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Original Research Article

To Compare the Effect of Dynamic Stretching and Muscle Energy Technique On Hamstring Length, Pain Intensity, and Functional Performance in Individuals with Patellofemoral Pain Syndrome - A Comparative Study

Sumedh Laxman Chopade *[1], Mayur Ajmera [2], Quazi Ibtesaam Huma [3].

*[1] Undergraduate Student of Shiva Trust's Aurangabad College of Physiotherapy, India.

[2] Professor HOD, Department of Physiotherapy in Musculoskeletal Shiva Trust's Aurangabad College of Physiotherapy, Aurangabad, India.

[3] Assistant Professor, Department of Physiotherapy in Neurosciences, Shiva Trust's Aurangabad College of Physiotherapy, Aurangabad, India.

ABSTRACT

Background: The hamstring group consists of three primary muscles at the back of the thigh: the semitendinosus, semimembranosus, and biceps femoris. Hamstring weakness or tightness can disrupt the normal biomechanics of the knee. For instance, when the hamstrings are tight, they may limit knee joint mobility, potentially worsening patellofemoral pain. The lower extremity functions as a kinetic chain; when the hamstrings are not working effectively, they can influence the pelvis and hips. This can result in altered loading patterns on the knee, increasing stress on the patellofemoral joint. So we selected two techniques for lengthening the muscle so that the study's objective is to compare the effect of that technique in individuals with patellofemoral pain.

Aim: To Investigate and compare the effect of dynamic stretching and muscle energy technique on hamstring length, pain intensity, and functional performance in individuals with patellofemoral pain syndrome

Methodology: Twenty-six subjects enrolled in each group based on inclusion and exclusion criteria i.e. Group A Dynamic Stretching and Group B Muscle Energy Technique. Hamstring length was assessed by the 90-90 SLR, pain intensity by NPRS, and Functional performance by the LEFS on the Day 1, 3, and 9. Then, the mean and standard deviation are calculated.

Study design: Comparative study

Result: Both techniques show a significant on compared, on day 3 (SLR p-value = 0.0001) (NPRS p-value = 0.05) (LEFS p-value = 0.069) and on day 9 (SLR p-value = 0.0001) (NPRS p-value = 0.0001) (LEFS p-value = 0.0029) also in individual technique for dynamic stretching (p-value = 0.0001) and Muscle energy technique (p-value = 0.0047).

Conclusion: Both dynamic stretching and muscle energy techniques effectively address hamstring tightness, pain intensity, and functional performance in individuals with patellofemoral pain syndrome.

KEY WORDS: Hamstring Muscle, Dynamic Stretching, Muscle Energy Technique, 90-90SLR (Straight Leg Raise), NPRS (Numerical Pain Rating Scale) and LEFS (Lower Extremity Function Scale)

Address for correspondence: Sumedh Laxman Chopade, Undergraduate student of Shiva Trust's Aurangabad College of Physiotherapy, Aurangabad, India
E-Mail: sumedhchopade2001@gmail.com

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INTRODUCTION

The hamstring muscles are crucial for lower extremity function, significantly aiding activities like walking, running, and squatting. Their strength and flexibility are essential for athletic performance, overall mobility, and injury prevention. By working together, these muscles enable smooth, coordinated movements, highlighting their importance in daily life and sports [1]. Patellofemoral joints have high stress during typical activities of daily living making it a common location for injuries. In daily living activities, the joint reaction forces on the patellofemoral joint are high like during the stance phase of gait, when peak knee flexion is nearly 20 degrees the compression force is 25% to 50% of body weight. The greater knee flexion and greater quadriceps activity as during running, so the forces reaches over 10 times body weight. So, the joint reaction forces are influenced by the magnitude of the quadriceps force and the knee angle. So, the abnormal pathomechanics of the patellofemoral joint can lead to patellofemoral joint dysfunction [2].

The Patellofemoral joint dysfunction is also known as "Anterior knee pain". The incidence of anterior knee pain is 22/1000 person per year women are more affected than men [3,4]. Patellofemoral pain syndrome has multiple causes, including functional disorders of the lower extremity, patellar maltracking, altered patellofemoral joint kinematics, weakness in hip external rotators and abductors, increased rear-foot eversion at heel strike, and hamstring muscle imbalance or tightness. Notably, female patients with this syndrome exhibit higher hamstring and gastrocnemius muscle forces during walking and running compared to males. Consequently, it is concluded that patients with patellofemoral pain syndrome may experience greater joint contact force and compression stress than healthy individuals [5].

The study done on the kinetics and kinematics of stair climb with EMG in a patellofemoral pain syndrome patient in that the patient report shows excessive hamstring activity and quadriceps activity which resulted in lower net knee extensor movement compared to the control subject [6]. Hamstring tightness is common in those with patellofemoral pain and often results in muscle shortening. Athletes often experience hamstring strains, highlighting the importance of flexibility for injury prevention and performance enhancement. Muscle tightness can greatly hinder athletic performance, emphasizing flexibility's role in optimal biomechanics. However, assessments of various stretching and manual techniques to alleviate hamstring tightness have produced mixed results [7].

A manual technique known as MUSCLE ENERGY TECHNIQUE involves controlled, voluntary isometric contractions of that muscle group. It is widely endorsed by experts in the osteopathy field and has now become a valuable tool in various manual therapy disciplines [8]. MET is purported to effectively elongate shortened muscles, enhance joint mobility, and promote the drainage of fluids from peripheral regions [9]. This approach primarily focuses on soft tissue and is alternatively referred to as active muscular relaxations [10].

MET consists of two main components: relaxing an overactive muscle and improving the stretch of a shortened muscle or its fascia, especially when connective tissue changes occur. Two key neurophysiological principles explain the neuromuscular inhibition during these techniques. The first, post-contraction inhibition (or post-isometric relaxation), indicates that a muscle relaxes briefly after contraction. The second, reciprocal inhibition, suggests that when one muscle contracts, its opposing muscle is inhibited. To maximize range of motion and muscle extensibility, using an isometric variation that recruits the agonist's muscle is recommended [11].

Dynamic stretching entails moving the limb from its neutral position to the end range, where the muscles are at their maximum length subsequently, the limb is returned to its original position. This dynamic action is performed smoothly and in a controlled manner, with repetition for a specified period [12]. Research has investigated the impact of dynamic stretching protocols on muscle performance, and these studies generally indicate a positive relationship [13].

This study aims to investigate and compare the effectiveness of dynamic stretching and muscle energy techniques on hamstring length and pain, function in patellofemoral pain syndrome.

MATERIALS AND METHODOLOGY

A Comparative study was conducted in Chhatrapati Sambhajinagar (Aurangabad). This comparative study involved a total sample size of 52 participants, which was calculated by using the sample size calculator and then divided evenly into two groups of 26. A convenience sampling method was used. The study population consists of individuals with patellofemoral pain syndrome who also exhibited hamstring tightness.

The tightness was assessed by 90-90 Straight leg raising test hamstring length., For normal flexibility, the knee extension should be within 20 degrees of a full extension known as the popliteal angle. If the angle is less than 125 degrees, the hamstring is considered to be tight. normally. Pain intensity is measured by a numerical pain rating scale where 0 is no pain and 10 is the worst pain imaginable and functional performance was measured with the Lower extremity function scale, as reliability was 0.94. It consists of 20 questions about a person's ability to perform everyday tasks, the maximum score is 80. This evaluation was taken on days 1 before the treatment and on day 3 after the treatment and a follow-up evaluation was taken on Day 9 to check the differences. The Data was enrolled in Microsoft Excel, mean and standard deviation were calculated, and paired t-tests were used for significance.

RESULTS

In the study, they were two groups, Group A (n=26) Dynamic Stretching Technique and Group B (n=26) Muscle Energy Technique was taken with a mean age of 23.03 and 23.96 respectively. In Group A 16 females and 10 males and Group B 13 females and 13 males. [Table 1]

Table 1: General characteristics of the participants

Age	23.03± 23.96
Gender	Group A: 10:16
(male: female)	Group B: 13:13

Table 2: Mean, Standard deviation, and p-value of 90-90 SLR, NPRS, and LEFS At days 1, 3 and 9.

Outcome measure	Day	Mean± standard deviation	p-value
90-90 SLR in degree	Day 1	115.08±116.5	0.2303
	Day 3	128.27±139.6	<0.0001*
	Day 9	127.31±132.62	<0.0001*
NPRS	Day 1	7.5±7.11	0.056
	Day 3	5.07±4.34	0.0543
	Day 9	2.26±0.5	<0.0001*
LEFS	Day 1	36.92±36.35	0.73
	Day 3	51.38±54.38	0.067
	Day 9	63.69±69.31	0.0029*

Table 2 shows the Mean, Standard deviation, and p-value of 90-90 SLR, NPRS, and LEFS On days 1, 3, and 9. In that 90-90SLR test, values increased significantly on day 9, whereas NPRS values decreased significantly on day 9 and LEFS Score values Increased substantially on day 9 *denotes p-value is significant (p<0.05)

Table 3: Group A Mean and Standard Deviation of 90-90 SLR at days 1 and 9.

(DS) 90-90 SLR IN DEGREE	DAY 1	DAY 9	P VALUE
MEAN	115.08	127.31	
STANDARD DEVIATION	3.6	5.87	<0.0001*

Table 4: Mean and Standard Deviation of 90-90 SLR At days 1 and 9

(MET)90-90 SLR IN DEGREE	DAY 1	DAY 9	P VALUE
MEAN	116.54	132.62	= 0.0047*
STANDARD DEVIATION	4.42	25.13	

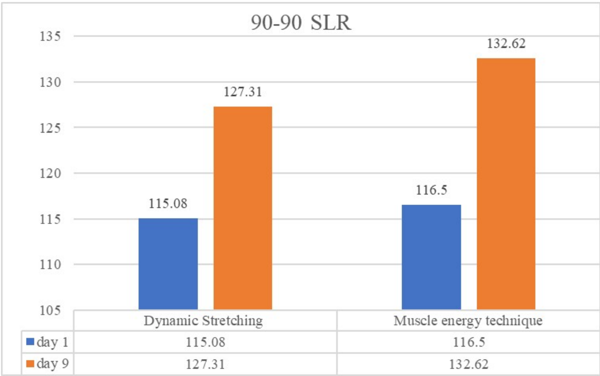

Chart 1: shows that the mean and standard deviation of 90-90 SLR

DISCUSSION

The present study aimed to evaluate the effects of dynamic stretching and muscle energy techniques on hamstring length, pain levels, and functional abilities in individuals suffering from patellofemoral pain syndrome. Demographic information, such as age, gender, and occupation, was gathered from the participants. It was observed that individuals aged 18 to 35 are particularly vulnerable to patellofemoral pain related to hamstring tightness. The mean age of the participants in the study was 23.03 ± 23.96 years.

These results align with the findings of Sarah S. Aldharman et al. (2022), who investigated the prevalence of patellofemoral pain and knee pain within the general population of Saudi Arabia. Their study involved 1,558 participants aged 18 to 40, with a predominance of females, although this difference did not reach statistical significance. This may be due to variations in lower limb biomechanics between genders. The research indicated that individuals under 40 are more prone to experiencing patellofemoral pain (PFP) and knee pain compared to older age groups [14].

Wolf Petersen et al. examined patellofemoral pain syndrome and identified potential contributors to dynamic valgus, such as reduced strength in the hip abductors or pes planus valgus. This functional misalignment is linked to imbalances in the quadriceps, tight hamstrings, or tension in the iliotibial band [15].

Lisa C. White, Philippa Dolphin, et al. (2009) conducted a cross-sectional observational study on hamstring length related to patellofemoral pain syndrome, measuring hamstring flexibility using the passive knee extension method. Their findings indicated that reduced hamstring flexibility can lead to excessive knee flexion and increased patellofemoral joint reaction forces [16].

In this study, Group A received dynamic stretching while Group B underwent muscle energy techniques, with evaluations on Day 1 (pre-treatment) and Days 3 and 9 (post-treatment). By Day 9, Group A showed significant improvements, including increased hamstring length, reduced pain, and enhanced lower extremity function, indicating a lasting beneficial effect of dynamic stretching. Similar findings were reported by Adel Rashad Ahmed et al., who compared muscle energy techniques and dynamic stretching on hamstring flexibility in healthy adults, measuring at baseline, Day 6 (post-test), and Day 10 (follow-up). Participants in the dynamic stretching group performed leg swings into hip flexion for 30 seconds, alternating with hip extension, with both techniques effectively enhancing hamstring flexibility [17].

In contrast, Masahiro Iwata et al. (2019) explored the long-term effects of dynamic stretching on hamstring range of motion and passive stiffness. Their protocol involved ten 30-second knee extensions with rest periods. The study showed that dynamic stretching significantly improved the range of motion and reduced passive stiffness, likely due to changes in muscle-tendon viscoelasticity and increased pain tolerance [18].

Peng Cai et al. (2023) conducted a systematic review and meta-analysis on dynamic versus static stretching effects on hamstring flexibility, analyzing 27 randomized controlled trials involving 606 participants. They found that multiple sessions of static stretching resulted in greater increases in hamstring range of motion compared to dynamic stretching, though both techniques were similar in effects on myofascial length [19].

In the current study, Group B, which received muscle energy techniques, showed significant improvements by Day 9. These enhancements in hamstring length were likely due to neurophysiological mechanisms like the stretch reflex and autogenic inhibition, along with reduced pain levels and improved lower extremity function. This aligns with Ahmed et al.'s findings, which indicated that the muscle energy technique was more effective than dynamic stretching [17]. Additionally, Mohd. Waseem, Shibili Nuhmani, et al. (2009) investigated the muscle energy technique's effectiveness in improving hamstring flexibility among 20 male participants with tightness. Significant improvements in hamstring flexibility were noted after five days of treatment and a follow-up on Day 8 [20].

Yeh-Hyun Kang et al. (2023) performed a systematic review and meta-analysis assessing the impact of Muscle Energy Technique (MET) on hamstring flexibility, analyzing data from 10 electronic databases up to March 2022. They found that MET significantly enhances hamstring flexibility compared to traditional stretching methods or no treatment [21].

In contrast, Cheraladhan E. Sambandham et al. (2011) studied the immediate effects of MET and eccentric training on hamstring tightness in 60 healthy females aged 18 to 22. Their results showed no significant differences in effectiveness between the two techniques [22]. Ballantyne, F., Freyer, et al. noted that the immediate improvement in passive knee extension from MET was due to increased stretch tolerance, without changes in viscoelastic properties [8]. Similarly, Waseem, M., Nuhmani, et al. found comparable results in their study of Indian collegiate males, supporting the effectiveness of MET over eccentric training [10]. Handel, M. et al. reported that techniques like post-isometric stretching with MET improve range of motion compared to static or ballistic stretching [23]. Ross, A.C. et al. identified that a 30-second stretch is optimal and suggested that MET might enhance muscle length through creep and plastic changes in connective tissue [24].

Freyer, G. discussed that increasing muscle extensibility involves both neurophysiological factors and mechanical changes, with the inhibitory Golgi tendon reflex contributing to muscle relaxation [8]. Additionally, joint movement and isometric contractions can alleviate pain via the Gate-Control Theory. The Lower Extremity Functional Scale (LEFS), which measures daily functional tasks, showed increased scores in the MET group by Day 9, indicating improved function with significant p-values. This aligns with findings from Vani Vijayan et al., who reported significant improvements with MET in individuals with piriformis syndrome following 14 treatment sessions over two weeks. In the muscle energy technique group, the Lower Extremity Functional Scale evaluation on Day 9 showed increased scores, indicating improved function with a statistically significant p-value. These results are consistent with Vani Vijayan et al.'s study, which compared MET and stretching in individuals with piriformis syndrome, also yielding significant p-values after 14 sessions over two weeks [25].

CONCLUSION

In conclusion, both dynamic stretching and muscle energy techniques effectively address hamstring tightness in individuals with patellofemoral pain syndrome. Dynamic stretching is particularly beneficial for increasing hamstring length, reducing pain, and improving lower extremity function on days 1, 3, and 9. Stretching before exercise can also lower the risk of muscle injury and enhance functional outcomes. Therefore, consistent use of these techniques is likely to yield better results over time. Further research is needed to identify additional improvements for individuals with patellofemoral pain syndrome.

Conflicts of interest: None

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