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Comparison of suboccipital muscle inhibition and Bowen technique on hamstring tightness in college students

Comparación de la técnica de inhibición muscular suboccipital y la técnica Bowen sobre la rigidez de los isquiotibiales en estudiantes universitarios

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Abstract

Muscle tightness refers to the inability of a muscle to function through the full range of motion (ROM) of the specific joint. Prolonged sitting posture, which keeps the hamstrings in a contracted position, is a common cause of hamstring tightness among students. The study aims to compare and analyse the efficacy of suboccipital muscle inhibition techniques and the Bowen technique in reducing hamstring tightness among college students. In a six-week study, 40 participants were randomly assigned to two groups according to inclusion and exclusion criteria. Suboccipital muscle inhibition was applied to Group A (n=20), and the Bowen method was given to Group B (n=20). Pre- and post-intervention data were collected using the straight-leg raise (SLR) and active knee extension (AKE) tests. Both groups showed statistically significant improvements in bilateral SLR and AKE ($p < 0.01$). Post-test comparison between Group A and Group B revealed a statistically significant difference in right SLR ($p = 0.002$), left SLR ($p = 0.008$), right AKE ($p = 0.008$), and left AKE ($p < 0.01$), with Group B demonstrating superior improvement. The findings suggest that both techniques were effective; however, the Bowen technique demonstrated greater improvements in range of motion and overall flexibility among college students.

Keywords: hamstring tightness; Bowen technique; suboccipital muscle inhibition; manual therapy; health and well-being

Resumen

La rigidez muscular se refiere a la incapacidad de un músculo para funcionar a través del rango completo de movimiento (ROM) de una articulación específica. La postura prolongada en sedestación, que mantiene a los isquiotibiales en una posición contraída, es una causa común de rigidez de los isquiotibiales entre los estudiantes. Este estudio tuvo como objetivo comparar y analizar la eficacia de la técnica de inhibición muscular suboccipital y la técnica Bowen en la reducción de la rigidez de los isquiotibiales en estudiantes universitarios. En un estudio de seis semanas, 40 participantes fueron asignados aleatoriamente en dos grupos según criterios de inclusión y exclusión. Al Grupo A (n=20) se le aplicó la técnica de inhibición muscular suboccipital, mientras que al Grupo B (n=20) se le administró la técnica Bowen. Los datos pre y post intervención se recopilaron mediante las pruebas de elevación de pierna recta (SLR) y extensión activa de rodilla (AKE). Ambos grupos mostraron mejoras estadísticamente significativas en los valores pre y post prueba de SLR y AKE de forma bilateral ($p < 0.01$). La comparación post intervención entre el Grupo A y el Grupo B reveló una diferencia estadísticamente significativa en la SLR derecha ($p = 0.002$), SLR izquierda ($p = 0.008$), AKE derecha ($p = 0.008$) y AKE izquierda ($p < 0.01$), demostrando el Grupo B una mejoría superior. Los hallazgos sugieren que ambas técnicas fueron efectivas; sin embargo, la técnica Bowen mostró mayores mejoras en el rango de movimiento y la flexibilidad general entre los estudiantes universitarios.

Palabras clave: rigidez de los isquiotibiales; técnica Bowen; inhibición de los músculos suboccipitales; terapia manual; salud y bienestar



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Introduction

Optimal hamstring flexibility is essential for efficient lower-limb function and proper spinal mechanics. Reduced hamstring extensibility can disrupt lumbo-pelvic movement patterns, resulting in functional impairments and increasing the risk of musculoskeletal conditions, including low back pain (Cai et al., 2023). Limited range of motion (ROM) at the hip or knee joint is commonly associated with hamstring tightness and may present with discomfort in the posterior thigh. Hamstring tightness is prevalent across different age groups and is recognized as a common musculoskeletal concern (Maghsoud Eivazi Gh et al., 2012).

Hamstring tightness is one of the most common musculoskeletal problems among college students. Previous research has reported that approximately 68% of students aged 18–25 years experience hamstring stiffness (Linklater et al., 2010). Undergraduate students often spend prolonged periods sitting during academic activities (Garn & Simonton, 2023). Sustained sitting postures involving posterior pelvic tilt and prolonged knee flexion may keep the hamstrings in a shortened position, gradually reducing muscle flexibility over time (Arab & Nourbakhsh, 2014).

Excessive hamstring tightness may impair muscular performance, alter hip alignment and spinal mechanics, and contribute to low back pain among college students (Koli & Anap, 2018; Kamalakannan et al., 2020). Various physiotherapy interventions have been used to improve hamstring flexibility. Previous studies have shown that physical therapy approaches can improve knee extension and reduce movement-related impairments (Namkorn et al., 2024). Additionally, the Active Release Technique (ART) has demonstrated improvements in hamstring flexibility through enhanced tissue mobility and neuromuscular relaxation (Abideen et al., 2024).

Among the various manual therapy approaches, the Suboccipital Muscle Inhibition Technique and Bowen Technique have gained attention for their potential role in improving muscle flexibility and promoting myofascial relaxation. The Suboccipital Muscle Inhibition Technique (SMIT) promotes fascial relaxation through gentle pressure applied to the suboccipital region. A reduction in suboccipital muscle tone has been associated with decreased knee flexor muscle tone through myofascial mechanisms (Aparicio et al., 2009). Studies have demonstrated that SMIT can improve hamstring

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flexibility and may also help reduce chronic headache symptoms, reflecting its broader therapeutic effects on myofascial and neuromuscular function. (Hareeshankar D et al., 2026). The Bowen Technique (BT) is a soft-tissue restorative intervention that utilizes gentle rolling movements applied with the fingers and thumbs to targeted muscles and connective tissues (Marr et al., 2011).

The passive Straight Leg Raise (SLR) and Active Knee Extension (AKE) tests are commonly used to assess hamstring tightness, with the SLR test generally considered more reliable. These assessment tools are regarded as standard methods for evaluating hamstring flexibility and related musculoskeletal impairments (Banerjee & Mukhi, 2020).

Although several physiotherapy interventions have been investigated for improving hamstring flexibility, evidence regarding the comparative effectiveness of manual therapy approaches remains limited. Both the Suboccipital Muscle Inhibition Technique (SMIT) and Bowen Technique (BT) are used clinically to improve muscle flexibility; however, studies directly comparing these interventions for hamstring tightness among college students are lacking. This absence of comparative evidence limits clinicians ability to select the most effective treatment approach for targeted management. Therefore, this study aimed to compare the efficacy of SMIT and BT in alleviating hamstring tightness among college students and to provide evidence that may support clinical decision-making.

Methodology

A comparative study was conducted among college students recruited from a private institution between October 2025 and November 2025. This study was conducted in accordance with the guidelines of the institutional ethics committee for human research, with approval reference number ISRB No. 05/07/2025/ISRB/FR/SCPT. To estimate the required sample size, a priori power analysis was performed using G*Power software for an independent t-test. With an effect size of 0.5, a significance level (α) of 0.05, and a statistical power of 0.80, the calculated sample size was 32 participants. Considering possible dropouts, the sample size was increased, and a total of 40 participants were included in the final analysis. Initially, 60 participants were recruited for the study; the final sample was reduced to 40 due to a considerable number of

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dropouts, participants who had declined to participate, and exclusions based on eligibility criteria (Figure No. 1).

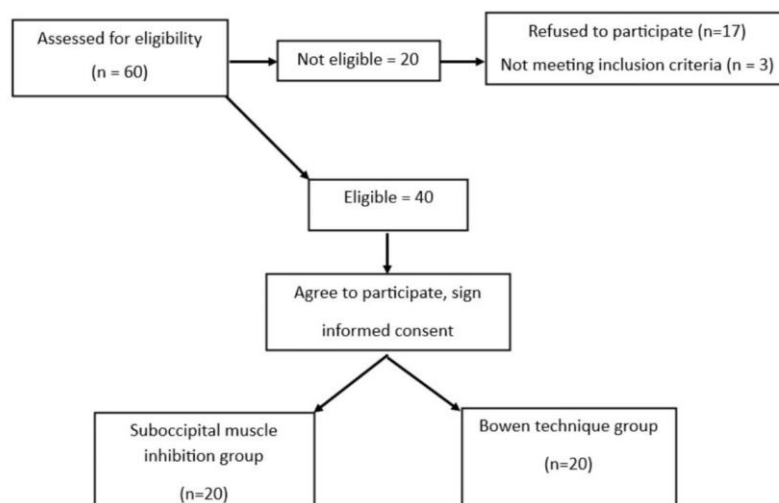


Figure1. Consort chart

A total of 40 participants were randomly allocated into groups through simple random sampling using the lottery method, ensuring an unbiased and representative sample. The study was explained to all 40 participants, and their consent forms were obtained. To ensure fairness, a neutral researcher conducted the allocation process. Since the study followed a single-blind design, participants were not informed of their group assignments. Group A (n=20) administered the suboccipital muscle inhibition technique (SMIT) and Bowen technique (BT) to Group B (n=20). Inclusion criteria of the study were Subjects who are willing to participate; both asymptomatic male and female were included; Age group between 18-25; prolonged sitting for 6 to 10 hrs; Single leg raising test <70 degree; Active knee extension test >20 degree, Exclusion criteria of the study was history of neurological problem, History of musculoskeletal problem or fracture of lower limb and spine; Tendon injury of hamstring; Metabolic or inflammatory disorders; Individuals with joint instability; Participants taking muscle relaxants, painkillers, or anti-inflammatory drugs; Yoga practitioners, gymnasts, or dancers.

The interventions were administered by multiple experienced physiotherapists who were well-acquainted with the specific techniques employed in the study. To ensure consistency and clinical proficiency, all physiotherapists underwent structured training in



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the intervention protocols before participant involvement. A pre-test evaluation was conducted, and both groups underwent the manual techniques for two weeks, six days a week. Post-intervention outcomes were recorded after the two-week program. Demographic data were collected from each participant before treatment, which is illustrated in Table 1.

Table 1: Baseline Comparison between Group A and Group B

Variable	Group A	Group B
Age (Mean $\pm$ SD)	19.65 $\pm$ 1.182	19.6 $\pm$ 1.27
BMI (Mean $\pm$ SD)	19.73 $\pm$ 3.36	20.77 $\pm$ 2.78
Sitting hours	8.55 $\pm$ 1.637	8.35 $\pm$ 1.565
Gender(M/F)	8/12	9/11
Level of physical activity (n)	Sedentary	5
	Moderate	11
	Active	3

*SD= Standard Deviation, *BMI= Body Mass Index

Study procedure:

SMIT was administered to Group A, while BT was administered to Group B for both legs simultaneously for six days a week, for a total of 2 weeks. The procedure goes as follows.

Group A received the Suboccipital Muscle Inhibition Technique

The Suboccipital Muscle Inhibition (SMI) technique is performed with the participant in a supine position, with eyes closed to promote relaxation. The therapist is seated at the head end of the treatment table, with elbows supported on the surface. Both hands are placed beneath the participant's head with palms facing upward, fingers flexed, and the finger pads positioned along the posterior arch of the atlas. A gentle upward force is applied to the atlas, directed toward the ceiling, along with slight cranial traction. This pressure is sustained for approximately two minutes and repeated for five cycles, or until adequate tissue relaxation is achieved (Kariya et al., 2021).

Group B received the Bowen Technique

Participants are positioned in a prone lying position. The therapist places the thumb over the hamstring muscle and applies pressure by gently hooking the muscle along its lateral border. The thumb is then gradually flattened on the lateral side while the

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remaining fingers are placed along the medial side of the muscle. A small gap is maintained between the thumb and fingers to facilitate coordinated muscle relaxation. Each treatment session is carried out for a duration of 20 minutes (Kage et al., 2017).

Outcome measure

Straight leg raise test:

The Active Straight leg raising test was carried out by the participants lying supine, knees and hips completely stretched. The examiner secured the contralateral lower extremity. During the test, one leg is actively raised with a goniometer placed at the femoral greater trochanter. The test stops if the opposite foot rotates or the knee lifts off the board. It is performed twice per side, recording the highest value, and discontinued if pain occurs.

Hamstring flexibility assessed through the Straight Leg Raise test is categorized as follows: 50–55° (marked tightness), 56–60° (very poor), Poor (61–65°), fair (66–70°), good (71–75°), and 76–80° (very good), and >80° (excellent) (Abideen et al., 2024).

Studies assessing the intra-rater reliability of this test have reported a strong standard error of measurement (SEM) and an intraclass correlation coefficient (ICC) of 0.91, which is low, ranging from 2.2 to 2.6° for SLR (Neto et al., 2015).

Active knee extension test:

The participants were asked to lie in a supine position with both the hips and knees at 90 degrees of flexion, supported on the examination table for the assessment. Flexing the tested limb until the thigh made contact with the frame, maintaining a degree of 90 with the table. Meanwhile, the opposite limb remained stabilized and fully expanded in a neutral rotational position by a second examiner. A universal goniometer was positioned at the lateral condyle of the femur. The goniometer's arm was positioned in line with the thigh, pointing toward the greater trochanter, while the other was aligned along the leg toward the malleolus on the side. The popliteal angle degree was then measured using the average of three consecutive observations as the final measurement for the AKET outcome (Hamzeh et al., 2020). Both sexes have different cut-off values for hamstring tightness consideration; for men, the active knee extension angle should be greater than 33.0°, and for women, it should be greater than 23.4° (Yildirim et al., 2018). The AKE



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test demonstrated good ICC (3,1) for both intra-rater and inter-rater reliability of 0.882 and an ICC (2,1) of 0.886, respectively (Olivencia et al., 2018).

Statistical analysis:

The data analysis was performed using IBM SPSS Statistics. Statistical analysis to evaluate the effects of SMIT and BT on hamstring tightness among college students involved both paired and independent t-tests. A paired t-test was used to assess within-group improvements, while an independent t-test was conducted to compare post-test outcomes between Group A and Group B. All statistical tests were performed with a 95% confidence interval and a significance level set at $p < 0.05$.

Result:

Statistical analyses were conducted between the groups, and a significant difference was noted. Based on the collected data, pre- and post-test mean values and effect size were determined.

Within-group results:

Group A showed improved hamstring flexibility following SMIT, with significant changes in both SLR and AKE values bilaterally. Group B, which received Bowen Technique, demonstrated greater improvements in hamstring flexibility, with more substantial changes in both SLR and AKE measurements on both sides, as presented in Table 2.

Table 2: SLR and AKE pre- and post-test value comparison

	GROUP	PRE -TEST (Mean $\pm$ SD)	POST-TEST (Mean $\pm$ SD)	t VALUE	p VALUE
SLR ^a (Rt ^c)	GROUP A	59.10 $\pm$ 5.81	65.6 $\pm$ 5.05	-14.256	< 0.01
	GROUP B	59 $\pm$ 4.95	70.35 $\pm$ 4.06	-13.760	< 0.01
SLR ^a (Lt ^d)	GROUP A	55.95 $\pm$ 4.81	61.90 $\pm$ 4.30	-9.701	< 0.01
	GROUP B	56.65 $\pm$ 4.78	65.85 $\pm$ 4.67	-5.779	< 0.01
AKE ^b (Rt ^c)	GROUP A	35.15 $\pm$ 3.34	28.65 $\pm$ 2.007	6.007	< 0.01
	GROUP B	34.10 $\pm$ 3.65	26.70 $\pm$ 2.34	7.532	< 0.01
AKE ^b (Lt ^d)	GROUP A	34.10 $\pm$ 3.27	29.40 $\pm$ 3.15	4.262	< 0.01
	GROUP B	34.70 $\pm$ 3.06	25.35 $\pm$ 3.84	9.343	< 0.01

Note: ^a SLR – Straight Leg Raising, ^b AKE – Active Knee Extension, ^c Rt – Right, ^d Lt – Left



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Between-group results:

As shown in Table 3, Group B demonstrated significantly greater post-test improvements than Group A in bilateral SLR and AKE outcomes, indicating the superior effectiveness of the Bowen Technique in improving hamstring flexibility.

Table 3: Post-test values of group A and group B for SLR and AKE

	GROUP	MEAN $\pm$ SD	t VALUE	p VALUE
SLR ^a (Rt ^c)	GROUP A	65.60 $\pm$ 5.051		
	GROUP B	70.35 $\pm$ 4.06	-3.275	0.002
SLR ^a (Lt ^d)	GROUP A	61.90 $\pm$ 4.30		
	GROUP B	65.85 $\pm$ 4.67	-2.781	0.008
AKE ^b (Rt ^c)	GROUP A	28.65 $\pm$ 2.00		
	GROUP B	26.70 $\pm$ 2.34	2.827	0.008
AKE ^b (Lt ^d)	GROUP A	29.40 $\pm$ 3.15		
	GROUP B	25.35 $\pm$ 3.84	3.644	< 0.01

^a SLR – Straight Leg Raising, ^b AKE – Active Knee Extension, ^c Rt – Right, ^d Lt – Left

Discussion

This study examined the effects of the Suboccipital Muscle Inhibition Technique (SMIT) and Bowen Technique (BT) on hamstring tightness among college students. The findings demonstrated that both interventions improved hamstring flexibility; however, participants receiving BT showed greater improvements in SLR and AKE outcomes compared to those receiving SMIT. These findings suggest that although both interventions are beneficial, BT may provide a greater therapeutic effect in improving hamstring flexibility.

Previous studies have reported an association between prolonged sitting duration and reduced hamstring flexibility among college students and young adults (Behera et al., 2024). Sedentary behavior and prolonged sitting positions are believed to maintain muscles in shortened postures, leading to adaptive changes in muscle extensibility and increased hamstring tightness (Waqas et al., 2016). Considering that college students commonly spend prolonged periods in sitting activities, the present findings further support the need for effective physiotherapy interventions targeting flexibility limitations in this population.



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Although earlier studies reported that SMIT effectively improves hamstring flexibility (Prajapati & Shukla et al., 2020), the present study observed superior outcomes with BT. Differences in treatment mechanisms and physiological responses may explain this variation. BT involves gentle rolling movements and sustained pressure that may influence fascial tissues and stimulate Golgi tendon organs around myotendinous junctions, potentially producing neuromuscular relaxation and reducing tissue tension (Wilks, 2013). Previous evidence has also shown that a single session of BT significantly improved hamstring flexibility and maintained effects for up to one week (Marr et al., 2011). The superior outcomes observed in the present study may therefore be attributed to both immediate neuromuscular responses and broader fascial effects associated with BT. Research conducted among football players showed notable improvement in hamstring flexibility after Pilates-based training. Even though the population differed from the present study, the results suggest that different intervention methods may improve hamstring extensibility by influencing neuromuscular control and fascial mobility (Thomas, A. J et al., 2026).

Previous investigations examining manual therapy interventions for hamstring tightness have demonstrated varied outcomes. Muscle Energy Technique (MET), neurodynamic sliding techniques, myofascial release, and instrument-assisted soft tissue mobilization have all shown beneficial effects in improving flexibility (Ashraf et al., 2024; Kang et al., 2023; Badusha et al., 2025; Saxena et al., 2025). However, findings across studies remain inconsistent. Some investigations reported greater effectiveness with MET or neurodynamic interventions, whereas others observed similar outcomes between BT and alternative techniques (Kishwar Batool et al., 2024). These inconsistencies may arise from differences in participant characteristics, intervention duration, treatment frequency, and outcome assessment methods. Therefore, treatment effectiveness may not depend solely on the intervention itself but also on patient-specific and methodological factors. The greater effectiveness of BT observed in the current study may indicate that its fascial and neuromuscular effects are particularly advantageous for college students with flexibility limitations associated with sedentary behavior.

Similarly, prior studies have shown that SMIT can improve flexibility through its influence on the superficial back line and fascial continuity, contributing to muscular

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relaxation (Cho et al., 2015). Aparicio and Quirante (2009) also demonstrated immediate improvements in hamstring length following SMIT among individuals with short hamstring syndrome. The present findings support these observations, as participants receiving SMIT demonstrated improvements in flexibility outcomes. However, despite its effectiveness, SMIT produced comparatively smaller improvements than BT. This suggests that although SMIT may be effective in producing short-term neuromuscular responses, BT may exert broader or more sustained effects through additional soft tissue and fascial mechanisms. Earlier studies have highlighted the importance of objective methods for assessing hamstring tightness (Anandhan et al., 2026). However, the present study employed clinical measures such as the Active Knee Extension and Straight Leg Raise tests, which are commonly used in practice but may be affected by examiner variability and participant response, thereby increasing the possibility of measurement bias.

Overall, the findings of the present study indicate that both SMIT and BT are effective interventions for improving hamstring flexibility among college students. However, BT demonstrated superior improvements across flexibility outcomes. These findings contribute additional evidence supporting the clinical application of BT as a potentially more effective intervention for individuals with hamstring tightness.

Limitations and Recommendations

The present study had several limitations. First, the sample size was relatively small and participants were recruited from a single institution, which may limit statistical power and reduce the generalizability of findings. Therefore, the results may not be directly applicable to broader populations with varying demographic or clinical characteristics. Second, long-term follow-up was not performed; therefore, the sustained effects of the interventions remain unknown. The absence of a double-blind design may also have increased the possibility of bias. Additionally, variations in intervention application and unmeasured psychological factors such as participant expectations, motivation, and placebo responses may have influenced the outcomes.

Future studies should include larger multicenter samples involving diverse populations and longer follow-up periods to improve external validity. Further



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investigations involving sedentary working professionals and different age groups may help determine the broader clinical applicability of these interventions

Conclusion:

Both the Suboccipital Muscle Inhibition Technique (SMIT) and Bowen Technique (BT) were effective in improving hamstring flexibility among college students. However, the Bowen Technique demonstrated significantly greater improvements in flexibility and joint range of motion, indicating superior therapeutic effectiveness in reducing hamstring tightness. These findings provide practical implications for physiotherapy practice and contribute additional evidence to support evidence-based intervention selection.

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