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Effect of Jack-Knife Stretching Versus Active Stretching to Improve Hamstring Flexibility in Students with Hamstring Tightness

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ABSTRACT

BACKGROUND: The hamstring muscles, positioned at the posterior aspect of the thigh, play a key role in enabling knee flexion. Tightness in these muscles arises when their ability to lengthen is diminished, leading to reduced joint mobility. With a rise in sedentary behavior, the incidence of hamstring tightness is rising among young adults, particularly students. This study aimed to compare the effects of jack knife stretching and active stretching techniques on hamstring tightness in students.

MATERIALS AND METHODOLOGY: A comparative research design was adopted with participants selected through convenience sampling. Ethical clearance was secured prior to data collection. Fifty participants were divided into two groups: Group A received Jack Knife stretching, and Group B received Active stretching. Evaluation parameters included Active Knee Extension Test, Finger to Floor Distance Test, and Numerical Pain Rating Scale.

RESULTS: The result demonstrated that both stretching interventions produced improvements in hamstring flexibility. Significant progress was observed in both groups after a four-week intervention. While no significant difference was found between the groups in most of the outcome measures, Jack Knife stretching showed a greater improvement in right knee extension post-intervention.

CONCLUSION: Both stretching methods are beneficial and can be used in therapeutic settings to enhance hamstring flexibility. Jack Knife stretching may offer additional advantages in improving functional movements, particularly knee extension.

KEYWORDS: Hamstring tightness, Jack Knife stretching, Active stretching, Active Knee Extension Test, Finger to Floor Distance Test, Numerical Pain Rating Scale.

INTRODUCTION

Flexibility is a fundamental component of physical fitness, contributing significantly to efficient movement pattern, joint health, and overall biomechanical function. The hamstring muscle group comprises the semitendinosus, semimembranosus, and biceps femoris, playing essential roles as hip extensors and knee flexors. When these muscles lose their capacity to elongate, joint mobility becomes limited. [1]

Hamstring tightness is prevalent in the young adult population, particularly students, resulting in reduced flexibility, poor posture, and increased susceptibility to low back pain. The rise in sedentary habits among individuals aged 18-25 has led to a high

prevalence rate of hamstring tightness, reported at 68%. [2] Prolonged sitting among college students can contribute to reduced soft tissue extensibility and the development of trigger points, exacerbating muscle stiffness.[3] Other studies also found hamstring tightness common among individuals with low physical activity levels. [4,5] Even among athletic population, this condition can persist due to imbalance training.[5]

Hamstring flexibility can be measured using tools like Active Knee Extension Test (AKET), Finger to Floor Distance Test (FFD). The AKET provides a reliable measure by evaluating the angle formed during active extension of the knee while the hip is held at a 90-degree angle, this test is widely used for hamstring tightness assessment in clinical and occupational settings. [6,7] The FFD test assesses hamstring extensibility during movement and is considered highly reliable with a score of 0.99. [8]

Jack Knife stretching has shown multiple benefits, including increased blood circulation and reduction of tightness in the hamstring.[9] This technique is the combination of static and dynamic elements to effectively lengthen the hamstring muscle.[10,11] Its primary aim is to promote flexibility through physiological adaptation and improved viscoelastic properties.[12,13] The moment involves squatting while holding the ankles, extending the knees, and maintaining the stretch for five seconds and repeat five times per set. [13,14]

Active stretching is another effective approach, commonly used for home-based exercises. It relies on voluntary contraction of the antagonist muscles to create a stretching in the target muscle. This method enhances not only flexibility but also proprioceptive feedback and muscle balance, making it ideal for individuals needing dynamic control. [15,16] Stretch intensity, duration, and body positioning significantly influence the efficacy of hamstring flexibility interventions. [17-20] Evidence suggests that controlled intensity and optimal stretch posture are critical for effective neuromuscular adaptation. [21] It is important to study hamstring flexibility among students as studies show that there is a significant increase in hamstring tightness with extended sitting hours. [24]

While both the techniques are utilized in the practice, there is limited comparative research examining their relative effectiveness in improving hamstring flexibility. This study aims to evaluate and compare the effectiveness of jack knife stretching and active stretching techniques in the students with hamstring tightness.

AIM: To compare the effectiveness of jack-knife stretching versus active stretching in improving hamstring flexibility among students with hamstring tightness.

OBJECTIVES:

- To assess the baseline hamstring flexibility of students with tight hamstring.
- To evaluate the effect of jackknife stretching on hamstring flexibility.
- To evaluate the effect of active stretching on hamstring flexibility.
- To compare the effectiveness of both stretching techniques in improving hamstring flexibility.

MATERIALS & METHODS

After obtaining permission from institutional scientific research committee and authorities of department of physiotherapy, the researcher met the students of first year to fourth year as per students' availability on each day. After explaining the purpose of the study and procedure, written consent was obtained. Then Active Knee Extension Test, Finger to Floor Distance Test and Numerical Pain Rating Scale measurements were taken. After data collection the students underwent intervention as per their allotted groups for 4 weeks. Post intervention measurements were taken after 4 weeks.

PROCEDURE

The study was conducted on 50 university students who met the inclusion and exclusion criteria. All participants provided written informed consent before taking part. The students were divided into two groups: Jack-Knife stretching group (n=25) and Active stretching group (n=25). Following approval from the institutional scientific research committee, Department of Physiotherapy, the researcher approached students from first year to fourth year. The procedure of this study was explained to all the subjects participated in the study. A written informed consent was obtained from all the subjects. Demographic data was collected and pre-treatment measurements of Hamstring flexibility was measured before the intervention using AKET and FFD test which are known for their high reliability.

Subsequently, both Jack-Knife stretching and Active stretching was given to allotted groups for three alternate days in a week and continued for four weeks.

Active Knee Extension Test

During the AKE test, the subject's test leg was positioned at a 90o at hip and knee joints. From that position, extension of the knee was performed with a relaxed ankle position until they felt a maximum stretch and hold the position for five seconds, the examiner monitored compensated lumbar extension movement with visual inspection. The knee extension angle was measured using a goniometer.

Floor To Finger Distance Test

This test was used to measure hamstring flexibility. First the subject should be in standing position and were then asked to bend forward to their ability. Then they were asked to maintain an extended knee position and the distance between the floor and the subject's finger was measured using inch tape.

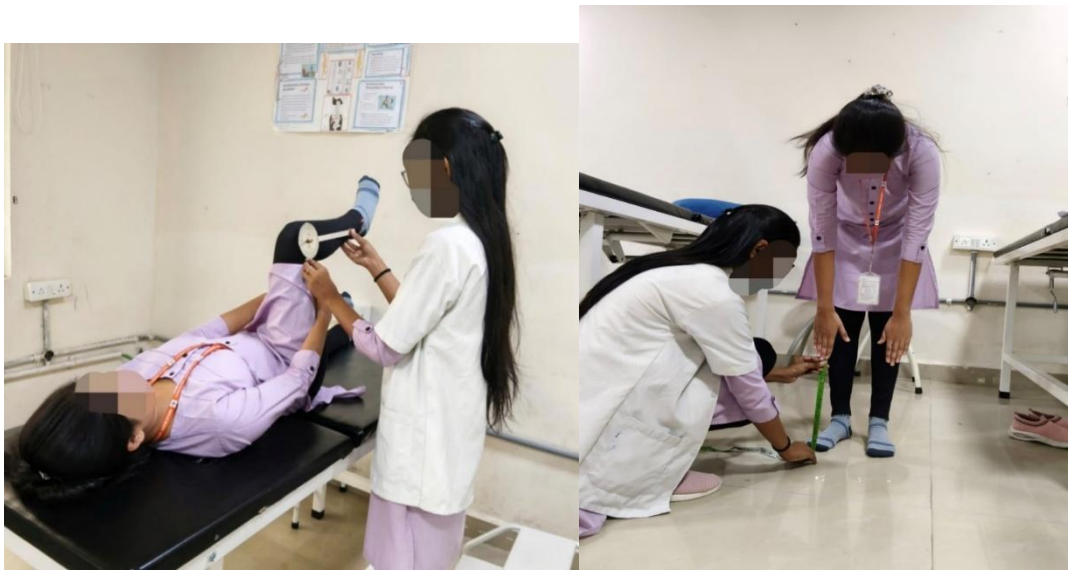

Figure 1: Active Knee Extension Test
Figure 2: Finger To Floor Distance Test

Jack-Knife Stretching Group

In this technique the subjects were asked to position themselves in full squat and hold both the ankles from the behind. They were then instructed to extend their knees fully holding the ankles while bringing their chest close to their thighs. This position was held for 5 seconds and is repeated for 5 times, two sets each day. Alternate day intervention was given for 4 weeks.

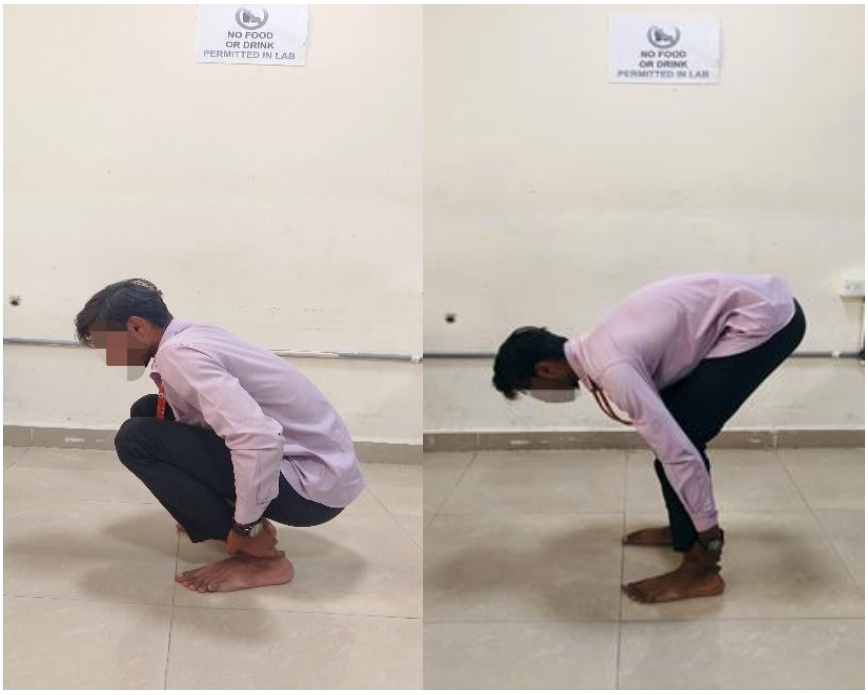

Figure 3: Jack-Knife Stretching - Starting Position
Figure 4: Jack-Knife Stretching- Ending Position

Active Stretching Group

In this technique the subjects were asked to perform self stretching of hamstring in sitting position. Subject sitting with stretched legs straight out in front of body with knee fully extended. While maintaining the neutral position of spine and flexing at the hips, the subject reaches forward with both hands as far as possible until, mild tension is felt in the posterior thigh. Each stretch position was held for 30 seconds, five times per day. Alternate day intervention was given for 4 weeks.

Figure 5: Active Stretching

STATISTICAL ANALYSIS

The statistical analysis was done using SPSS software version 27. As this study was an interventional, the data distribution and choice of measures were made according to variables and descriptive data. Confidence interval at 95%. Statistical significance level is at $p<0.05$ value. Descriptive statistics was used to summarize demographic data and baseline characteristics. Shapiro-Wilk Test

was used to test Normality. Paired t-Test was used to assess within-group changes in measurements of pre- and post-intervention. Independent t-Test was used to compare the mean changes between the two groups.

RESULT

Demographic Data and Baseline Characteristics

TABLE 1: Baseline characteristics statistical analysis- Age

Variables	Group	Sample Size	Mean	SD	p Value
Age	Group A	25	20.44	0.768	0.056
	Group B	25	20.92	0.954	

Table 1 represents the baseline demographic data indicates that the mean age of participants in the Group- A was 20.44 years (SD = 0.768), while in the Group- B it was 20.92 years (SD = 0.954). The p-value of 0.056 suggests that there is no statistically significant difference in age between the two groups at baseline, indicating that the groups were well-matched in terms of age prior to the intervention.

TABLE 2: Baseline characteristics statistical analysis

Variable	Sample Size	Mean	SD	P-value
Right NPRS	50	6.60	1.40	0.22
Left NPRS	50	6.04	1.59	0.48
Right Active Knee Extension	50	23.41	2.56	0.02
Left Active Knee Extension	50	24.74	2.39	0.77
FFD Test	50	14.44	5.57	0.10

Table 2 represents the Baseline characteristics of all the variables. No significant difference was observed between the groups, except for the right AKE Test which showed a statistically significant difference (p = 0.02).

WITHIN GROUP ANALYSIS WITH TWO GROUPS

GROUP- A (Jack-Knife Stretching):

TABLE 3: Jack-Knife Stretching Group – Within Group Analysis

Variable	Pre-Mean ± SD	Post-Mean ± SD	Paired t-test	P-value
Right NPRS	6.36 ± 1.381	4.52 ± 1.418	19.468	0.001
Left NPRS	5.88 ± 1.740	4.08 ± 1.913	18.000	0.001
Right AKE Test	23.96 ± 2.300	25.88 ± 2.315	-19.461	0.001
Left AKE Test	24.52 ± 2.220	26.32 ± 2.135	-18.000	0.001
FFD Test	13.16 ± 4.947	11.36 ± 4.932	22.045	0.001

Table 3 represents the within-group analysis done using Paired t-Test for the Group A shows statistically significant improvements (p = 0.001) across all measured variables – NPRS, AKE Test and FFD Test.

GROUP- B (Active Stretching)

TABLE 4: Active Stretching Group – Within Group Analysis

Variable	Pre-Mean ± SD	Post-Mean ± SD	Paired t-test	P-value
Right NPRS	6.84 ± 1.405	5.04 ± 1.428	22.045	0.001
Left NPRS	6.20 ± 1.443	4.36 ± 1.524	19.468	0.001
Right AKE Test	22.32 ± 2.594	24.12 ± 2.633	-12.728	0.001
Left AKE Test	24.32 ± 2.594	26.04 ± 2.669	-18.767	0.001
FFD Test	15.72 ± 5.955	13.80 ± 5.802	19.461	0.001

Table 4 represents the within-group analysis done using Paired t-Test for the Group B shows statistically significant improvements ($p = 0.001$) across all measured variables – NPRS, AKE Test and FFD Test.

BETWEEN GROUP ANALYSIS

TABLE 5: In Between Group Analysis of NPRS

Variable	Group A Mean ± SD	Group B Mean ± SD	t-Test	P-value
Right NPRS - Pre	6.36 ± 1.381	6.84 ± 1.405	-1.218	0.229
Right NPRS - Post	4.52 ± 1.418	5.04 ± 1.428	-1.292	0.203
Left NPRS -Pre	5.88 ± 1.740	6.20 ± 1.443	-0.708	0.482
Left NPRS - Post	4.08 ± 1.913	4.36 ± 1.524	-0.572	0.570

Table 5 represents the in between group comparison of NPRS. The Independent t-Test was used to compare the differences between two independent groups (Group A and Group B). No significant differences between Group A and Group B both pre- and post-intervention.

TABLE 6: In Between Group Analysis of Active Knee Extension Test (AKET)

Variable	Pre-Mean ± SD	Post-Mean ± SD	t-Test	P-value
Right AKET - Pre	23.96 ± 2.300	22.32 ± 2.594	2.365	0.022
Right AKET - Post	25.88 ± 2.315	24.12 ± 2.635	2.509	0.016
Left AKET - Pre	24.52 ± 2.220	24.12 ± 2.635	0.293	0.771
Left AKET - Post	26.32 ± 2.135	26.04 ± 2.669	0.410	0.684

Table 6 represents the in between group comparison of AKE Test. The Independent t-Test was used to compare the differences between two independent groups (Group A and Group B).

Right Active Knee Extension Test: Significant differences found pre- and post-intervention between groups with a p-value of 0.022. Suggests that Group A (Jack-Knife stretching) improved significantly more than the other in right knee flexibility/extension.

Left Active Knee Extension Test: No significant difference between groups. Both groups had similar improvements or no significant change compared to each other.

TABLE 7: In Between Group Analysis of Finger to Floor Distance Test (FFD)

Variable	Pre-Mean ± SD	Post-Mean ± SD	t-Test	P-value
FFD Test - Pre	13.16 ± 4.947	15.72 ± 5.955	-1.633	0.105
FFD Test - Post	11.36 ± 4.932	13.80 ± 5.802	-1.602	0.116

Table 7 represents the in between group comparison of AKE Test. The Independent t-Test was used to compare the differences between two independent groups (Group A and Group B). No significant difference between groups was seen, means both groups had similar improvements or no significant change compared to each other.

DISCUSSION

The present study was conducted to compare the effect of Jack Knife Stretching and Active Stretching techniques on improving hamstring flexibility among students with hamstring tightness. The results demonstrated that both stretching interventions were effective in enhancing hamstring flexibility; however, Jack Knife Stretching showed relatively greater improvements across multiple outcome measures.

Sairyo et al. examined the effects of jack knife stretching over a four-week period using PFIA and FFD as outcome measures. Their findings revealed a significant improvement in hamstring flexibility, with

FFD improving by approximately 22 cm and PFIA increasing from 50.6 degree to 83.8 degree, indicating a marked gain in range of motion.[9] In comparison, our study also demonstrated a significant reduction in FFD and improvement in active knee extension following Jack Knife stretching, there by reinforcing the effectiveness of this technique in improving hamstring flexibility among young adults.

Amruta Kabra et al. compared the Jack Knife stretching with PNF stretching in individuals with hamstring tightness, concluded that while both techniques led to statistically significant improvement in FFD and active knee extension, Jack Knife stretching resulted in more immediate improvements.[10] Similarly, our findings also demonstrated that although both Jack Knife and Active stretching significantly reduced hamstring tightness, Jack Knife stretching was associated with greater gains in right knee extension and overall flexibility.

Hamilton conducted a study focusing on adolescents with back pain and compared the effects of standing versus seated Jack Knife stretching. The participants practiced twice daily for four weeks, and flexibility was evaluated using the FFD test. The standing jack knife technique proved more beneficial, particularly due to its functional alignment and active involvement of postural muscles. [12], while Vaniya et al. also noted comparable findings in physiotherapy students. [22], Nishikawa et al. confirmed immediate flexibility gain with both active and passive methods.[23] Similarly, in our study, participants in the jack knife stretching group showed superior improvements in flexibility score compared to the active stretching group.

In the present study the Finger-to-Floor Distance (FFD), Active Knee Extension (AKE) test, and Numeric Pain Rating Scale (NPRS) were used as objective and subjective measures of flexibility and discomfort. Intra-group analysis revealed significant improvements in both Group A (Jack Knife Stretching) and Group B (Active Stretching) post-intervention ($p < 0.05$), indicating the effectiveness of both techniques in reducing hamstring tightness. Inter-group comparison showed that Group A had better post-test scores compared to Group B, suggesting that Jack Knife Stretching might be more effective than Active Stretching in enhancing hamstring flexibility.

Overall, the interventions appear beneficial, but Jack-Knife stretching protocol may offer a slight advantage for enhancing specific functional outcomes such as right knee extension. Hence both the techniques can be used clinically to increase the flexibility and range of motion of the hamstring muscle.

CONCLUSION

The present study proved that both the stretching techniques namely, Jack-knife and Active stretching are equally effective for increasing the flexibility of hamstring muscles in students with hamstring tightness. However, Jack-Knife stretching showed a greater improvement in right knee extension post-intervention when compared to Active stretching, making it a potentially more effective intervention for targeted improvement for enhancing specific functional outcomes such as knee extension.

Declaration by Authors

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Conflict of Interest: The authors declare no conflict of interest.

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