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To find the effectiveness of foamrolling along with dynamic Stretching vs Hold and relax PNF technique on tight hamstring muscle in young adults

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Abstract: Background: Hamstring tightness is a frequent musculoskeletal problem in young adults usually caused by shortened muscle length or increased stiffness. It can reduce flexibility, restrict the range of motion, and raise the risk of injuries. Stretching techniques such as foam rolling, dynamic stretching, and proprioceptive neuromuscular facilitation (PNF) have been widely used to enhance muscle extensibility. Objective: This study aimed to compare the effectiveness of foam rolling combined with dynamic stretching versus hold-and-relax PNF stretching in improving hamstring flexibility among young adults. Methods: Thirty participants with hamstring tightness were randomly allocated into two groups (n=15 each). Group 1 did foam rolling and dynamic stretching, while Group 2 had hold-and-relax PNF stretching. Group 1 did foam rolling and dynamic stretching, while Group 2 had hold-and-relax PNF stretching. Interventions were performed five days per week for five weeks. Hamstring flexibility was assessed using the Sit-and-Reach test, and active knee extension (AKE) was measured with a goniometer. Results: Both groups demonstrated significant improvement within their interventions (p<0.005), but Group 2 showed greater gains in flexibility and range of motion compared to Group 1. Conclusion: The hold-and-relax PNF stretching technique was more effective than foam rolling with dynamic stretching in improving hamstring flexibility and range of motion in young adults.

Keywords: Hamstring tightness, foam rolling, PNF stretching, dynamic stretching, Sit-and-Reach test, AKE

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INTRODUCTION

Hamstring tightness refers to a reduction in the normal range of motion, often accompanied by discomfort and movement restriction. The hamstring muscle group, consisting of the semitendinosus, semimembranosus, and biceps femoris, is vital for lower limb mobility. Prolonged sedentary behaviors, such as sitting for long periods, can lead to adaptive shortening of these muscles, causing decreased flexibility. Chronic hamstring tightness alters lower limb biomechanics, resulting in mild knee flexion during activities, increased quadriceps load, and higher patellofemoral joint reaction forces. Over time, this may cause knee pain, gait disturbances, and even lower back discomfort. In athletes, reduced hamstring flexibility increases susceptibility to injuries due to altered pelvic alignment and lumbar spine mechanics. [1, 5,6]

Flexibility means how well a joint or several joints can move through the best possible range of motion,

and it's important for keeping the body's movements normal and avoiding injuries. The Active Knee Extension (AKE) test, Sit-and-Reach test, and Straight Leg Raise (SLR) are common ways to check how flexible the hamstrings are. Several interventions have been developed to enhance hamstring flexibility, including static stretching, dynamic stretching, foam rolling, and proprioceptive neuromuscular facilitation (PNF) techniques. Among these, PNF stretching, particularly the hold-and-relax method, has been reported to improve flexibility by utilizing neuromuscular mechanisms such as autogenic inhibition. Foam rolling, in contrast, works as a self-myofascial release technique to enhance tissue mobility and circulation.[2,7,5,9,10]

While these techniques have been studied separately, a few comparative studies have evaluated the combined effect of foam rolling with dynamic stretching versus the PNF hold-and-relax method in young adults with hamstring tightness.[3,7,8,11] This study tries to address this gap by checking how well both treatments work in increasing hamstring flexibility and movement range

NEED OF THE STUDY

Hamstring tightness happens because of a lot of sitting and not moving much. This leads to less flexibility in the hamstrings because the muscles, tendons, and fascia get shorter over time. This shortening stays with the body for a long period at some angle of contraction, such as in a prolonged sitting position. Many studies have shown that static stretching and foam rolling are effective in treating hamstring tightness. Few studies have examined how dynamic stretching, combined with foam rolling and hold and relax stretching, influences range of motion and flexibility in young adults. Therefore, the need for this study is to find out the effectiveness of foam rolling along with dynamic stretching vs the hold and relax PNF stretching technique in hamstring tightness in young adults

AIM OF THE STUDY

To find out the effectiveness of foam rolling along with dynamic stretching Vs hold and relax PNF stretching technique in hamstring tightness in young adults.

OBJECTIVES

1. To study the effect of foam rolling along with dynamic stretching compared with hold and relax PNF stretching techniques on hamstring tightness in young adults, on range of motion variations measured by goniometry.

2. To study the effect of foam rolling along with dynamic stretching compared with hold and relax PNF stretching techniques on hamstring tightness in young adults, on flexibility variation measured by the sit and reach bench

METHODOLOGY

Study Design: Experimental Study

Study Period: 5 days a week for 5 weeks.

Sample Size = 30

A total of 30 subjects were selected and split into two equal groups using a random drawing method.

Study Setup: KKC College of Physiotherapy. {KKC institutions, Puttur, Tirupati (D.T)}

Inclusion Criteria

- The age of the subjects must be above 18 years.
- Subjects with AKE test results greater than 15 °were included.
- Subjects with a sit-and-reach test score of <13 cm were included.
- Both male and female

Exclusion Criteria

- AKE test less than 15 degrees were excluded
- Sit & Reach test <13 centimeters were excluded
- Surgery in lower limbs & spine
- Hamstring injury in the previous 6 months
- Contractures
- Neurological disorders
- People who were taking part in any other fitness programs were excluded.

Outcome Measures

Primary Outcome: Active Knee Extension Range of motion. [AKE]

Secondary Outcome: Flexibility. [S&R]

Materials

Goniometry, Sit and Reach Bench, Foam Roller, Inch Tape, Straps, Pillows, Pen, Pencil, Couch, Mat, Iron Stand.

STUDY PROCEDURE

A complete assessment was performed for the 30 subjects who were found eligible for participation in this study. Informed consent forms were obtained from all participants, and the study was explained to them.

The pre-participation evaluation consisted of a sit-and-reach bench used to assess FLEXIBILITY, and a goniometer was used to assess active knee extension ROM.

The subjects were randomly allocated to two groups using the lottery method. Each group contained 15 subjects. Pre-intervention outcome measurements were recorded before starting the treatment, and post-

intervention outcome measurements were recorded after 5 weeks.

1. **Evaluation of range of motion for group-1 & group-2.**

Range of motion was measured using goniometry at baseline and post-intervention in degrees.

2. **Evaluation Of Flexibility For Group-1 & Group-2**.

Flexibility was measured at baseline and post-intervention using a sit-and-reach bench, which contains a scale on top of the bench in centimeters

INTERVENTION

1. **Intervention for group-1.**

Table 1: Intervention for group 1 includes foam rolling and dynamic stretching

	Foam Rolling	**Dynamic Stretching**
QUADRICEPS	The body is lying face down with the quadriceps of the right leg on the foam roller. The foam rolling starts at the top part of the quadriceps, moves down to just above the kneecap, and goes back and forth for 30 seconds. This is repeated for 3 minutes, and then the same process is done on the left leg	Start by standing up straight. Step one leg back, bend both knees so that the front thigh is level with the ground, and then bring the back leg forward. Keep repeating this motion for 1 minute, and do it three times
HAMSTRINGS	Put the back of the right leg's hamstring on the foam roller. Roll the foam roller from the top part of the hamstring down to the knee and then back up, moving it back and forth for 30 seconds. Repeat this for 3 minutes, then switch to the left leg.	Start by standing straight. Lift one leg forward and bend your knee. Then move that leg forward again, keeping your knee straight. Do the same with the other leg. Keep going back and forth, moving each leg forward one after the other. Continue this for 1 minute, and repeat the whole thing three times.

2. **Interventions for group-2.**

The intervention for group 2 includes PNF stretching.

PNF – [HOLD AND RELAX]

Participants were lying on their backs with their left leg tied to the table. The investigator used a stopwatch to measure fixed periods for stretching, contracting, and relaxing to keep the process consistent. For each stretch, the investigator gently bent the hip to stretch the hamstring, keeping the knee straight and not allowing the hip to twist. The lower leg was placed on the investigator's shoulders. The hamstring was stretched until the participant felt a slight stretch, and this position was held for 7 seconds. Then, the participant tried to push their leg down toward the table against the investigator's resistance for 3 seconds. After that, they were asked to relax for 5 seconds. The investigator then stretched the muscle again for 5 seconds and stretched it again until the participant felt a mild stretch, holding this position for 7 seconds. This full sequence was repeated 5 times, with a 20-second break between each repetition.

Duration: 5 days a week for 5 weeks.

STATISTICAL ANALYSIS

The data were analyzed and interpreted statistically using the Statistical Package for Social Science software [SPSS] and Microsoft Excel 2007. A paired T-test was used in each group to compare the pre-post, and an unpaired T-test was used to compare the changes after the intervention. P <0.005 was found to be statistically significant.

RESULTS

Table 2: Mean Of Knee Joint [Right] Range Of Motion [Ake] Test In Group-I & Group Ii

Descriptive statistics

	Paired t-test			
Group 1Knee Joint Range of Motion Extension (AKE) Test right	**Mean**	**SD**	**t value**	**P value**
Pre Test	54.67	6.39	6.524	<0.001
Post Test	45.20	7.21		

	Paired t-test

Group 2 Knee Joint Range of Motion Extension (AKE) Test right	Mean	SD	t value	P value
Pre Test	55.67	8.84	13.048	<0.001
Post Test	37.80	8.25		

Table 2 represents the outcome measures of the right knee AKE pre-test in Group I with a mean of 54.67 and SD 6.39. After the intervention post-test, the mean was 45.20 and the SD of 7.21 with a t-value of 6.524. Group II had a mean of 55.67 and an SD of 8.84. After the intervention, the post-test mean was 37.80 and the SD of 8.25, and the t-value was 13.048. Therefore, the P-value was 0.001, which is less than 0.05 (P <0.05). There was a significant change in the pre-and post-test results on the right side during the study period

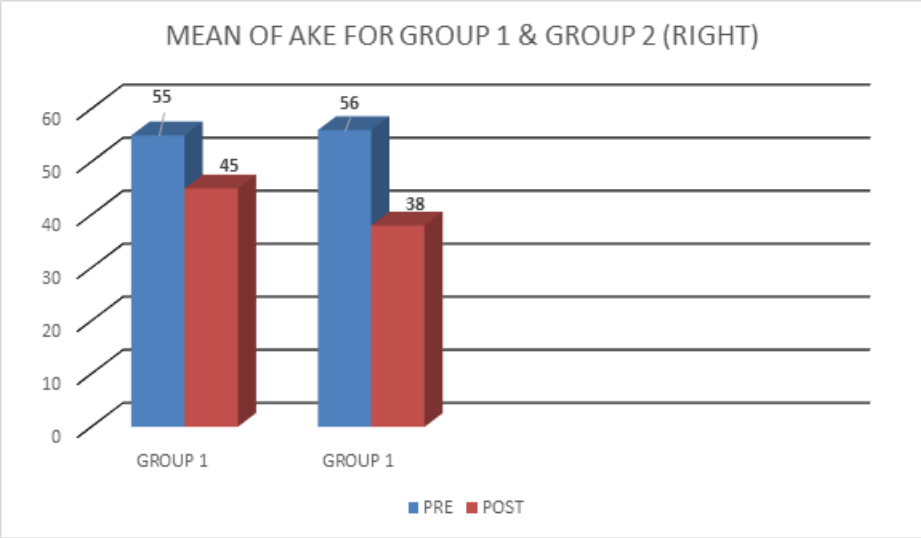

Figure 1: Mean of knee joint range of motion (AKE) test (Right) in Group I & Group II

Table 3: Mean Of Knee Joint Range Of Motion [Ake] Test [Left] In Group-I & Group-Ii

Descriptive statistics

	Paired t- test

Group 1Knee Joint Range of Motion Extension (AKE) Test left	Mean	SD	t value	P value
Pre Test	56.00	7.37	9.584	<0.001
Post Test	47.13	7.54		

	Paired t- test			
Group 2Knee Joint Range of Motion Extension (AKE) Test left	Mean	SD	t value	P value
Pre Test	54.67	7.67	12.324	<0.001
Post Test	38.60	7.01		

Table 3 represents outcome measures of the left knee AKE pre-test in group I, with a mean of 56.00 and SD 7.37. After the intervention, the post-test of the mean was 47.13 with an SD of 7.37. Group II had a mean of 54.67 and SD 7.67 after the intervention; the post-test mean was 38.60 with an SD of 7.01. The t-value was 9.584, and the P-value was 0.001, which is less than 0.05 ($P<0.05$). There was a significant change in the pre- and post-test on the left side during the study period.

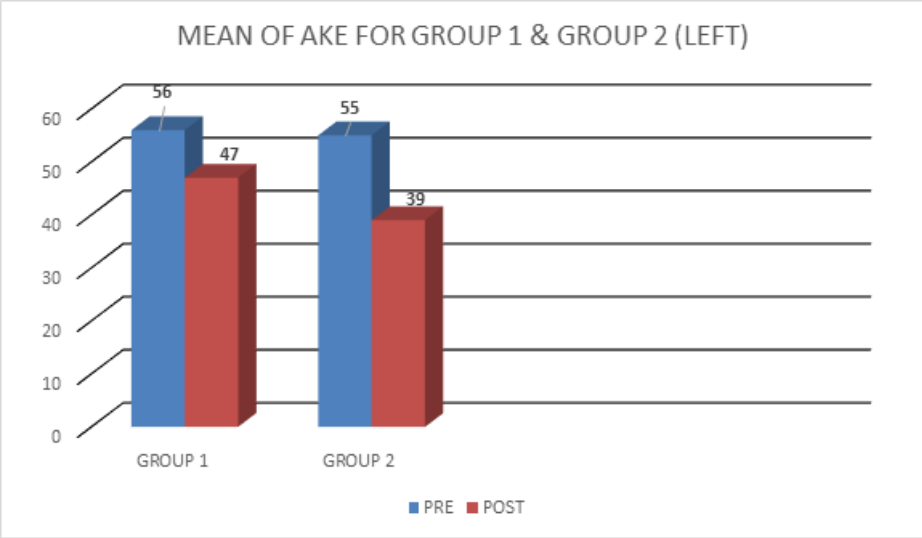

Figure 2: Mean of knee joint range of motion (AKE) test (LEFT) in group I & group II

Table 4: Mean of flexibility sit and reach in group i.

Descriptive statistics

	Paired t-test			
Group 1Flexibility (Sit and Reach) Test	**Mean**	**SD**	**t value**	**P value**
Pre Test	5.70	3.15	-12.846	<0.001
Post Test	10.80	2.51		

	Paired t-test			
Group 2Flexibility (Sit and Reach) Test	**Mean**	**SD**	**t value**	**P value**
Pre Test	5.67	3.24	-15.668	<0.001
Post Test	16.33	3.28		

Table 4 represents the outcome measures of flexibility sit and reach pre-test in group I with a mean of 5.70 and SD 3.15. After the intervention post-test mean was 10.80 with an SD of 3.15, the t-value was 12.846. In group II, the mean was 5.67 and SD was 3.24. After the intervention, the post-test mean was 16.33 with an SD of 3.28, and the t-value was -15.668, so that the P-value was 0.001, which is less than 0.05 (P<0.05). There was a significant change in the pre-and post-tests during the study period.

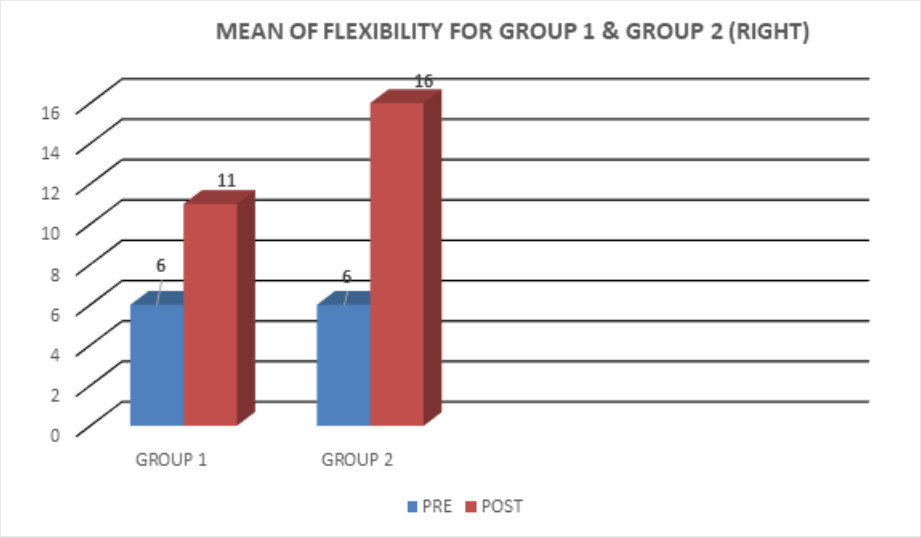

Figure 3: Mean Of Flexibility Sit And Reach In Group I & Group

Table 5: Post analysis comparisons between group-1 & group-2.

Descriptive statistics

POST ANALYSIS COMPARISION BETWEEN GROUP-1 & GROUP-2.			
PARAMETER	**G-I MEAN ± SD**	**G-II MEAN ± SD**	**P.VALUE**
AKE [RT]	45.2 ± 7.21	37.8 ± 8.25	<0.014
AKE[LT]	47.13 ± 7.54	38.6 ± 7.01	<0.03
FLEXIBILITY	10.8 ± 2.51	16.33 ± 3.28	<0.001

The above table 5 depicts post analysis comparison of all outcomes with mean value and S.D for group – 1

and group – 2 for right AKE pre-test 45.2 ± 7.21 and group-2 37.8 ± 8.25 of P-value <0.014, left AKE pre-test 47.13 ± 7.54 and group-2 38.6 ± 7.01 of P-value <0.03, for FLEXIBILITY group-1 10.8 ± 2.51 and group-2 16.33 ± 3.28 of P-value <0.001. And the P-value is <0.05 for all outcomes after post-analysis comparison, so this study shows that the findings were statistically significant

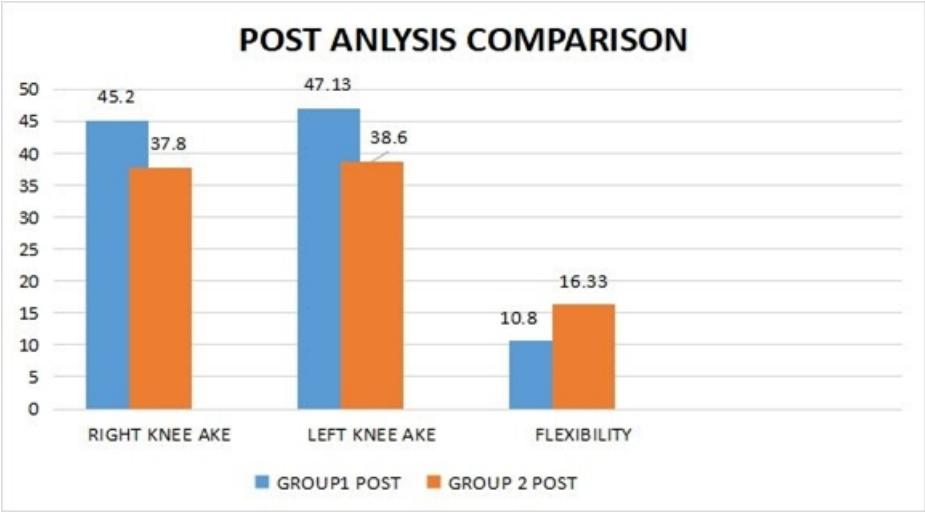

Figure 4: Post analysis comparison between group I & group II.

DISCUSSION

The hamstrings play a crucial role in the biomechanics of the lower limbs, contributing to fundamental activities such as walking, running and squatting. Reduced hamstring muscle flexibility is a prevalent clinical finding among young adults and is often considered a common musculoskeletal complaint or disorder, which can lead to functional impairments. A shortened hamstring muscle can cause joint imbalances and poor postural alignment, potentially resulting in injury and joint dysfunction.

Pre and post intervention values of ake between group-1 & group-2 in both lower extremities.

The present study results show an increase in active knee extension test results and a reduction in hamstring tightness in both groups in weeks after intervention. The post-analysis comparison of results shows reduced hamstring tightness in group 2 when compared to group 1, with a P-value (<0.05), which is statistically significant on both sides. MARVIN C. TANIGAWA, M. A. et. All this study shows is improved range of motion by increasing hamstring muscle length. Therefore, using this hold & relax PNF technique on hamstrings results in improving active knee extension by decreasing the tightness of hamstrings. The hold and relax technique in PNF helps train the stretch receptors in the muscle spindle so they can quickly adjust to longer muscle length, which leads to the muscle being able to stretch more. [12,9]

Pre and post intervention values of hamstring flexibility between group-1 & group-2.

The present study showed that flexibility in both groups was improved in the post-analysis comparison with a P-value (<0.05), which is statistically significant. ALBERT PEREZ-BELLMUNT, et. all 2023this study shows that the PNF group had results demonstrating greater increase in the flexibility and improved knee extension angle when compared to other stretching techniques.

Flexibility is a key part of physical fitness. If someone isn't flexible, it can make their movements less efficient both during physical activities and in everyday tasks. It also makes them more likely to suffer from hamstring injuries.. Further stiffness and short hamstrings may contribute to low back pain. (9) In this study pre and post-intervention results within the individual groups revealed significant improvement in both groups [<0.001], especially the group-2 hold and relax [PNF] was more effective in increasing hamstring muscle flexibility in young adults than group-1.

PNF stretching is a method that uses autogenic inhibition to increase the range of motion. This process involves reducing the activity of the stretched muscle, allowing it to lengthen, and creating long-term changes in how much it can stretch. These changes happen because of complex interactions between the central and peripheral nervous systems. This leads to a greater range of motion, especially when the hamstring is held in a stretched position and then the same muscle is contracted isometrically.

CONCLUSION

The present study shows that both interventions were beneficial in improving hamstring flexibility and range of motion among young adults with hamstring tightness. However, the hold-and-relax PNF stretching technique yielded significantly greater improvements compared to foam rolling combined with dynamic stretching.

The study also concluded that the hold-and-relax PNF technique was much more effective in improving the range of motion and flexibility of the hamstring muscles in healthy, young adults

LIMITATION &RECOMMENDATIONS

- Only active knee extension was taken in this study.
- This study used a limited number of samples.
- Hip range of motion should be included in this study.
- Modified hold and relax technique can be included in the hold & relax technique place.
- Compare the study with other populations.

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