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Original Research Article

Immediate and Short-Term Effects of Hamstring Active Release Technique on Lower Limb Flexibility and Functional Status in Sedentary Young Adults

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Name of Author:
Subhashchandra Rai[1], Manjula Shantaram[2], Jilna Jills[3], Riyas Basheer K B[4]*

Affiliation: *[1]Research Scholar, Indira Gandhi Technological and Medical Sciences University, Ziro, Arunachal Pradesh - 791120 & Professor cum Principal, Tejasvini Physiotherapy College (affiliated to RGUHS), Mangalore, Karnataka - 575028.*
[2]A J Research Centre, A J Institute of Medical Sciences and Research Centre, Mangalore, Karnataka – 575004.
[3]Physiotherapy Intern, Tejasvini Physiotherapy College (affiliated to RGUHS), Mangalore, Karnataka - 575028.
4Vice Principal & Associate Professor, Tejasvini Physiotherapy College (affiliated to RGUHS), Mangalore, Karnataka - 575028.

Corresponding Author:
Dr. Riyas Basheer K B

Abstract: ***Background:*** Sedentary behaviour in college students contributes to hamstring tightness, impacting lower limb flexibility and function. Objective of the study was to evaluate the effects of Active Release Technique (ART) compared to passive stretching on hamstring flexibility and lower limb functional status. ***Methods:*** Eighty participants (40 males, 40 females; aged 18–25) with unilateral hamstring tightness were randomized into ART and control groups. ART involved trigger point release with active knee flexion; the control group received passive straight leg raise stretching. Flexibility was assessed using the Active Knee Extension Test (AKET), pain via Numerical Pain Rating Scale (NPRS), and function using the Single Leg Pelvic Bridge Hold Test (SLPBHT), measured pre-intervention, immediately post, and after 24 hours. ***Results:*** ART significantly improved AKET scores and reduced NPRS scores ($p < 0.05$). No statistically significant improvements were found in functional performance (SLPBHT) within or between groups. ***Conclusion:*** ART is effective for improving hamstring flexibility and relieving pain in sedentary young adults, but does not significantly enhance functional performance.

Keywords: Active Release Technique, Hamstring Flexibility, Trigger Point Therapy, Sedentary Lifestyle, Lower Limb Function

INTRODUCTION

Sedentary behaviour among college students has become increasingly prevalent due to easy access to digital technology and academic demands. Many students spend prolonged hours engaging in screen-based activities, such as attending lectures, using computers, and recreational device usage. This trend has led to a marked decrease in physical activity and introduced biomechanical changes that contribute to musculoskeletal stress.1

One of the most affected muscle groups in this context is the hamstring, which spans across both the hip and knee joints. The hamstrings including the biceps femoris, semitendinosus, semimembranosus, and adductor magnus (hamstring portion) are essential for hip extension and knee flexion. Prolonged sitting maintains the knees in a flexed posture, resulting in adaptive shortening of the hamstrings. This tightness impairs mobility and predisposes individuals to conditions such as plantar fasciitis, patellofemoral pain syndrome, and lumbar postural dysfunction.2

Hamstring flexibility is not only vital for normal biomechanical function but also plays a crucial role in optimizing force production during eccentric and concentric muscle contractions. Limitations in flexibility have been shown to adversely affect joint mechanics, reduce performance, and alter movement patterns, particularly in weight-bearing and locomotor tasks.3,4

Multiple assessments are used to quantify hamstring flexibility, including the Active Knee Extension Test (AKET), which offers high reliability and reproducibility. Muscle flexibility should also be differentiated from joint hypermobility, the latter being related to ligamentous laxity and genetic factors.5,6 The Beighton score is often used to exclude individuals with generalized joint hypermobility from flexibility studies to minimize confounding variables.7

Manual therapy techniques such as the Active Release Technique (ART) have gained prominence for addressing soft tissue adhesions, reducing muscle tension, and enhancing range of motion. ART differs from passive techniques by integrating specific movement patterns with manual pressure to restore tissue quality and functional length. Despite its popularity, there is limited literature addressing ART's direct impact on lower limb functional performance, particularly in young adults with sedentary lifestyles.8,9,10,11

This study aims to bridge that gap by evaluating the immediate and short-term effects of ART on hamstring flexibility and functional status among medical students who spend 5–6 hours seated daily. By comparing ART with passive stretching interventions, the research seeks to determine whether ART offers superior outcomes in improving muscle flexibility and functional capacity in this population.

MATERIALS AND METHODS

Study Design: This was a parallel group pre-post interventional comparative study aimed at evaluating the immediate and short-term effects of Active Release Technique (ART) on hamstring flexibility and lower limb functional status in sedentary young adults.

Sample Size: It was calculated based on the equation $n = 2 (Z\alpha + Z\beta) \sigma 2 / (X1 - X2)2$, where σ is estimated from the study conducted by Kothawale S, et.al (2018)12 and yield a number of 72 as the minimum sample and considering 10% dropout 80 individuals was recruited for the study.

Participants: Eighty healthy college students (40 males and 40 females), aged 18–25 years, were recruited from Tejasvini Hospital Group of Institutions in Mangalore, Karnataka. Inclusion criteria included unilateral hamstring tightness, defined as a minimum of 5° restriction as measured by the Active Knee Extension Test (AKET). Exclusion criteria comprised history of lower limb or spinal surgery, musculoskeletal conditions limiting mobility, medication usage affecting muscle performance, and evidence of generalized joint hypermobility per Beighton score criteria.

Ethical Considerations: All participants provided written informed consent after receiving a detailed explanation of the study procedures. The study adhered to ethical standards consistent with institutional guidelines. This study was registered under Clinical Trials Registry – India (CTRI)

prospectively (CTRI/2025/05/086431 dated 06/05/2025).

Group Allocation and Intervention Protocol: Participants were assigned into two groups. ART Group (n = 40): Manual pressure was applied over the trigger point in the hamstring region using the therapist's elbow while the participant actively performed prone knee flexion. Each repetition involved a 6-second hold over the trigger area, followed by 6 repetitions of knee flexion per set. This cycle was repeated for 6 sets. Control Group (n = 40): Participants underwent passive straight leg raise (SLR) stretching. Each stretch was held for 30 seconds across 3 repetitions, targeting maximal hamstring elongation with the knee in full extension. Outcome Measures: Hamstring Flexibility was assessed using the Active Knee Extension Test (AKET) in a supine 90/90 position. A universal goniometer was used to measure the angle of knee extension, referencing the lateral femoral condyle and lateral malleolus, while maintaining neutral lumbar posture.1 Pain Intensity was evaluated using the Numerical Pain Rating Scale (NPRS) ranging from 0 (no pain) to 10 (worst possible pain), specifically quantifying tenderness over the trigger point.13 Lower Limb Functional Performance was measured using the Single Leg Pelvic Bridge Hold Test (SLPBHT). Participants performed a single-leg glute bridge and maintained position with hips aligned until fatigue, with hold time recorded in seconds.10,14 All measurements were recorded at three intervals: pre-intervention, immediately post-intervention, and 24 hours post-intervention.

Statistical Analysis: Analysis was conducted using SPSS Version 21.0. Data normality was assessed using the Kolmogorov-Smirnov test. Descriptive statistics were expressed as mean ± standard deviation. Within-group comparisons across time points were analysed using Repeated Measures ANOVA. Between-group comparisons were performed using Independent t-tests. Statistical significance was set at $p \leq 0.05$, with a 95% confidence interval.

RESULTS

Eighty participants (40 males, 40 females) aged between 18–25 years were enrolled and evenly randomized into ART and control groups. Baseline characteristics (Table 1) including age, height, weight, and hamstring flexibility (AKET), were comparable between groups ($p > 0.05$). Right-sided hamstring (Figure 1) tightness was more prevalent across groups (77.5% of total sample)

Variables	ART Group	Control Group
Age (Years)	20.05 ± 1.76	19.90 ± 1.61
Height (cm)	165.75 ± 9.41	166.75 ± 9.92
Weight (Kg)	55.25 ± 11.32	55.15 ± 9.96
AKET (Degree) Pre	50.54 ± 6.48	46.19 ± 7.80

Table 1: Demographic Summary

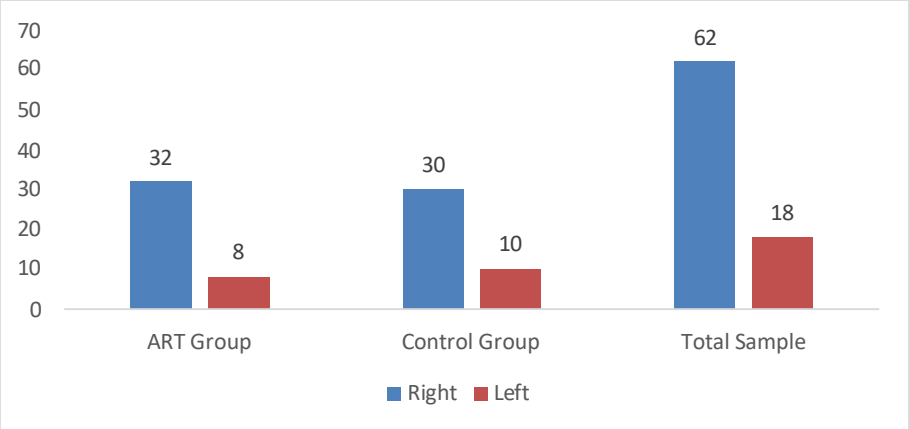

Figure 1: Hamstring Tightness Distribution across the Groups

In ART Group, **Flexibility (AKET) was** Significant improved from pre- to post-intervention ($p < 0.001$), with a partial decline at 24 hours yet still improved compared to baseline. **Pain (NPRS)** significantly increased post-treatment due to release pressure, followed by pain reduction at 24 hours ($p < 0.01$). **Function (SLPBHT) n**o statistically significant change observed ($p > 0.05$). In Control Group, **Flexibility** Improvement noted post-intervention and maintained at 24 hours ($p < 0.001$). **Pain shows m**inimal change across all time points ($p > 0.05$). **Function** no statistically significant variation ($p > 0.05$) (Table 2).

Time Interval	ART GROUP			CONTROL GROUP		
	AKET	NPRS	SLPBHT	AKET	NPRS	SLPBHT
Pre	50.54 ± 6.48	5.35 ± 1.35	31.45± 15.44	46.19± 7.80	4.50 ± 1.35	39.64 ± 22.95
Post	40.04 ± 6.84	6.45 ± 1.67	33.57 ± 22.15	35.79 ± 7.60	4.52 ± 1.13	38.96 ± 20.59
24 Hrs	46.97 ± 6.84	5.52 ± 1.30	35.72 ± 20.08	41.66 ± 6.77	4.50 ± 1.19	43.20 ± 24.43
f value	152.651	10.968	1.709	147.995	0.15	1.997
Sig.	0.000[a]	0.000[a]	0.193*	0.000[a]	0.982*	0.145*
[a] Repeated measures of ANOVA and Post-hoc analysis by Bonferroni *No statistical significant difference						

Table 2: Within-Group comparison of outcomes

ART was significantly more effective than passive stretching in improving hamstring flexibility at all measured intervals. **Pain levels decreased significantly** in the ART group compared to control. **Functional performance (SLPBHT)** did not show statistical improvements in either group, suggesting limited sensitivity of the test for capturing short-term functional gains (Table 3).

Variables	Time Intervals	Mean Difference	Sig. (2-tailed)
NPRS	Pre	0.85	0.006*
	Post	1.93	0.000*
	24 Hrs	1.03	0.000*
AKET	Pre	4.35	0.008*
	Post	4.35	0.009*
	24 Hrs	5.31	0.001*
SLPBHT	Pre	8.19	0.065
	Post	5.39	0.263
	24 Hrs	7.49	0.138
*Statistically Significant (Independent t Test)			

Table 3: Between-Group comparison of Outcomes

DISCUSSION

This study investigated the immediate and short-term efficacy of the hamstring Active Release Technique (ART) in improving lower limb flexibility and functional status among sedentary young adults. The findings demonstrate that ART is significantly more effective than passive stretching in enhancing hamstring muscle length and reducing trigger point pain, consistent with prior research on myofascial release techniques.

Participants in the ART group exhibited a marked improvement in flexibility, evidenced by significant changes in Active Knee Extension Test (AKET) scores. This aligns with findings from George et al. (2006), who reported substantial increases in hamstring flexibility following a single session of ART.15 The mechanical principle underlying ART targeting adhesions while lengthening muscle tissue through guided movement appears to play a key role in restoring extensibility. This supports the clinical utility of ART in treating muscle tightness resulting from prolonged sedentary postures.

Significant reductions in pain were observed in the ART group, as measured by the Numerical Pain Rating Scale (NPRS). This validates earlier work by Mistry et al. (2015), which highlighted ART's role in alleviating pain by addressing soft tissue fibrosis and restoring normal neuromuscular function.16 The transient increase in NPRS post-intervention may be attributable to localized pressure during treatment, yet this was followed by effective symptom relief at 24 hours.

Interestingly, no statistically significant improvement was detected in functional status using the Single Leg Pelvic Bridge Hold Test (SLPBHT), within or between groups. This may be due to the test's emphasis on proximal hip stabilizers rather than isolated hamstring performance. The lack of change suggests that functional gains may require more

prolonged intervention or alternate outcome measures sensitive to neuromuscular adaptation. Additionally, performance-based tests such as hop tests or isokinetic evaluations could better reflect improvements in dynamic function.

A notable finding was the higher prevalence of right-sided hamstring tightness, consistent with data from Thakur et al. (2016) and Pawar et al. (2021), who reported biomechanical and dominance-based asymmetries in muscle length.17,18 These results emphasize the importance of accounting for limb dominance in treatment planning and further support the inclusion of bilateral assessments in future studies.

While passive stretching yielded positive results, ART demonstrated superior improvements in both flexibility and pain reduction. This reinforces conclusions drawn by Kothawale and Rao (2018), who found ART more effective than other soft tissue mobilization methods.12 However, the lack of long-term follow-up restricts conclusions regarding sustained benefits.

Given its non-invasive nature and immediate effects, ART could be integrated into physical therapy protocols for sedentary populations or athletes experiencing hamstring dysfunction. Its versatility in addressing both flexibility and pain makes it a valuable addition to clinical tools for musculoskeletal care.

Limitations & Future Suggestions: Pain quantification was subjective and lacked instrumentation-based validation, Functional testing focused on proximal muscle groups, potentially underrepresenting distal lower limb function, Gender-based differences and long-term outcomes were not explored, limiting generalizability. Further research should incorporate longer follow-up periods, stratify participants by limb dominance and gender, and explore alternative functional performance metrics. Investigating ART's influence on dynamic tasks and integrating electromyographic analysis may also yield deeper insights into neuromuscular adaptation.

CONCLUSION

This study demonstrates that the hamstring Active Release Technique (ART) significantly improves muscle flexibility and alleviates pain over trigger points among sedentary young adults. Compared to passive stretching, ART produced superior gains in hamstring extensibility, as measured by the Active Knee Extension Test (AKET), and greater pain relief, as reflected in NPRS scores. However, neither intervention showed statistically significant effects on functional performance as assessed by the Single Leg Pelvic Bridge Hold Test (SLPBHT).

These findings suggest that ART is a reliable short-term intervention for improving flexibility and reducing localized tenderness in individuals affected by prolonged sitting. Further investigation is warranted to explore long-term outcomes and functional gains using more comprehensive assessment tools.

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Guardian/ Parent's consent: All participants provided written informed consent after receiving a detailed explanation of the study procedures. The study adhered to ethical standards consistent with institutional guidelines.

Ethical Approval: The study was a part of randomized controlled trial prospectively registered (CTRI/2025/05/086431) in Clinical Trials Registry-India (CTRI) approved by the Institution Review Board of Tejasvini Physiotherapy College, Mangalore (Ref. No: TPC/IRB/BPT/2024/01) and by the Research Ethics Committee of Indira Gandhi Technological and Medical Sciences University, Ziro (Ref. No: IGTAMSU/VC/2025/052).

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