30 minutes on each leg). After the session, the immediate effect of the treatment was noted by comparing the active knee extension test of both legs and conducting the ultrasonographic assessment. The pretest and post-test scores were analysed using the Kolmogorov Smirnov test.

Results: The results showed that there was a 41.39% reduction in the AKE of the right leg and a 42.40% reduction in the AKE on the left leg of the participants which was statistically significant. Postintervention statistically significant differences were found in an increase in the length, blood flow, and decrease in thickness of the hamstring muscle (p-value $\leq$0.001) after a 60 minute session of MaRhyThe©.

Conclusion: MaRhyThe© for 60 minutes duration (30 minutes each leg) produces beneficial effects such as improved tissue extensibility, increased blood microcirculation, and decreased tissue thickness in subjects with asymptomatic hamstring tightness.

Keywords: Active knee extension, Microcirculation, Musculoskeletal pain, Ultrasonography

INTRODUCTION

The hamstring is a muscle situated in the posterior aspect of the thigh which consists of three muscles which include semitendinosus, semimembranosus, biceps femoris long head, and short head. A part of the adductor magnus is also considered a hamstring muscle [1]. The main function of a hamstring muscle is flexion of the knee joint and extension of the hip joint. The hamstring plays an important role in performing activities of daily living such as walking, running, and jumping and some of the gluteal movements [2]. The inability to fully extend the knee when the hip is flexed, as well as discomfort or pain along the posterior thigh and/or knee, are usually attributed to hamstring muscle tightness. The flexibility of this two-joint muscle group is crucial for everyday postures and activities [3]. The main reason for it is the reduced ability of the muscle to deform hence forcing the movements at the joint to restrict themselves [4].

Hamstring tightness is a decreased range of motion with an associated feeling of restriction in the posterior thigh. The most frequent cause of hamstring tightness is an intense form of activity; strenuous exercise leads to tightness. Because hamstring tightness impacts body posture and causes musculoskeletal pain, finding a new effective approach to restore hamstring flexibility is critical. According to a previous study prevalence of hamstring tightness is very high amongst people between the age group of 18-25 years [5]. Several physical therapists have an opinion that when "apparent hamstring inflexibility/tightness" is identified during clinical examination, quick and instantaneous changes in various clinical signs and symptoms may emerge over time due to tissue extensibility malfunction.

Matrix Rhythm Therapy (MaRhyThe©) was developed by Dr. Ulrich Randoll in Germany in the 1990s. It is widely used in Germany. MaRhyThe© is applied by the Matrixmobil®, which is a Class IIA medical device. Like a crank handle, it is mechano-magnetically synchronising the body's intrinsic vibrations via the neuromuscular system in the alpha rhythm (8-12 Hz). The treatment approach is a systemic one, using physiological rhythms and focusing on Extracellular Matrix (ECM) to normalise the metabolism by optimisation of cellular logistics [6-8].

The purpose of this study was to determine the immediate therapeutic effectiveness of MaRhyThe© in individuals with asymptomatic hamstring tightness.

MATERIALS AND METHODS

This quasi-experimental single session study was conducted in KAHER Institute of Physiotherapy, Belagavi, Karnataka, India, from November 2020 to January 2021. Ethical clearance (Sl. No: 779) was obtained from the Institutional Ethical Committee. The study was with Clinical Trial Registry - India with reference no: CTRI/2021/03/031728. The purpose and procedure of the study were explained and written informed consent was obtained.

Sample size was calculated based on previous prevalence study and sample size determined was 30 [5]. A total of 63 people were screened for the study out of which 30 were included which fit into the exclusion criteria.

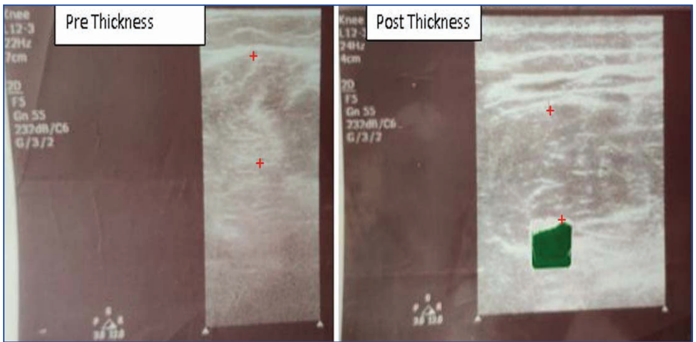
Inclusion and Exclusion criteria: Subjects willing to participate in the study, asymptomatic subjects with hamstring tightness and knee flexion angle greater than 20°, subjects with an age group of 18-25 years, subjects with a body mass index of 18.5-24.9 kg/m^2

were considered in inclusion criteria. Subjects showing associated symptoms due to hamstring tightness like lower back pain, on any kind of medications for musculoskeletal problems, or who underwent musculoskeletal surgeries in the past six months were excluded from the study.

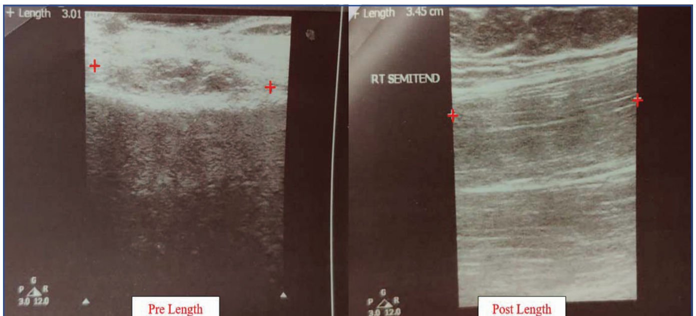
A brief demographic data of age, weight, height, and Body Mass Index (BMI) was taken from the participants before the assessment. The dependent variable used to assess hamstring flexibility was the Active Knee Extension (AKE) test and the Ultrasonographic assessment provided information on microscopic values i.e. length of muscle fibre, size of muscle fibre, and blood circulation of the hamstring muscle.

Study Procedure

Ultrasonography procedure: The entire ultrasonography assessment was performed in a dark, cold, and safe environment by the same person for all the subjects. The same linear probe was used for pre and postevaluation of the length, thickness, and blood flow. The subject was made to lie in a prone position with the posterior thigh exposed and their foot outside the couch so as to attain a stretch in the muscles. The water-based gel was applied to the thigh and the linear probe was used to locate the origin and insertion of the hamstring muscle. After locating the origin and insertion of the muscle, segmental length of the muscle was calculated and sum of all the measurements were taken in order to determine the length of the muscle. Along with the length, muscle thickness at the muscle bulk was measured and blood flow of the minor arteries were noted. Measurements of the thickness of the hamstring muscle [Table/Fig-1], hamstring length [Table/Fig-2], and blood flow [Table/Fig-3] were recorded preintervention and postintervention.



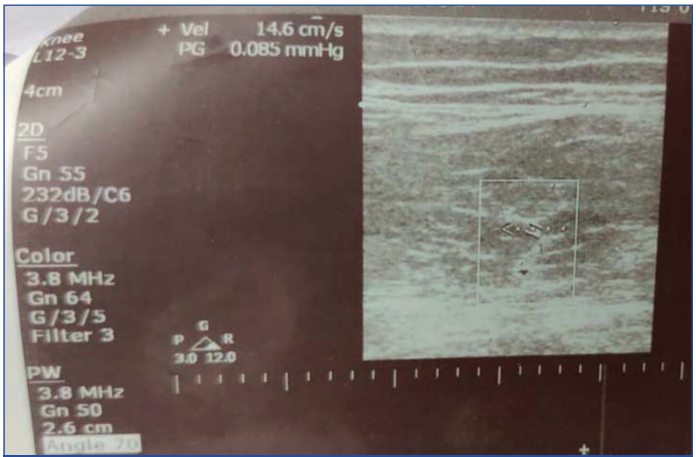
[Table/Fig-1]: Preintervention and postintervention ultrasonographic hamstring thickness assessment.



[Table/Fig-2]: Preintervention and postintervention ultrasonographic hamstring length assessment.

Active knee extension test: The patient was made to lie down on the examination table. The testing limb was lifted to a position perpendicular to the ground, with the hip at 90° of flexion and the knees extended. A lag of 20° from the full extension was regarded normal; anything less than 20° degrees was termed hamstring tightness. A goniometer was used to determine this range. The fulcrum was at the knee, with the fixed arm pointing to the greater trochanter and the moving arm pointing to the lateral malleoli [9].

Interventional procedure: During the session, the participant was asked to lie comfortably in a prone position. To avoid the friction



[Table/Fig-3]: Ultrasonographic blood flow assessment.

created by the Matrix Mobil®, the hamstring muscle was exposed and talcum powder was administered to the treatment region. The Matrix Mobil® is a rod-shaped with a spiral-shaped vibration head that vibrates at 8-12 Hz. Matrix Mobil® was used in a longitudinal stroking manner, with the probe of the device being pushed into the muscles of the hamstring. The session was delivered for 60 minutes, with 30 minutes on each of the hamstring muscles side.

STATISTICAL ANALYSIS

Data were tabulated using Microsoft excel version 16 and analysed using Statistical Package for Social Sciences (SPSS) software version 20.0 and the statistical level of significance was set at p-value <0.05. Normality of pretest and post-test scores of all parameters was done by the Kolmogorov Smirnov test. A dependent t-test was applied for precomparison and postcomparison.

RESULTS

Mean age, weight, height and BMI is presented in [Table/Fig-4]. All parameters pretest and post-test scores were following a normal distribution [Table/Fig-5].

			Age (years)		Height (cm)		Weight (kg)		BMI (kg/m²)	
Gender	N	%	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male	13	43.33	22.45	1.81	175.09	5.87	65.65	7.30	21.48	2.89
Female	17	56.66	22.89	1.56	159.74	9.02	54.97	8.27	21.57	2.82
Total	30	100.0	22.73	1.64	165.37	10.91	58.89	9.40	21.53	2.79

[Table/Fig-4]: Distribution of male and females with mean age and BMI.

Variables	Timepoint	Z-value	p-value
Active knee extension right leg	Pretest	0.8800	0.4210
	Post-test	0.9520	0.3250
	Difference	1.0140	0.2550
Active knee extension left leg	Pretest	0.8830	0.4160
	Post-test	1.2010	0.1120
	Difference	1.0820	0.1920
Length of hamstring muscle (cm)-Right leg	Pretest	0.6560	0.7830
	Post-test	0.7100	0.6940
	Difference	0.8520	0.4620
Length of hamstring muscle (cm)-Left leg	Pretest	0.6780	0.7470
	Post-test	0.8100	0.5270
	Difference	1.3020	0.0680
Thickness of hamstring muscle (mm)-Right leg	Pretest	1.1340	0.1530
	Post-test	1.0840	0.1910
	Difference	1.3180	0.0620
Thickness of hamstring muscle (mm)-Left leg	Pretest	1.0050	0.2640
	Post-test	1.0880	0.1870
	Difference	1.0560	0.2150

Blood flow of hamstring muscle (cm/sec) -Right leg	Pretest	0.8120	0.5250
	Post-test	0.8900	0.4070
	Difference	1.0540	0.2160
Blood flow of hamstring muscle (cm/sec) -Left leg	Pretest	0.9490	0.3290
	Post-test	0.7980	0.5480
	Difference	0.6950	0.7200

[Table/Fig-5]: Normality of pretest and post-test scores of all parameters by Kolmogorov Smirnov test.

There was a significant decrease in AKE angle with percentage of change on the right leg was 41.395 and on the left leg was 42.405 [Table/Fig-6]. There was a significant increase in the length of the hamstring muscle with a mean difference of -2.23 on the right-side and -2.00 on the left-side [Table/Fig-7].

There was a significant difference in the thickness of the hamstring muscle (mm) in the right leg and left leg postintervention [Table/Fig-8]. There was a significant increase in the blood flow of the hamstring muscle (cm/sec) the in right leg and left leg postintervention [Table/Fig-9].

AKE test values	Timepoints	Mean	SD	Mean difference	SD difference	Percentage of change	p-value
Right leg	Pretest	47.83	8.06	19.80	5.37	41.39%	<0.001*
	Post-test	28.03	5.47				
Left leg	Pretest	47.17	8.68	20.00	6.94	42.40%	<0.001*
	Post-test	27.17	5.85				

[Table/Fig-6]: Comparison of pretest and post-test scores of Active knee extension in right leg and left leg.
*Dependent t-test

Variables	Timepoints	Mean	SD	Mean difference	SD difference	Percentage of change	Paired t-test	p-value
Length of hamstring muscle (cm)-Right leg	Pretest	20.81	3.84	-2.23	0.61	-10.74	-20.1281	<0.001*
	Post-test	23.04	4.17					
Length of hamstring muscle (cm)-Left leg	Pretest	20.77	3.84	-2.00	1.85	-9.64	-5.9229	<0.001*
	Post-test	22.77	3.92					

[Table/Fig-7]: Comparison of pretest and post-test intervention scores of length of hamstring muscle (cm) in right leg and left leg.
*Dependent t-test

Variables	Timepoints	Mean	SD	Mean difference	SD difference	Percentage of change	p-value
Thickness of hamstring muscle (mm)-Right leg	Pretest	20.43	7.13	1.61	2.06	7.86	<0.001*
	Post-test	18.82	6.78				
Thickness of hamstring muscle (mm)-Left leg	Pretest	20.52	7.06	1.80	0.81	8.79	<0.001*
	Post-test	18.71	7.10				

[Table/Fig-8]: Comparison of pretest and post-test intervention scores of Thickness of hamstring muscle (mm) in right leg and left leg.
*Dependent t-test

Variables	Timepoints	Mean	SD	Mean difference	SD difference	Percentage of change	p-value
Blood flow of hamstring muscle (cm/sec)-Right leg	Pretest	11.71	4.60	-2.07	1.30	-17.71	<0.001
	Post-test	13.78	4.88				
Blood flow of hamstring muscle (cm/sec)-Left leg	Pretest	11.68	4.96	-2.09	0.95	-17.90	<0.001
	Post-test	13.78	5.10				

[Table/Fig-9]: Comparison of pretest and post-test intervention scores of Blood flow of hamstring muscle (cm/sec) in right leg and left leg.
*Dependent t-test

DISCUSSION

As a newly developed therapeutic tool, MaRhyThe© has been used in comparatively limited research investigations. It has been demonstrated to be useful in improving joint range of motion, muscular flexibility, pain reduction, and daily life capabilities [6].

According to the results of case report, MaRhyThe© improves blood circulation. The compressive effect induced by the application of MaRhyThe© may produce additional soft tissue mobilisation and afferent impulses due to the action of vibration [10]. According to Callaghan MJ [11], the major function of mechanical vibration massage is to enhance blood circulation, and the tonic vibration reflex produces active muscle contraction in mechanical vibration.

As a result of the muscle contraction, blood flow may have increased leading to the flexibility of the hamstring muscle. Previous studies have shown that the use of mechanical vibratory devices increased blood flow by 20%, 26%, and 46% [12-14].

According to Button C et al., applying a mechanical vibration level to the bloodstream generates a 22 minute spike in blood flow. Increased blood flow to the hamstring muscle must have contributed to an increase in muscular temperature, allowing muscles to relax and release tension [13]. Muscle tension and tightness are alleviated, allowing a muscle to stretch to its full length without restriction and increasing range of motion. The effect of vibration on muscle perfusion has recently gotten a lot of research due to the supposed health benefits of being able to enhance blood flow. Vibration-induced increase in muscle perfusion appeared to be proportional to the vibratory stress applied. As a result, modulating the vibratory load may be able to produce desirable improvements in muscle perfusion to minimise inflammation, discomfort, and accelerate muscle tissue repair after an acute injury or in chronic circulation disorders like peripheral vascular disease [15]. Reflexive muscular contractions [16,17] are widely used to describe the process that causes vibration-induced increases in muscle perfusion. Enhanced blood viscosity and artery diameter contribute to improved microcirculation, which results in increased blood flow, oxygen, and metabolite exchange at the tissue site [10]. This promotes fibroblastic activity, which improves soft tissue function and leads to increased range of motion, which assists tissue healing. Similar tissue healing effects were seen in a previous study using Instrument Assisted Soft Tissue Mobilisation (IASTM) on Plantar Fasciitis [18]. The acute effects of MaRhyThe© versus passive stretching on female hamstring flexibility were examined by Ratwani N et al., that concluded that MaRhyThe© is better in improving hamstring muscle flexibility than passive stretching

[19]. Further studies are needed to study comparing other clinical tools to improve the length of the hamstring muscles.

Limitation(s)

The study's sample size is small hence generalisation of the results is limited. Absence of control or placebo group was there. The long-term effect was not evaluated in this study.

CONCLUSION(S)

MaRhyThe© for 60 minutes (30 minutes each leg) produces beneficial effects on subjects with asymptomatic hamstring tightness between the ages of 18 and 25 years. The ultrasonographic assessment revealed a significant increase in hamstring muscle length and blood flow, as well as a decrease in hamstring muscle thickness As a result, the researchers propose using MaRhyThe© as part of physiotherapeutic therapy in clinical settings for persons with the tightness of hamstring muscles.

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PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Cardiovascular and Thoracic Surgery Physiotherapy, KAHER Institute of Physiotherapy, Belagavi, Karnataka, India.
2. Intern, Department of Cardiovascular and Thoracic Surgery Physiotherapy, KAHER Institute of Physiotherapy, Belagavi, Karnataka, India.
3. Intern, Department of Cardiovascular and Thoracic Surgery Physiotherapy, KAHER Institute of Physiotherapy, Belagavi, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Varun Chandrakant Naik,
Assistant Professor, Department of Cardiovascular and Thoracic Surgery Physiotherapy,
Kaher Institute of Physiotherapy, 2nd Floor, Nehru Nagar,
Belagavi-590010, Karnataka, India.
E-mail: varunnaik@klekipt.edu.in

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