Research Article

Effectiveness of muscle energy techniques and friction massage in hamstring tightness amongst young athletes of Pakistan

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ABSTRACT

Background: compromised hamstring flexibility is a risk factor to sports-related injuries, as muscular tightness is believed to reduce athletic performance. Different muscle energy techniques and friction massage are commonly practiced by manual therapists to improve hamstring flexibility.

Objectives: To compare the effectiveness of muscle energy technique and friction massage in hamstring tightness among young athletes in Pakistan

Methodology: A randomized controlled trial was conducted at Helping Hand Institute of Rehabilitation Sciences (HHIRS), Mansehra, and Neurological Orthopaedic and Sports Injury Services Mansehra (NOSIS). A total of n=60 young athletes between 18-25 years with hamstring tightness and limited straight leg raise range of motion (<110⁰) were included in the study. The non-probability purposive sampling was used for data collection then the participants were randomly divided into Group A (n=20) received Post facilitation stretch (PFS), group B (n=20) received post-isometric relaxation (PIR), and Group C (n=20) which received deep friction massage through electronic massager. The athletic performance of the participants was assessed using the YMCA sit and reach test (S&RT) for flexibility, agility run test (ART) for agility, vertical jump test (VJT) for explosive power, and 100-meter run test (RT) for speed and explosive power at baseline, 10th day, and 20th day of the intervention.

Results: The participants had a mean age of 21.55±2.05 years. The result showed that participants who received PFS showed significant (p<0.05) results as compared to PIR and FM after the 10th day, regarding VJT (p=0.006), ART (p=0.015), S&RT (p<0.001) and 100m RT (p<0.001). After the 20th day, PFA showed better results than PIR and FM after the 10th day. The participant who received FM showed less improvement than the remaining two groups but statistically significant p<0.05.

Conclusion Muscle energy techniques, particularly PFS and PIR, proved effective in enhancing athletic performance parameters, including vertical jump, agility, and flexibility, among young athletes with hamstring tightness. These findings support their use in sports rehabilitation and injury prevention.

Keywords: friction massage; hamstring tightness; manual mobilization technique; muscle energy technique; soft tissue mobilization post isometric relaxation; post facilitation stretch.

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INTRODUCTION

Flexibility is a muscular attribute that affects an individual's ability to move smoothly and promotes the optimal and safe performance of physical activity [1]. It is regarded as a crucial component of healthy biomechanical performance in sports. The studies found that flexibility has a number of benefits associated with it, including improved athletic performance, reduced risk of injury, the avoidance or reduction of soreness after exercise, and improved coordination [2, 3].

Three muscles collectively known as the hamstrings have a propensity to contract quickly. As the most frequent type of sports injury, hamstring strain is what causes hamstring injuries [4]. The range of motion and flexibility of the pelvic, hip, and knee joints are diminished when these muscles are tight. Muscle tightness limits physical performance, including daily tasks, and is a significant intrinsic component in sports injuries, which in turn affect athletic performance due to extended recovery durations, high expense of treatment, and injury Severity [2, 5]. The literature suggests that Reduced hamstring flexibility has been linked to an increased risk of patella tendinopathy, hamstring strain injuries, and muscle damage after eccentric activity [6].

Numerous clinical circumstances, including poor posture, systemic illness, persistent mild muscular strain, and neuromusculoskeletal lesions, can lead to muscle inflexibility [7]. Previous Literature reports that sports like football, rugby, and soccer are prone to hamstring injuries. Instead of force, excessive strain during eccentric contraction is what causes damage, and the length of the activation phase prior to eccentric contraction affects how severe the injury is [6, 8]. Reduced maximum muscle length, lack of flexibility, strength imbalance, inadequate warm-up, exhaustion, lower back injury, poor lumbar posture, and increased muscle neural tension are modifiable risk factors; however, muscle compositions, age, race, and prior injuries are non-modifiable risk factors [9].

Improved hamstring flexibility has been the subject of several studies. The approach, level of effort, length of time, and frequency that is most advantageous or produces the best outcomes, however, are still up for debate. Numerous techniques in manual therapy including different stretching methods and Friction massage are currently being practiced improving flexibility and range of motion [10]. Stretching has been regarded as an essential component of a physical training program to increase the range of motion [11].

A manual approach called muscle energy technique (MET); invented by osteopaths, is currently practiced by many manual therapy specialists to stretch, and strengthen, as a lymphatic/venous pump, and extend the range of motion. MET is a biomechanics-based diagnostic system used to identify and qualify an articular range of motion restriction [12]. Contract relax strategies have been studied for their impact on hamstring flexibility [12]. The efficacy of MET is evident by the number of studies conducted on the performance of athletes that It can be used to enhance a joint's range of motion, thus enhancing the athletic performance of hamstrings in fields [13-16]. Although the individual efficacy of enhancing athletic performance by improving hamstring flexibility has been proved by many research studies, providing evidence in favor of both techniques; MET and friction Massage[10, 15-17].

Hamstring tightness is a common issue among young athletes and is considered a potential risk factor for sports-related injuries. While Muscle Energy Techniques (MET) and friction massage are commonly used by manual therapists to address hamstring tightness, there is a lack of research specifically investigating their effectiveness among young athletes in Pakistan. Therefore, a study in this context is necessary to fill the existing gap in literature. So, the objective of the current study was to determine the effectiveness of muscle energy technique and friction massage in hamstring tightness among young athletes in Pakistan.

METHODOLOGY

This randomized clinical trial (NCT03680300) was conducted after approval from research and ethical committee of the Helping Hand Institute of Rehabilitation Sciences (HHIRS/REC/2017/08/29/01), Mansehra, and the private clinic Neurological Orthopaedic and Sports Injury Services (NOSIS) (NOSIS/Research/2017/08/25/03), Mansehra August 2017 till February 2019.

Athletes having hamstring tightness with straight leg raise (SLR) <110^0, ages ranging from 18 to 25 years were included in the study, through the lottery method and were randomly allocated into two groups. Athletes not fulfilling the inclusion criteria or having hamstring injury or any other lower extremity-related injury or presenting with LBP or with any deformity were excluded from the study. A total sample size of n=60, and n=150 athletes were screened out for hamstring tightness through a nonprobability convenience sampling technique. (Figure 1)

General demographic data including, age, gender, occupational history, and sports played was obtained. The athletic performance of the participants was assessed using the YMCA sit and reach test (S&RT) for flexibility, agility run test (ART) for agility, vertical jump test (VJT) for explosive power, and 100-meter run test (RT) for speed and explosive power at baseline, 10th day, and 20th day of the intervention.

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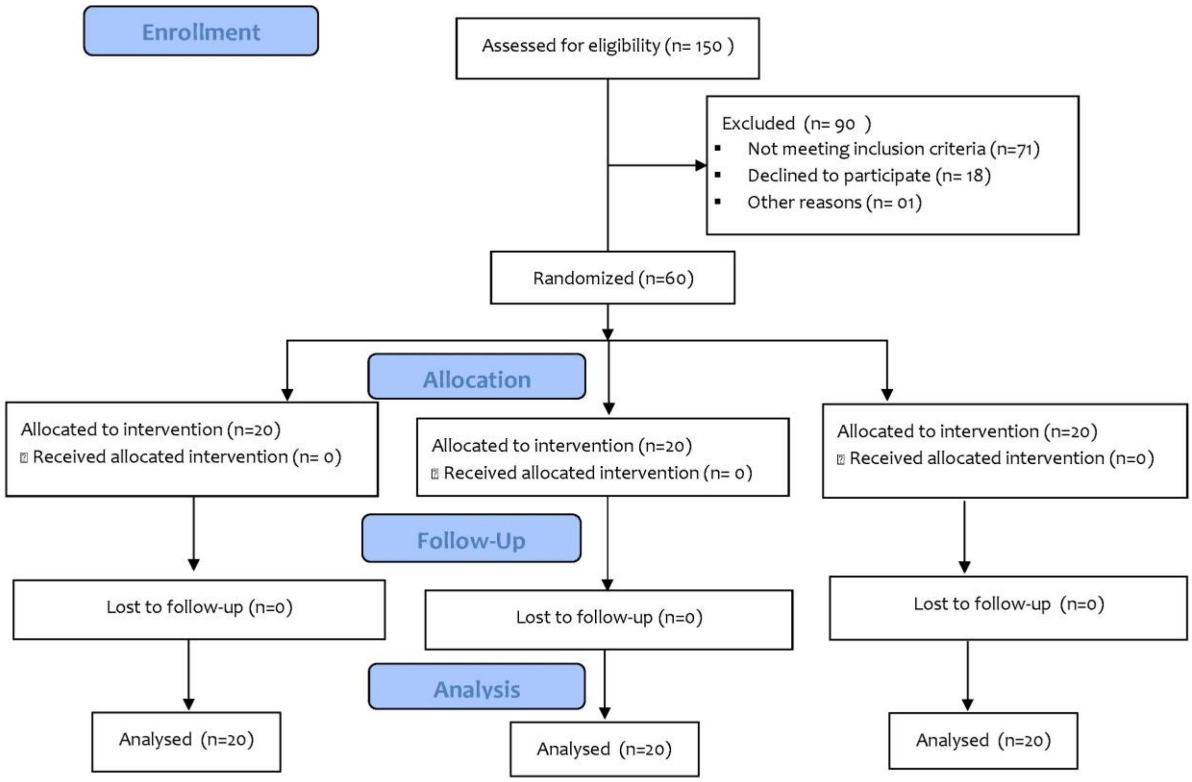

Figure:1 Consort Diagram

The intervention procedure for each of the three athlete groups included a pre-treatment phase that was standardized, followed by individualized therapy. Each participant had a 20-minute session that started with Transcutaneous Electrical Nerve Stimulation (TENS) and the application of a heat pack. The athletes from the three groups received different therapy following this initial phase, according to their placement in the groups. Group A received a facilitation stretch (PFS), for this, the hamstring muscle was placed in a position that was halfway between totally relaxed and fully stretched. For 5-10 seconds, the patient contracts the agonist against the therapist's opposing force with the greatest effort. After 5-10 seconds, the patient was advised to relax and relinquish the effort, while the therapist stretched the muscle to a new barrier and held it for 10 seconds. The technique was repeated 3-5 times or more, with a relaxing pause of around 20 seconds between each repetition. Unlike the PIR approach, it was held in between totally relaxed and fully stretched positions every time, rather than starting from a new barrier.

Group B received Post Isometric relaxation (PIR), which was performed by stretching the hamstring muscle to the point where the initial resistance to movement was felt, or to the length where discomfort was minimal. While the therapist applied resistance opposite to the motion, the hypertonic muscle was contracted submaximally (10-20%) for 5 to 10 seconds away from the barrier. The athlete was instructed to inhale while completing the contraction, and then relax and exhale afterward. Then, to take up the slack for the new barrier, a passive mild stretch was performed. This method was repeated 2–3 times from the new barrier.

Group C therapist used a thrive massager to deliver a 20-minute friction massage to the hamstrings. Introducing the "Thrive Massager" by Thrive Wellness, a revolutionary electronic handheld massager designed to provide unparalleled relaxation and muscle relief. The TM-5000 model comes equipped with advanced technology, offering a range of massage techniques, including percussive and vibration modes, tailored to suit different muscle needs. Its ergonomic design ensures a comfortable grip during application, making it easy to use for anyone seeking therapeutic relief.

To begin the massage session, ensure the Thrive Massager is fully charged for optimal performance. Familiarize yourself with the various massage heads and settings to select the most suitable one for your needs. Find a quiet and comfortable space to perform the massage, and if using massage oils or lotions, apply a small amount to the targeted area, ensuring it is clean and free from any cuts or abrasions.

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Holding the Thrive Massager firmly but not too tightly, position the chosen massage head against the muscle area requiring attention. Maintain a slight angle of around 30 degrees to the skin's surface. Start the massager at the lowest intensity setting and gradually increase it to a comfortable level. Apply the massager in slow and controlled motions, focusing on tight or sore muscles. Follow the muscle fibers, moving in a circular or linear direction, avoiding excessive pressure and prolonged focus on one spot.

During the massage, continuously adjust the intensity and experiment with different massage modes to find the most effective one for your needs. The duration of each massage session should typically be 5 to 10 minutes per muscle group, and if any discomfort or pain arises during the process, stop immediately.

After the massage, take a few minutes to relax and allow your muscles to rest. Store the Thrive Massager in a cool and dry place for future use. However, it is crucial to note that this protocol serves as general guidance and does not replace professional medical advice. Prior to using any electronic massager or embarking on a new health regimen, consult with a healthcare professional, especially if you have any pre-existing medical conditions or concerns. The Thrive Massager offers a promising tool for relaxation and relief, and with proper application and care, you can replicate this protocol for a rejuvenating experience.

The descriptive statistics for demographics and normality index were evaluated, as per statistical analysis the data was non-parametric therefore, for between-group analysis Kruskal Wallis test with post hoc analysis, and for within-group analysis Friedman test, along with the Wilcoxon sign rank test for pairwise comparison were applied. The level of significance was set at $p<0.05$, and SPSS ver 28 was used for data analysis.

RESULTS

All the Participant included in the study were Male, with mean age of 21.55±2.05 years, the average heights of athletes was 171.33±7.9 cm, their Mean weight was 67.16±7.04 kg, and reported BMI was 22.9±2.7 kg/cm2, the average playing hour of these athletes on daily basis was 2.22± 1.59 hours.

Within group analysis, the Friedman test and pairwise changes with Wilcoxon signed ranked test showed significant ($p<0.001$) improvement in all variables, including VJT, ART, S&RT and 100m ST from overall and each assessment level from baseline to 10th day and after 20th day. (Table 1)

Table 1: Within-group Analysis

		PIR				PFS				FM			
		Friedman test			Wilcoxon Sign Rank	Friedman test			Wilcoxon Sign Rank	Friedman test			Wilcoxon Sign Rank
		Median (IQR)	Mean rank	X^2(df)	p-value	Median (IQR)	Mean rank	X^2(df)	p-value	Median (IQR)	Mean rank	X^2(df)	p-value
Vertical Jump	Baseline	14(4.7)	1.0		0.00***a	17(10)	1.0		0.00***a	16(3)	1.02		0.00***a
	10th day	20(3)	2.0	40(2)	0.00***b	22.5(9.5)	2.0	40(2)	0.00***b	18(3)	2.03	38.5(2)	0.00***b
	20th day	26(5)	3.0		0.00***c	29(12.5)	3.0		0.00***c	20(3)	2.95		0.00***c
Agility Run Test	Baseline	19.7(2.8)	3.0		0.00***a	18.4(1.7)	3.0		0.00***a	18.9(2.28)	3.0		0.00***a
	10th day	17.2(1.7)	2.0	40(2)	0.00***b	16.1(2.3)	2.0	40(2)	0.00***b	18.1(1.74)	2.0	40(2)	0.00***b
	20th day	15.4(2.0)	1.0		0.00***c	14.2(2.4)	1.0		0.00***c	17.4(1.20)	1.0		0.00***c
YMCA sit and reach	Baseline	3(2.0)	1.0		0.00***a	3(1.7)	1.0		0.00***a	3(1)	1.02		0.00***a
	10th day	7(2.0)	2.0	40(2)	0.00***b	8(3)	2.0	40(2)	0.00***b	4(1)	1.98	39.2(2)	0.00***b
	20th day	12.0(3.7)	3.0		0.00***c	15(2.75)	3.0		0.00***c	7(1)	3.0		0.00***c
100-meter sprint	Baseline	18.7(2.0)	3.0		0.00***a	18.2(2.02)	3.0		0.00***a	18.3(1.81)	2.9		0.00***a
	10th day	16.2(1.7)	2.0	40(2)	0.00***b	15.2(1.36)	2.0	40(2)	0.00***b	17.2(1.81)	1.9	20.2(2)	0.00***b
	20th day	14.5(2.1)	1.0		0.00***c	12.5(0.87)	1.0		0.00***c	16.8(0.76)	1.20		0.00***c

[a]baseline to 10th day, [b]0th to 20th day & [c]baseline to 20th day; PIR-Post Isometric Relaxation, PFS-Post Facilitation Stretch, FM-Friction Massage
Level of significance: $p<0.05$, $p<0.01$** & $p<0.001$****

The Kruskal Wallis H test showed that, all groups were comparable at the baseline, so after 10th day and after 20th day there were significant difference among groups regarding the vertical jump test, agility run test YMCA sit and reach test and 100 meter sprint. The post hoc analysis showed that participant received PFS showed significant ($p<0.05$) result as compare to PIR and FM after 10th day, regarding VJT (MR=42.5 vs. MR=30.33 vs. MR=18.77, p=0.006), ART (MR=20.2 vs. MR=32.5 vs. MR=38.8, p=0.015), S&RT (MR=43.25 vs. MR=34.8 vs. MR=13.45, $p<0.001$) and 100m ST (MR=17.05 vs. MR=30.85 vs. MR=43.6, $p<0.001$). After 20th day, PFA showed better results than PIR and FM as after 10th day. The participant received FM showed least improvement than remaining two group but statistically significant. (Table 2)

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Table 2: Between-group comparison

		Baseline					10th day					20th day				
		Kruskal Wallis				Post hoc	Kruskal Wallis				Post hoc	Kruskal Wallis				Post hoc
		Median (IQR)	Mean rank	X²(df)	p-value	p-value	Median (IQR)	Mean rank	X²(df)	p-value	p-value	Median (IQR)	Mean rank	X²(df)	p-value	p-value
Vertical Jump	PIR	14(4.75)	24.5	3.7(2)	0.147	0.105[a]	20(3)	30.33	18.5(2)	0.006**	0.010*[a]	26(5)	33.10	37(2)	0.00***	0.003**[a]
	PFS	17(10)	34.73			0.49[b]	22.5(9.5)	42.4			0.013*[b]	29(12.5)	45.85			0.00***[b]
	FM	16(3)	32.23			0.103[c]	18(3)	18.77			0.00***[c]	20(3)	12.55			0.00***[c]
Agility Run Test	PIR	19.7(2.8)	35.6	2.6(2)	0.085	0.10[a]	17.2(1.7)	32.50	11.7(2)	0.015*	0.02*[a]	15.4(2.0)	30.08	3.39(2)	0.00***	0.00***[a]
	PFS	18.4(1.7)	26.30			0.32[b]	16.1(2.3)	20.20			0.22[b]	14.2(2.4)	14.78			0.00***[b]
	FM	18.9(2.28)	29.90			0.512[c]	18.1(1.74)	38.80			0.001**[c]	17.4(1.20)	46.65			0.00***[c]
YMCA sit and reach	PIR	3(2.0)	29.58	3.3(2)	0.231	0.250[a]	7(2.0)	34.8	31.7(2)	0.00***	0.027*[a]	12.0(3.7)	33.45	38.9(2)	0.00***	0.00***[a]
	PFS	3(1.7)	35.60			0.068[b]	8(3)	43.25			0.00***[b]	15(2.75)	45.98			0.00***[b]
	FM	3(1)	26.13			0.547[c]	4(1)	13.45			0.00***[c]	7(1)	12.08			0.00***[c]
100-meter sprint	PIR	18.7(2.0)	33.60	1.4(2)	0.549	0.279[a]	16.2(1.7)	30.85	23(2)	0.00***	0.008**[a]	14.5(2.1)	30.73	43(2)	0.00***	0.00***[a]
	PFS	18.2(2.02)	27.05			0.43[b]	15.2(1.36)	17.05			0.00***[b]	12.5(0.87)	12.25			0.00***[b]
	FM	18.3(1.81)	30.85			0.565[c]	17.2(1.81)	43.60			0.012*[c]	16.8(0.76)	48.53			0.00***[c]

[a]PIR Vs PFS, [b]PFS Vs FM & [c]PIR Vs FM; PIR-Post Isometric Relaxation, PFS-Post Facilitation Stretch, FM-Friction Massage
Level of significance: p<0.05, p<0.01** & p<0.001****

DISCUSSION

The primary goal of this study was to compare the efficacy of Muscle Energy Techniques (MET), specifically Post-Isometric Relaxation (PIR) and Post-Facilitation Stretch (PFS), versus Friction Massage (FM), in improving hamstring flexibility and preventing sports injuries in young amateur athletes. In comparison to FM, PFS considerably increased hamstring flexibility and athletic performance, according to the study. The study assessed athletic performance using a variety of variables, including vertical leap, agility run test, YMCA sit and reach test, and 100-meter sprint test. The statistical analysis confirmed that MET, particularly PFS, was beneficial in alleviating hamstring tightness and improving athletic performance. This finding was consistent with an earlier study that found MET to be beneficial to hamstring flexibility and muscle function [2, 12].

According to the study, PFS entails tightening the hamstring isometric ally and then actively stretching it. This mechanism stimulates Golgi tendon organs and results in autogenic inhibition, which reduces the activity of muscle spindles, which is responsible for the muscle's stretch reflex [18]. PFS has been proven to increase hamstring flexibility and improve the muscle's length-tension relationship, which is important for generating force during exercises such as vertical jumping and sprinting [19].

Another MET employed in the study was these impacts aided athletic performance, especially in the vertical jump and sprint. This procedure relaxed the muscles, lowered muscular tone and stiffness, and optimized the hamstring length-tension relationship. These impacts aided athletic performance, especially in the vertical jump and sprint [20].

FM, a soft tissue manipulation technique, on the other hand, is primarily designed to break down adhesions and scar tissue, enhance blood flow, and stimulate healing. While it did provide some temporary muscle relief, it was not as beneficial as MET in improving hamstring flexibility and athletic performance [21].

The agility run test findings revealed that the PIR and PFS groups performed significantly better than the FM group. PFS was especially helpful in improving agility because it increased hamstring flexibility while decreasing muscle stiffness and resistance, allowing for smoother transitions between activities and faster changes of direction. The YMCA sit and reach test also revealed that PFS and PIR improved hamstring flexibility significantly. In this regard, PFS beat FM. Athletes were able to reach further during the test due to increased hamstring flexibility, resulting in better scores. In the 100-meter sprint test, all three groups improved, with the PFS group improving the most significantly. PFS's ability to improve sprint performance and lower the risk of injury by increasing hamstring flexibility, stride length, and force generation, contributed to Improved sprint performance and reduced the risk of injury during explosive sprint movements [22].

In the current study baseline BMI differences were not considered during data collection. Which may affect the results of intervention on the performance of non-athletes.

CONCLUSION

The METs, particularly PFS, was more effective than FM in improving hamstring flexibility and optimizing muscle length-tension relationships. This enhanced performance in a variety of athletic tests, such as the vertical jump, agility run, YMCA sit and reach, and 100-meter sprint. The study's findings backed up the use of MET as an effective technique for reducing sports injuries and improving athletic performance in amateur athletes.

DECLARATIONS & STATEMENTS

Author's Contribution

KH: substantial contributions to the conception and design of the study.
SR: acquisition of data for the study.
NIB: interpretation of data for the study.
SS: analysis of the data for the study.

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NIB and SS: drafted the work.
KH, SR, NIB, SB and SS: revised it critically for important intellectual content.
KH, SR, NIB, SB and SS: final approval of the version to be published and agreement to be accountable for all aspects.
Of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors contributed to the article and approved the submitted version.

Ethical Statement

This randomized clinical trial (NCT03680300) was conducted after approval from research and ethical committee of the Helping Hand Institute of Rehabilitation Sciences (HHIRS/REC/2017/08/29/01), Mansehra, and the private clinic Neurological Orthopedic and Sports Injury Services (NOSIS) (NOSIS/Research/2017/08/25/03)

Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

Due to privacy or ethical considerations, the data presented in this study are available upon request from the corresponding author.

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None to declare.

Conflicts of Interest

The authors declare no conflict of interest.

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