International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 • Website: www.ijfmr.com • Email: editor@ijfmr.com

Comparative Analysis of the Short Term Effect of Foam Rolling, Myofascial Release and Dynamic Stretching on Hamstring Flexibility in College Students.

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Abstract
Background: Hamstring tightness is common among college students and may contribute to altered posture, reduced mobility, and an increased risk of musculoskeletal injuries. Various physiotherapy techniques such as myofascial release (MFR), foam rolling, and dynamic stretching are widely used to improve muscle flexibility; however, their comparative short-term effectiveness remains uncertain.
Objective: To compare the short-term effects of myofascial release, foam rolling, and dynamic stretching on hamstring flexibility in college students.
Methodology: A comparative experimental study was conducted among 60 students aged 18–25 years with clinically diagnosed hamstring tightness. Participants were randomly assigned into three groups: Group A (MFR + dynamic stretching), Group B (foam rolling + dynamic stretching), and Group C (dynamic stretching alone). Interventions were given for five consecutive sessions. Hamstring flexibility was assessed using the Active Knee Extension (AKE) Test and Sit and Reach Test before and after the intervention. Data were analyzed using paired t-tests, ANOVA, and non-parametric tests.
Results: All three groups demonstrated significant within-group improvements in hamstring flexibility ($p < 0.05$). Between-group analysis revealed a significant difference ($p = 0.0339$), with Group B (foam rolling + dynamic stretching) showing the greatest improvement, followed by Group A, and the least in Group C.
Conclusion: All three interventions were effective in improving hamstring flexibility in the short term; however, combining foam rolling with dynamic stretching yielded the most significant improvement. Integrating foam rolling into pre-exercise or rehabilitation routines may enhance flexibility outcomes in young adults.

Keywords: Foam rolling, Myofascial release, Dynamic stretching, Hamstring flexibility, College students

1. Introduction

The hamstrings, comprising the biceps femoris (long and short head), semitendinosus, and semimembranosus, are biarticular muscles located on the posterior thigh. They serve as primary knee flexors and secondary hip extensors, playing a key role in lower-limb mobility and dynamic movement, and are therefore classified as "mobilizers" [1]. Muscle flexibility—the capacity to elongate and allow unrestricted joint range of motion (ROM)—is essential for efficient movement patterns, functional performance, and injury prevention[2]. Hamstring tightness is commonly associated with biomechanical compensations, postural deviations, and an increased risk of musculoskeletal injuries, making flexibility training a vital component of physiotherapy management[3]. Several therapeutic approaches aim to improve muscle extensibility and joint mobility, including static stretching (sustained end-range positioning) [5], dynamic stretching (repetitive, controlled movements through full ROM)[5], and proprioceptive neuromuscular facilitation. Additionally, myofascial techniques such as foam rolling—which reduces soft tissue tension by stimulating the Golgi tendon organ[6]—and myofascial release—which applies sustained manual pressure to address fascial restrictions[7]—are increasingly integrated into clinical practice. Emerging evidence suggests that dynamic stretching, particularly when performed for durations exceeding 90 seconds, may significantly enhance both flexibility and neuromuscular performance. This study seeks to compare the short-term effects of these interventions to determine the most effective method for addressing hamstring tightness within physiotherapy settings.

Hamstring tightness is frequently observed among college students and can negatively affect posture, mobility, and injury risk. Although techniques such as myofascial release, foam rolling, and dynamic stretching have individually shown positive effects on flexibility, their combined use remains underexplored. In clinical and athletic settings, these methods are often integrated; however, limited evidence exists comparing their combined application with dynamic stretching alone. Hence, this study aims to address this gap by evaluating the short-term effects of myofascial release plus dynamic stretching, foam rolling plus dynamic stretching, and dynamic stretching alone to determine the most effective approach for improving hamstring flexibility in young adults.

2. Methodology

A comparative experimental study was conducted to evaluate the short-term effects of three intervention protocols—myofascial release (MFR) with dynamic stretching, foam rolling with dynamic stretching, and dynamic stretching alone—on hamstring flexibility among college students. The study included 60 undergraduate and postgraduate students from Ahmedabad, aged between 18 and 25 years (mean age: 21 years). Participants were selected through the random chit method, and the total study duration was five months.

Eligible participants included both males and females who demonstrated hamstring tightness, confirmed by the Active Straight Leg Raise (90-90 Hamstring Tightness) Test. Individuals with a history of hamstring or lower limb injuries within the previous six months, neuromuscular or orthopedic conditions, or those taking medications affecting muscle tone or flexibility were excluded. Participants also needed to provide written informed consent prior to inclusion. Those who missed more than one intervention session or had recently participated in a similar study were excluded from the final analysis.

Following screening, all participants were randomly assigned to one of three groups: Group A received MFR followed by dynamic stretching, Group B underwent foam rolling followed by dynamic stretching, and Group C performed dynamic stretching alone. The interventions were administered under supervision to ensure consistency and safety across all sessions.

Participants were randomly assigned to three intervention groups, each designed to enhance hamstring flexibility through different techniques conducted over five consecutive sessions.

Group A (Myofascial Release + Dynamic Stretching): Manual myofascial release was performed by a therapist on the hamstring muscles (biceps femoris, semitendinosus, and semimembranosus) using gentle, sustained pressure along the muscle length for 2–5 minutes, followed by a 30-second rest for tissue relaxation. Participants then carried out dynamic stretching in a supine position with the hip flexed to 90°, performing active knee extensions continuously for over 90 seconds.

Group B (Foam Rolling + Dynamic Stretching): Participants performed self-administered foam rolling of the hamstrings while seated, rolling from the ischial tuberosity to the posterior knee with controlled pressure for 2 minutes. This was immediately followed by the same dynamic stretching routine as Group A—supine, hip flexed to 90°, and rhythmic active knee extensions for more than 90 seconds.

Group C (Dynamic Stretching Only): This group performed only dynamic stretching without any soft tissue release. In the supine position with the hip at 90° flexion, participants actively extended the knee through the full available range for over 90 seconds in a steady, controlled manner.

3. Results and Statistical Analysis

Active Knee Extension Test:

Group	Time	Mean	Std	Median	Min	Max
A	Post	37.94	8.95	38	24	57
	Pre	44.38	9.66	45	30	65
B	Post	28.44	7.88	28	15	44
	Pre	34.59	9.51	35	18	50
C	Post	31.53	9.47	29.5	20	52
	Pre	38.56	9.63	36	25	60

Table 1.1

This table displays the pre- and post-intervention mean, standard deviation, median, and range of AKE scores for each group. Group B showed the highest improvement with a mean post-score of 28.44° (from 34.59°), followed by Group A (from 44.38° to 37.94°), and Group C (from 38.56° to 31.53°), indicating all three interventions improved hamstring flexibility.

Group	Shapiro p-value (Pre)	Shapiro p-value (Post)
A	0.2537	0.2049
B	0.2217	0.1819
C	0.0167	0.0276

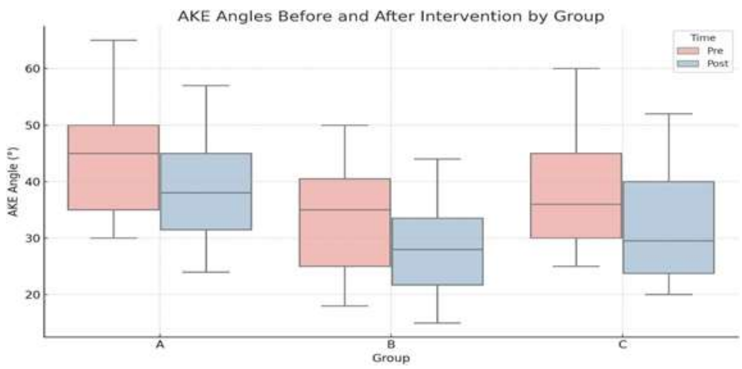
Table 1.2

This table shows Shapiro-Wilk p-values for pre- and post-intervention scores. Groups A and B had p-values > 0.05, indicating a normal distribution in their data. Group C showed slightly lower values (< 0.05), suggesting some variability, but overall, the data trends support consistent improvements across all groups.

Test	p-value
Levene's Test for Homogeneity	0.5307211115

Table 1.3

Levene's test result (p = 0.5307) suggests equal variance among the three groups, confirming that the differences observed in AKE outcomes are statistically comparable, with Group B demonstrating the most effective improvement.

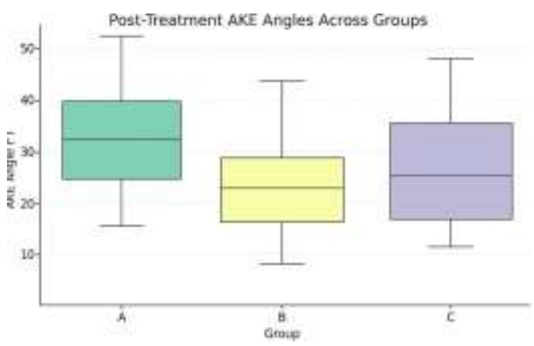


Graph 1.1

This graph shows the within group pre and post results of AKE after 5 days of continuous treatment group A (MFR and dynamic stretching), group B (foam roller and dynamic stretching) and group C (dynamic stretching alone).

Interpretation

It indicates that all the three interventions resulted in an increase in active knee extension angles and increase in hamstring flexibility.



Graph 1.2

This graph implies the between group comparison of group A (MFR and dynamic stretching) , group B (foam roller and dynamic stretching) and group C (dynamic stretching alone).

Interpretation

Post-hoc analysis could not be completed due to a missing library, but results suggest group-level differences worth exploring further, showing the increase in AKE angles and hamstring flexibility. Also shows significant difference in post-treatment active knee extension (AKE) angles between the three groups.

Sit and Reach Test:

Descriptive Statistics				
Group	**Mean Pre**	**Mean Post**	**SD Pre**	**SD Post**
A (MFR + Dynamic Stretch)	33.13	41.25	21.52	22.17
B (Foam Roller + Dynamic Stretch)	52.5	63.13	22.66	19.91
C (Dynamic Stretch only)	40.63	47.5	27.68	27.93

Table 2.1

This table presents the pre- and post-intervention mean and standard deviation (SD) scores for all three groups. Group B (Foam Rolling + Dynamic Stretching) showed the greatest improvement (from 52.5 to 63.13), followed by Group A (MFR + Dynamic Stretching) (from 33.13 to 41.25), while Group C (Dynamic Stretching only) had the smallest gain (from 40.63 to 47.5), indicating superior effectiveness of the combined interventions.

- Within-Group Paired t-Test Results (Pre vs Post): Group A: $p = 0.0000254$ → Significant improvement

Group B: $p = 0.000000085$ → Highly significant improvement Group C: $p = 0.0000388$ → Significant improvement

- Between-Group Comparison (Post Scores)

One-way ANOVA: $p = 0.0339$ → Significant difference between groups

- Kruskal-Wallis Test:

$p = 0.0416$ → Consistent nonparametric confirmation

Interpretation

All three interventions significantly improved flexibility. Foam roller + dynamic stretching (Group B) showed the greatest mean improvement. There is a statistically significant difference among the post-intervention scores, suggesting Group B is likely the most effective, followed by A, then C.

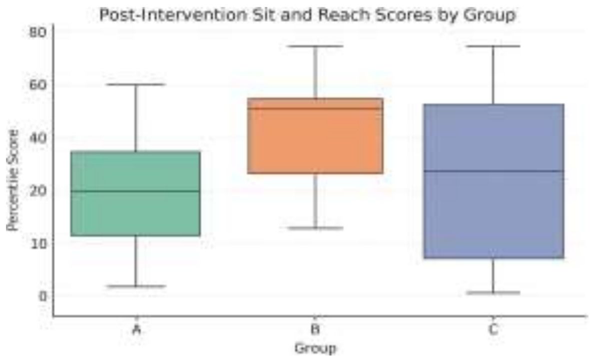
Graph 2.1

Interpretation:

Sit and Reach Test percentile scores before and after intervention for each group:

Group A (MFR + Dynamic Stretch) and Group B (Foam Roller + Dynamic Stretch) show noticeable improvements.

Group B has the highest post-intervention scores on average. Group C (only Dynamic Stretching) shows smaller gains.



Graph 2.2

Interpretation:

The between-group comparison graph showing Post-Intervention Sit and Reach Scores:
Group B (Foam Roller + Dynamic Stretch) has the highest median and most consistent improvement.
Group C shows a wide range, indicating variability in response. Group A also improved but with more moderate post-scores.

4. Discussion

The present study aimed to evaluate and compare the immediate effects of three popular flexibility-enhancing techniques—foam rolling, myofascial release (MFR), and dynamic stretching—on hamstring flexibility in college students. Flexibility is a key component in physical performance, injury prevention, and rehabilitation, especially among active populations like students who may be exposed to sport-related or postural stress. The Active Knee Extension (AKE) test and Sit and Reach Test were utilized to objectively measure changes in hamstring flexibility before and after intervention across three groups.

Active Knee Extension: -

The patient should be placed in a supine position with both the hips and knees flexed to 90 degrees, while maintaining a neutral alignment of the lumbar spine. Instruct the patient to secure their legs in this position by grasping the posterior aspect of their thighs, proximal to the knee. Subsequently, ask the patient to actively extend their knee then measure the ROM with a goniometer.

Graph 1.1 shows significant changes within groups pre and post intervention resulting in an increase in active knee extension angles and increase in hamstring flexibility. However, in graph 1.2 the comparison of group A (MFR and dynamic stretching), group B (foam roller and dynamic stretching) and group C (dynamic stretching alone) states, These preliminary findings show an increase in AKE angles and hamstring flexibility. Importantly, the active range of knee extension after treatment was significantly different across the three groups.

Sit And Reach Test: -

In it a yardstick with tape on a 15 -inch mark is placed on the floor. The participant extends the legs, the leg 10–12 inches separate, and sits with heels on the tape. Gradually reaching the front with the hands and with the palms below, the participant reaches the farthest for two seconds. The knees should remain extended without pressure, after which the value is noted.

Then, table 2.1 shows the Pre and post Descriptive statistics for Sit and Reach Test including Mean and Standard Deviation(SD) for the three groups. All three interventions significantly improved flexibility. Group B, which combined foam rolling with dynamic stretching, saw the most significant improvements. Group A also made notable progress, while Group C experienced more modest gains. Whereas, within group paired t- test (pre-post) gives that Group B shows the highly significant improvement followed by Group A and then Group C in hamstring flexibility. However, ONE WAY ANOVA shows that all three groups result in significant changes in hamstring flexibility. Graph 2.1 implies that Group B (foam roller + dynamic stretching) shows the highest post intervention score whereas Group A (MFR + dynamic stretching) gives noticeable improvement and Group C (only dynamic stretching) shows the smaller gains. Also, Graph 2.2 gives between group comparison Group B (Foam Roller + Dynamic Stretch) has the highest median and most consistent improvement. Group C shows a wide range, indicating variability in response. Group A also improved but with more moderate post-scores.

The final result and statistical analysis offers that Group B which is foam roller and dynamic stretching shows the highest improvement in hamstring flexibility followed by Group A which is MFR along with dynamic stretching than the less improvement shown in Group C which includes only dynamic stretching.

Interpreting the Results

The findings of this study suggest that foam rolling prior to dynamic stretching can significantly enhance hamstring flexibility in the short term. Foam rolling likely improves tissue quality and reduces muscle stiffness by breaking up fascial adhesions and increasing blood flow, thereby allowing dynamic stretches to be more effective.

Meanwhile, myofascial release, although manual and dependent on the practitioner's skill, also yielded noticeable improvements. Its hands-on nature might provide a more targeted effect than foam rolling, but its efficacy appears slightly less than that of foam rolling, possibly due to differences in pressure distribution or engagement of mechanoreceptors.

Dynamic stretching alone, while still beneficial, was less effective compared to when it was combined with either foam rolling or MFR. This suggests that preparing the muscle tissue with soft tissue techniques may "prime" the muscle to respond better to dynamic movements, highlighting the importance of a well-rounded warm-up or rehabilitation protocol.

Clinical and Practical Implications

From a physiotherapy and sports performance perspective, these findings offer valuable guidance:

Foam rolling should be considered a key component in warm-up routines, especially for individuals looking to optimize flexibility quickly before physical activity.

Combining dynamic stretching with a soft tissue mobilization technique—whether foam rolling or MFR—enhances outcomes and may reduce injury risk by improving range of motion.

Dynamic stretching on its own, while beneficial, may be insufficient when rapid or significant flexibility gains are desired, such as before athletic events or during early rehabilitation stages.

5. Conclusion:

All three methods helped improve hamstring flexibility in college students, but the combination of foam rolling and dynamic stretching worked the best. Myofascial release also showed good results, while stretching alone was less effective. Overall, adding foam rolling to a stretching routine may offer the most benefit in the short term.

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