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Research Article

The Immediate Effect of Dynamic Stretching and Foam Rolling on Hamstring Flexibility and Vertical Jump in College Students

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Abstract

Background: Hamstring muscle makes the posterior compartment of thigh and hamstring is the most common muscle which gets injured easily and main reason is tightness of hamstring muscles. The purpose of study was to assess the effect of foam roller and dynamic on hamstring flexibility and jump performance and to compare the effects of foam rolling and dynamic stretching on hamstring flexibility.

Methods: Thirty college students were selected for the study and allocated into two groups then group A was treated with foam rolling and group B was asked to perform dynamic stretching and the effect measured using active knee extension test (AKE) and active straight leg raise (ASLR) and vertical jump test. Student t test (two tailed, independent) has been used to find the significance of study Parameters on continuous scale between two groups (Inter group analysis) on metric parameters. For assessing the homogeneity of variance Leven`s test was used. A t-test was used to compare the means of two groups.

Results: The results showed that there was significant difference in AKE test in both groups ($P \leq 0.01$) there was significant improvement in ASLR and vertical jump in foam rolling Group and dynamic stretching group. The results show that there was improvement in AKE, ASLR and vertical jump in both groups.

Conclusion: By this study we conclude that the acute effects of dynamic stretching and foam rolling is to increases the flexibility of hamstring muscle and improvement in the vertical jump performance. But there is no significant difference when we compare the foam rolling with dynamic stretching.

Keywords: Hamstring Flexibility; Foam Rolling; Dynamic Stretching

Introduction

Hamstring muscle is formed by three different muscles together known as hamstring, the muscles forming hamstring include semitendinosus, semimembranosus and biceps femoris. This muscle form the bulk of posterior of thigh. The function of hamstring muscle is extension of hip and flexion of knee. Hamstring muscle is most prone to get injured and the most common cause is the decrease in flexibility or tightness of this muscle. Muscle tightness is caused by decrease in extensibility of the muscle and it results in decrease in range of motion of hip and knee joint [1]. The prevalence of hamstring tightness is high in students [2].

When there is pain or discomfort in the posterior compartment of thigh and difficulty to extend the knee when the hip joint is maintained in flexion, the cause of this is tightness or loss of flexibility of hamstring muscle" [3].

A warm up exercise program is important as it prepares a person for exercises, improves the blood flow, has beneficial effects on exercise performance and minimizes the chances of injury. Warm-up prepares the body physiologically for exercises. There are different types of warm up exercises, for example, stretching, jogging, skipping, cycling, jumping jacks, etc [4].

Tightness of the hamstrings may result in imbalances in muscle function, which in turn leads to muscle injuries, tendinopathies, patellofemoral pain syndrome, and also cause low back pain.

Stretching is one of the forms of warm up exercises performed to improve the flexibility of muscles and range of motion (ROM) of the adjacent joints (Medicine ACoS, 2017), decreases the tightness of myo-tendonous units, and optimize the muscle performance (Behm., *et al*. 2016). Different forms of stretching include, which

are commonly practiced include static stretching (SS), dynamic stretching (DS), ballistic stretching (BS) and proprioceptive neuromuscular facilitation [5].

It has been proven that dynamic Stretching improves joint ROM by improving extensibility of the muscles [6].

Hamstring muscle passes over both hip and knee joint hence is a two joint muscle and it helps in extension of hip and flexion of knee and is also a muscle for posterior pelvic tilt [7].

During ambulation, hamstring muscle controls the speed of knee extension to prevent damage to hip and knee joint while providing dynamic stability. Interaction of hamstring muscle around the knee joint provides the correct biomechanical movement and stability at the knee joint. The hamstring muscle also provides stability during abduction and adduction movements [8] to affect postural balance [9].

The ratio of the muscle strength between quadriceps and hamstring muscle has a vital role to play in maintaining the stability of hip and knee joint. In addition, the flexibility of hamstring muscle is very important to maintain the range of motion of hip and knee joint and thus for the functioning of musculoskeletal [10].

Now a days foam rolling is used in the field of rehabilitation and for fitness conditioning. Foam rolling is a self-myofascial release technique, so its use is on rise recently for the purpose of preparing for exercise and also for the recovery process of muscle function.

Foam rollers can be used in different fields like sports rehabilitation, exercise therapy and in fitness clubs. Foam rolling can be done by leaning the body against the foam roller and then move the body part over it. It has a relaxing effect on the facia and it also relaxes the muscles by releasing the tension. Foam rollers can be used for self-massage or myofascial release and hence foam rollers improve the muscle flexibility and joint ROM [11].

DS has been reported to improve joint ROM. it has been suggested that the increase in joint ROM seen after DS is due to increased tolerance of the muscle to the stretch [12].

Purpose of the Study

The purpose of study was to assess the effect of foam roller and dynamic on hamstring flexibility and jump performance and to compare the effects of foam rolling and dynamic stretching on hamstring flexibility.

Methodology

Thirty students took part in this study. They were be recruited from Hosmat college of Physiotherapy in Bangalore and were randomly allocated into two groups: group A consisted of foam rolling and group B dynamic stretching. All the participants were between the age of 18 to 25 years old. The criteria for was that the participants were screened for unilateral reduced hamstring flexibility and were currently doing no flexibility training. The participants were excluded if they were taking any muscle relaxants, or had any history of neurological, musculoskeletal condition, or metabolic disease affecting the intervention, had kidney stones, low joint mobility, acute pain or incomplete post fracture fusion. The students were asked not to perform any stretching exercises.

The participants were given to fill a consent form to participate in this research study.

Study design: A Comparative two group parallel before-after Interventional clinical study.

Procedure

Both the groups were supervised for the exercise.

Group A

Foam rolling was given to group A and foam roller was applied to the hamstring for 60 seconds 5 times for the total duration of 10. The subjects started by sitting on foam roller with body weight supported by hands and hamstring. The legs were kept straight in front while keeping the back straight.

Roll back and forth on the foam roller from knee upwards towards thigh up to gluteal region while focusing on tight areas of muscle. Also move from side to side to work over the whole of hamstring muscle.

Group B

The participants were asked to stand upright with their feet parallel and pointing forwards and the subjects were asked to hold parallel bar or two chairs for support holding with both the hands.

The subjects were asked to flex the hip joint every two seconds while maintaining knee extension so that the leg moves up in front of the body and the ipsilateral hamstring muscle was stretched. This was repeated five times so as to learn to perform the movement accurately and after learning the subject was asked to perform 10 repetitions fast and with maximum power without recoiling.

Hamstring flexibility measurement

The ASLR test in supine position and AKE test in sitting position were performed to measure hamstring flexibility. Change in

AROM was measured using the ASLR test. Subject was made to lie down in supine position and asked to flex the hip joint up to end of available while keeping the knee. Recording of hip flexion range was made with universal goniometer. AKE measured the angle of knee joint until the knee joint pulled the hamstring when the leg stretched on the seat. The ROM for ASLR and AKE was measured using universal goniometer. For ASLR test the axis of goniometer was placed over the lateral epicondyle of femur and the stationary arm parallel to the femur, and For AKE test the hip was flexed until thigh is vertical and the leg was actively straightened while keeping the thigh in vertical. The axis of goniometer was kept over lateral epicondyle of femur and static arm parallel to femur and line joining to the greater trochanter. The both tests will be taken 3 times and the average will be used.

Vertical jump test

The vertical jump was used to measure the performance of jump. Subjects were asked to stand and then put some markers on their finger and then flex the hip and knee and then take a vertical jump up to maximum height and touch the wall with fingers. The distance was measured between the floor and the marking using tape. Three attempts were made for vertical jump and the highest value was used for the data the examiner gave verbal cues to the subjects bend and reach high as much as possible with fingers touching the wall.

Statistical methods: Both descriptive and inferential statistical analysis was carried for this study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance.

Assumptions: 1. Dependent variables should be normally distributed, 2. There must be random distribution of samples which are taken from population, Cases of the samples should be independent.

Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups (Inter group analysis) on metric parameters. For assessing the homogeneity of variance Leven`s test was used. A t-test is an inferential statistical test which is used to find any significant difference between two groups or to compare the means of two groups. It is one of the many tests used to hypothesis testing in order to find out whether the treatment or the process is actually having an effect on the population under study, or whether the two groups are different from one another with the null hypothesis (H_0) is the true difference between different characteristics of population in these groups means is zero and the alternate hypothesis (H_a) is that the true difference between different characteristics is different from zero.

The paired t-test or dependent sample test is used to determine the null hypothesis that the mean differences between sets of paired observation is zero. Student t test (two tailed, dependent) has been used to find the significance of study parameters on continuous scale within each group [21-26].

Statistical software: Statistical software SPSS 22.0 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.) and R ver. 3.2.2. were used for the analysis of the data and for generating graphs and tables etc. we used Microsoft word and Microsoft excel.

Results

The results are present in table there was significant difference in Active knee extension (AKE) test in both groups (P value: $P \leq 0.01$), there was significant improvement in Active SLR and vertical jump in foam rolling Group and dynamic stretching group. The results show that there was improvement in active Knee extension (AKE), active SLR and vertical jump in both groups.

However, when comparing AKE, ASLR and Vertical jump between groups, there was no significant difference between two groups.

Vertical jump	Before	After	% Difference
Foam rolling			
< 50	0 (0%)	0 (0%)	0%
51 - 75	7 (46.7%)	7 (46.7%)	0%
76 - 90	8 (53.3%)	7 (46.7%)	-6.7%
91 - 100	0 (0%)	1 (6.7%)	6.7%
Dynamic stretching			
< 50	0 (0%)	0 (0%)	0%
51 - 75	3 (20%)	3 (20%)	0%
76 - 90	9 (60%)	7 (46.7%)	-13.3%
91 - 100	3 (20%)	5 (33.3%)	13.3%
Total	15 (100%)	15 (100%)	-

Table 1: Vertical jump.

Active knee extension	Before	After	% Difference
Foam rolling			
1 - 25	0 (0%)	0 (0%)	0%
26 - 50	14 (93.3%)	15 (100%)	6.7%
51 - 75	1 (6.7%)	0 (0%)	-6.7%
Dynamic stretching			
1 - 25	0 (0%)	0 (0%)	0%
26 - 50	14 (93.3%)	15 (100%)	6.7%
51 - 75	1 (6.7%)	0 (0%)	-6.7%
Total	15 (100%)	15 (100%)	-

Table 2: Active knee extension.

Active straight leg raise	Before	After	% Difference
Foam rolling			
51 - 70	10 (66.7%)	1 (6.7%)	-60%
71 - 90	5 (33.3%)	14 (93.3%)	60%
91 - 100	0 (0%)	0 (0%)	0%
Dynamic stretching			
51 - 70	10 (66.7%)	1 (6.7%)	-60%
71 - 90	5 (33.3%)	14 (93.3%)	60%
91 - 100	0 (0%)	0 (0%)	0%
Total	15 (100%)	15 (100%)	-

Table 3: Active straight leg raise.

Variables	Foam rolling	Dynamic stretching	Total	P Value
Vertical jump				
Before	74.79 ± 9.94	82.72 ± 11.83	78.75 ± 11.47	0.057
After	77.39 ± 10.06	83.96 ± 11.56	80.68 ± 11.16	0.108
DIFF	2.61	1.24	1.92	-
P value	<0.001**	<0.001**	<0.001**	-
Active knee extension				
Before	44.40 ± 4.79	44.40 ± 4.79	44.40 ± 4.70	1.000
After	38.73 ± 5.24	38.73 ± 5.24	38.73 ± 5.15	1.000
DIFF	5.67	5.67	5.68	-
P Value	< 0.001**	< 0.001**	< 0.001**	-
Active straight leg raise				
Before	71.60 ± 6.82	71.60 ± 6.82	71.60 ± 6.70	1.000
After	77.80 ± 4.98	77.80 ± 4.98	77.80 ± 4.90	1.000
DIFF	6.20	6.20	6.20	-
P Value	< 0.001**	< 0.001**	< 0.001**	-

Variables	Foam rolling	Dynamic stretching	Total	P Value
Vertical jump				
Before	74.79	82.72	9.94	11.83
After	77.39	83.96	10.06	11.56
DIFF	2.61	1.24	2.61	1.24
P value	< 0.001**	< 0.001**	< 0.001**	< 0.001**
AKE				
Before	44.4	44.4	4.79	4.79
After	38.73	38.73	5.24	5.24
DIFF	5.67	5.67	5.67	5.67
P value	< 0.001**	< 0.001**	< 0.001**	< 0.001**
ASLR				
Before	71.6	71.6	6.82	6.82
After	77.8	77.8	4.98	4.98

Table 4: Comparison of vertical jump, active knee extension and active straight leg raise in two groups studied at before and after.

+: Suggestive significance (P value: 0.05 < P < 0.10).

*: Moderately significant (P value:0.01 < P ≤ 0.05).

**: Strongly significant (P value: P ≤ 0.01).

Discussion

The aim of the study was to measure the effect of foam rolling and dynamic stretching on hamstring flexibility and compare the effects of foam rolling and dynamic stretching on hamstring flexibility and vertical jump. And the results of this study showed that there was improvement in hamstring flexibility and vertical jump after foam rolling as well after dynamic stretching.

There was improvement in AKE and ASLR values after foam rolling and dynamic stretching. The vertical jump values also showed significant difference before and after foam rolling and dynamic stretching.

Our study is in line with the study done by Yan Ho. Cheung who compared the effect of foam rolling with static stretching and found that both foam rolling and static stretching improves the hamstring flexibility [27].

This study is also in agreement with the study done by Roylance., *et al*. who found that foam rolling and static stretching can improve the flexibility of muscle significantly [28].

A study by MacDonald., *et al*. and Foam rolling has been shown to increase flexibility in previous studies [16,17] and the study by Su H., *et al*. is the most significant study which measures the acute effects of foam rolling on quadriceps muscle as pre performance exercise. MacDonald., *et al*. did a study and found that found acute

found rolling was effective in improving the extensibility of quadriceps as compared to sham group. Static and dynamic stretching has also been proven to increase the flexibility [29,30].

Although our results showed that there is no significant difference between foam rolling and dynamic stretching but this study is in partial agreement with Peacock, Krein, Silver, Sanders and Von Carlowitz (2014) who stated that using dynamic stretching with five minutes of foam rolling significantly improves the vertical jump and standing long jump [31].

Masahiro Iwata., *et al*. did a study measuring the acute and sustained effects of Dynamic stretching on flexibility of hamstring muscles in healthy individuals who were asked to do ten sets of DS (15 repetitions per set). And the authors concluded that DS caused a continued reduction in passive stiffness of the hamstring muscles and also caused improvement in range of motion (ROM) of knee joint [32].

Gayle Silveira., *et al*. in their research say that dynamic stretching increases the dynamic and static flexibility of hamstring muscle when dynamic stretching was used as warm up exercise while comparing the effects of static and dynamic stretching on hamstring flexibility [33].

Results found in study by Grant Wiseman showed That foam rolling self-myofascial release did not show any significant difference in force production but did produce significant increases for range of motion [34].

Our results contrast the results by Kieran O'Sullivan, Elaine Murray and David Sainsbury who compared the effects of Static stretching and dynamic stretching on hamstring flexibility and concluded that static stretching increased hamstring flexibility, whereas dynamic did not cause any significant increase in hamstring flexibility [35].

Our results are in contrast with the study done by Thomas., *et al*. and Healey., *et al*. The results of their study suggest that of foam rolling does not produce any significant improvement vertical jump performance [36].

Our findings are also in disagreement with study Hsuan Su., *et al*. who found that foam rolling gives better results as compared to static or dynamic stretching in acutely improving the flexibility of hamstring muscle and may be used as warm up [37].

With regards to using the foam roller, our data supports other investigators who also reported an increase in ROM. Regardless, it appears that subjects increase hip flexion ROM while using the foam roller. And in addition we compared the effects with dynamic stretching and found no significant difference [38].

Conclusion

By this study we conclude that the acute effects of dynamic stretching and foam rolling increases the flexibility of hamstring muscle and improves the vertical jump performance. But there is no significant difference when we compare the foam rolling with dynamic stretching.

Limitations and Future Recommendations

- The study was done during pandemic so it does affect our data collection and we needed help from some students to collect some part of data.
- The future recommendation will be to include other forms of stretching and look for long term effects of stretching and foam rolling. And in future research we will include patient population.

Conflict of Interest

No such conflict of interest.

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