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Muscle Energy Technique and Positional Release Technique in Hamstrings Tightness in Non-Specific Low Back Pain: An Experimental Study

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ABSTRACT

Background: Non-specific low back pain (NSLBP) is highly prevalent among college students largely attributed to prolonged sitting, poor posture, and associated hamstring tightness. Hamstring tightness alters pelvic alignment, increases lumbar spine stress, and perpetuates pain and dysfunction. While core stabilization exercises (CSE) are established for NSLBP management the comparative effectiveness of combining CSE with either Positional Release Technique (PRT) or Muscle Energy Technique (MET) for hamstring tightness in this population remains unclear. This study specifically compares the efficacy of PRT versus MET, both combined with CSE, in improving hamstring tightness, reducing pain intensity, and enhancing functional outcomes among college students with NSLBP.

Methods: A Randomised controlled trial was conducted with 80 college students with non-specific low back pain, aged between 18 and 25 years. Participants were randomly divided into two groups: Group A received Core Stabilisation exercises and Positional Release Technique on Hamstrings; Group B received Core Stabilisation exercises and Muscle Energy Technique on Hamstrings. The intervention was administered 3 sessions per week for 3 weeks on alternate days.

Results: Both groups demonstrated statistically significant improvements in all outcome measures following the three-week intervention ($p < 0.05$). Between-group analysis revealed highly significant differences ($p < 0.001$) in favor of Group B (CSE + MET) for Active Knee Extension Test, MODI scores, and lumbar ROM.

Conclusion: A multimodal physiotherapy approach is effective in managing NSLBP among college students. The combination of Muscle Energy Technique with Core Stabilization Exercises was found to be the most effective intervention, highlighting the importance of incorporating core stability training and MET on hamstrings to improve hamstring tightness, reduce pain, and enhance functional outcomes.

Keywords: Non-specific low back pain, Core stabilisation exercises, Muscle Energy Technique, Positional Release Technique, Hamstring tightness, College Students.

INTRODUCTION

Globally, non-specific low back pain (NSLBP) has emerged as a significant public health concern, with up to 84% of individuals experiencing an episode of low back pain during their lifetime[1]. NSLBP is a musculoskeletal condition characterized by pain localized between the costal margin and the inferior gluteal folds without identifiable pathology such as fracture, infection, tumour, or radiculopathy[2]. In India, low back pain affects approximately 42.4% of young adults, with college students being particularly vulnerable due to lifestyle-related risk factors[3].

Among college students, sedentary behaviour, prolonged sitting, and poor posture contribute to muscular imbalances, including progressive tightness of the hamstring muscles [4]. Hamstring tightness is especially common in university students aged 18–25 years[5]. Biomechanically, tight hamstrings exert a posterior pelvic tilt, flattening lumbar lordosis and increasing mechanical stress on the lumbosacral spine. This altered lumbopelvic rhythm perpetuates pain, restricts mobility, and leads to functional disability[6]. Furthermore, when core stabilizers such as the transversus abdominis and multifidus become weakened, secondary stabilizers like the hamstrings become hyperactive, exacerbating the imbalance and increasing joint loading[7].

Core stabilization exercises (CSE) are widely recognized as an effective intervention for NSLBP. These exercises re-educate deep trunk muscles, improve neuromuscular control, and enhance spinal segmental stability through co-activation of the transversus abdominis and multifidus[8]. However, CSE alone does not directly address peripheral hamstring tightness. Therefore, adjunctive manual techniques targeting hamstring flexibility are often required. Two manual therapy techniques used for hamstring tightness are Positional Release Technique (PRT) and Muscle Energy Technique (MET). PRT is a passive technique in which the muscle is positioned into a shortened, comfortable “position of ease” for approximately 90 seconds, reducing aberrant neuromuscular activity and promoting muscle relaxation[9].

MET is an active technique where the patient performs a gentle isometric contraction against therapist-applied counterforce followed by passive stretching therefore utilizing post-isometric relaxation and reciprocal inhibition to reduce muscle tone and enhance flexibility[10]. Both techniques have demonstrated independent efficacy in improving hamstring flexibility and reducing low back pain but comparative evidence when combined with CSE in college students remains limited[11].

Given that college students with NSLBP frequently present with concurrent hamstring tightness due to prolonged sitting, identifying the optimal manual therapy adjunct to core stabilization is clinically relevant. This study aims to compare the efficacy of PRT and MET both combined with core stabilization exercises, in improving hamstring tightness, reducing pain intensity and enhancing functional outcomes among college students with non-specific low back pain.

MATERIALS & METHODS

Participants and Study Design

This experimental study was designed as randomized controlled trial and involved 80 participants with Non-Specific Low back pain. They were recruited from Outpatient department of the Khalsa University, Amritsar and were also recruited through local clinical settings.

Recruited participants gave their written informed consent before participating in the study. This study was carried out in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Khalsa College, Amritsar. It is registered in Clinical Trial Registry of India, CTRI/2026/01/101288. The sample size was calculated with the help of G* Power (3.1.9.2). The significance level was set as α =0.05, the effect size =0.67 and the power of 0.84.

Eligibility criteria:

Inclusion criteria:

1. Participants were college going students aged between 18-25 years including both male and female.
2. Positive Active knee extension test.
3. No hamstring stretching in last 6 months.

4. Pain intensity more than 4 on Numerical Pain Rating Scale.
5. Mild to moderate functional disability as indicated by Modified Oswestry Disability Index Score.(20 to 60%)
6. Sedentary lifestyle and prolonged sitting due to academic activities on Global Physical Activity Questionnaire (GPAQ) (Total physical activity between <600 to 3000 MET-min/week).

Exclusion criteria

1. Specific low back pain.
2. Recent injuries and Spinal surgeries
3. Pregnancy
4. Limb length discrepancy
5. Any Neurological, Cardiovascular and Metabolic disorder.
6. Acute or chronic hamstring muscle strain
7. Musculoskeletal disorders

Outcome measures included

Numerical Pain Rating Scale:

The Numeric Pain Rating Scale is a tool for assessing pain intensity on 11-point scale (0 = no pain, 10 = worst imaginable pain). It is a unidimensional, self-reported instrument used to measure pain intensity. Participants are asked to rate their current pain by selecting a single integer that best corresponds to their perceived pain intensity [12].

Active Knee Extension Test:

The Active Knee Extension Test (AKET) is a standardized, reliable clinical assessment used to measure hamstring muscle flexibility. The test is performed with the participant positioned in supine lying with the hip and knee of the tested limb flexed to 90°. The contralateral leg remains extended and relaxed on the plinth. The participant is instructed to actively extend the knee as far as possible while the hip and knee is maintained at 90° flexion, without lifting the thigh from the supporting surface. The knee extension angle is measured using a universal goniometer. The Active Knee Extension (AKE) test has demonstrated excellent intra-rater reliability, with intraclass correlation coefficients (ICC) reported between 0.87 and 0.99 and good to excellent inter-rater reliability ranging from 0.81 to 0.96[13].

Modified Oswestry Disability Index (MODI):

The Modified Oswestry Disability Index (MODI) is a standardized, self-administered questionnaire designed to measure functional disability in individuals with low back pain. It consists of 10 sections assessing various activities of daily living: pain intensity, personal care, lifting, walking, sitting, standing, sleeping, social life, travelling, and employment. Each section is scored from 0 to 5, with higher scores indicating greater disability. The total score is expressed as a percentage, where 0% represents no disability and 100% represents maximum disability.

Universal Goniometer:

The universal goniometer is a standard clinical instrument used to measure joint range of motion (ROM) in degrees. It consists of three main components: a stationary arm (fixed arm), and a movable arm (moving arm), both of which are connected at the center axis (fulcrum). In this study, it was used to measure hamstring tightness. With the participant in supine lying and the tested hip flexed to 90°, the goniometer axis was placed over the lateral epicondyle of the femur, the stationary arm aligned toward the greater trochanter, and the movable arm toward the lateral malleolus. The knee extension angle was recorded for both lower extremities at baseline and post-intervention, where a higher angle indicated greater hamstring tightness [14].

METHODOLOGY

80 participants who were recruited after screening, divided randomly (using a lottery system) into 2 groups:

- Group A (Core Stabilization exercises along with Positional Release Technique on Hamstrings) (n=40)

- Group B (Core Stabilization exercises along with Muscle Energy Technique on Hamstrings) (n=40)

Group A:
Core Stabilization exercises along with Positional Release Technique on Hamstrings Total duration of 50 minutes.

Core Stabilization Exercises
Dosage: 3 sets of 15 repetitions with a 10-second hold.
Performed 3 sessions per week for 3 weeks on alternate days.

1. Abdominal Drawing-In Maneuver (ADIM) Supine Lying with Flexed Knees
Positioning of the Patient: The patient was positioned in crook lying (supine lying with hips flexed approximately 45° and knees flexed to 90°, feet flat on the plinth and hip-width apart). The upper limbs were placed comfortably by the side. The lumbar spine was maintained in a neutral position.
Procedure: The patient was instructed to gently draw the lower abdomen inward toward the spine without pelvic movement, rib flaring, or breath holding. Normal breathing was maintained during contraction. Each contraction was held for 10 seconds.

2. Abdominal Drawing-In Maneuver: Standing Position
Positioning of the Patient: The patient was positioned in standing with feet shoulder-width apart, knees slightly relaxed, arms resting by the side, and spine maintained in neutral alignment. Weight was distributed equally on both lower limbs.
Procedure: The patient was instructed to gently draw the abdomen inward without visible trunk movement or breath holding, maintaining spinal neutrality. Each contraction was sustained for 10 seconds while breathing normally.

3. Abdominal Drawing-In Maneuver: Prone Lying
Positioning of the Patient: The patient was positioned in prone lying. Upper limbs were placed comfortably beside the body.
Procedure: The patient was instructed to gently draw the abdomen away from the supporting surface without pelvic tilting or spinal extension. The contraction was maintained for 10 seconds with normal breathing.

4. Quadruped Position – Contralateral Arm and Leg Raising
Positioning of the Patient: The patient was positioned in quadruped (four-point kneeling) with hands placed directly under the shoulders and knees under the hips. The spine was maintained in a neutral position and head aligned with the trunk.
Procedure: The patient was instructed to perform the abdominal drawing-in maneuver. Then, the opposite arm and leg were slowly raised to shoulder and hip level respectively, maintaining trunk stability and avoiding pelvic rotation. The position was held for 10 seconds with controlled breathing before returning to the starting position. Patient was then asked to lower the arm and leg to the starting position and repeat the procedure with the opposite arm and leg.

Positional Release Technique (PRT) for Hamstring Muscles
Dosage: 90-second hold, 3 repetitions, 10 second rest period between repetitions. Total duration approximately 5 minutes per muscle. Performed 3 sessions per week for 3 weeks on alternate days (Monday, Wednesday, Friday)

1. PRT for Semimembranosus
Positioning of the Patient: The patient was positioned in supine lying on the treatment table. The affected lower limb was placed off the edge of the table so that the hip was in extension and slight abduction, and the knee was flexed comfortably.
The tender point for the medial hamstring (semimembranosus) was identified on the posteromedial surface of the tibia.

Procedure: After locating the tender point, the therapist flexed the knee further as required and applied internal rotation of the tibia to achieve a position of maximal comfort (position of ease), reducing tenderness significantly. Once the ideal position was obtained, gentle sustained pressure was applied over the tender point and maintained for 90 seconds while the limb was kept in the shortened position. After completion of 90 seconds, the limb was slowly and passively returned to the neutral position.

2. PRT for Biceps Femoris

Positioning of the Patient: The patient was positioned in supine lying with the affected leg placed off the edge of the table so that the hip was extended and slightly abducted, and the knee was flexed. The tender point for the lateral hamstring (biceps femoris) was located at the tendinous attachment of the biceps femoris on the posterolateral surface of the head of the fibula.

Procedure: After identifying the tender point, the therapist adjusted the limb into further knee flexion as needed. Slight adduction or abduction of the hip was performed to reduce tenderness and obtain a position of comfort. The position of ease was maintained, and sustained pressure was applied over the tender point for 90 seconds. Following the hold period, the limb was slowly and passively returned to the neutral starting position.

Group B- Core stabilization exercises along with Muscle Energy Technique on Hamstrings

Total session duration -38 minutes

Muscle energy technique (MET) on Hamstrings

Dosage: The isometric contraction is held for 7–10 seconds with normal breathing. Upon relaxation and exhalation, the therapist further extends the knee to the new resistance barrier. A gentle stretch is maintained for up to 30 seconds. The procedure is repeated 1–2 times. Duration: Each MET session is of 1 minute 50 second +10 seconds rest interval. 10 second hold with 2 repetitions. 3 sessions per week for 3 weeks. Total MET session time- 8 minutes (4 minutes on each side).

1. MET for Lower (Distal) Hamstrings

Patient Position: The patient lies in supine position. The hip is taken into full flexion. The knee is flexed initially. The non-treated leg remains either flexed or extended depending on hip flexor tightness.

Procedure: The therapist extends the knee until the first resistance barrier is felt. The patient is instructed to gently attempt to bend the knee (knee flexion) against therapist resistance (20–25% effort).

2. MET for Upper (Proximal) Hamstring

Patient Position: The patient lies in supine position. The affected limb is taken into a Straight Leg Raise (SLR) position, with the knee fully extended at all times. The opposite leg remains flexed or straight depending on hip flexor tightness.

Procedure: The therapist raises the straight leg until the first resistance barrier is felt. The patient is instructed to gently attempt to push the leg downward (hip extension effort) against therapist resistance (20–25% effort).

Statistical Analysis

Descriptive statistics, including mean, standard deviation, were calculated for the demographic characteristics. Further, inferential statistics, paired and unpaired t-test, were applied to assess within-group and between-group differences across baseline and after 3 weeks of intervention. The findings are presented in the form of tables followed by a detailed description, comparison, and interpretation of the results. The level of significant (p value) was set as $p \leq 0.05$.

RESULT

Table 1. Descriptive analysis of demographic characteristics among all groups

VARIABLES	GROUP – A (Mean ± SD)	GROUP – B (Mean ± SD)
Age (Years)	21.63 ± 2.24	21.25 ± 2.19
Height (cm)	167.55 ± 5.93	168.73 ± 6.95
Weight (kg)	60.95 ± 7.95	63.80 ± 10.27
BMI (Kg/m^2)	21.67 ± 2.29	22.40 ± 3.32

Table 1. Represents the baseline demographic characteristics of participants in Group A and Group B. Data are expressed as mean ± standard deviation (SD). Independent samples t-tests were conducted to compare the groups. The data is shown with mean ± standard deviation (SD). Independent sample t-tests were performed to determine if there were any statistically significant differences between the two groups. There were no differences between Group A and Group B with respect to age (21.63 ± 2.24 vs. 21.25 ± 2.19 years, t = 0.757, p = 0.451), height (167.55 ± 5.93 vs. 168.73 ± 6.95 cm, t = .814, p = .418), weight (60.95 ± 7.95 vs. 63.80 ± 10.27 kg, t = 1.388, p = 0.169), and body mass index (21.67 ± 2.29 vs. 22.40 ± 3.32 kg/m², t = 1.142, p = 0.257). These findings indicate that the two groups were well-balanced and comparable at baseline for the measured demographic variables.

Table 2. Within-Group Comparison of all the parameters in Group A (Core Stabilisation exercises and positional release technique on hamstrings)

Outcome Measure Group A	Pre Intervention (Mean ± SD)	Post Intervention (Mean ± SD)	p-value
NPRS	5.93 ± 1.02	2.25 ± 0.78	.0001**
Active Knee Extension Test (in degrees) Right	43.55 ±4.74	52.68 ± 6.12	.0001**
Active Knee Extension Test (in degrees) Left	41.60 ± 5.55	50.93 ± 7.58	.0001**
Lumbar flexion	5.38 ± 0.93	7.00 ± 1.18	.0001**
Lumbar Extension	2.00 ± 0.85	2.75 ± 0.90	.0001**
Lateral Lumbar Flexion- Right	24.43 ± 2.01	28.93 ± 2.71	.0001**
Lateral Lumbar Flexion- Left	24.53 ± 2.18	29.20 ± 3.11	.0001**
Modified Oswestry Disability Index (MODI)	24.93 ± 4.30	14.30 ± 2.68	.0001**

Table 2. Demonstrates the results of the within-group comparison (of Group A) of the Numerical Pain Rating Scale (NPRS) scores, Active Knee Extension Test scores at right and left side, Lumbar flexion, extension, lateral flexion and MODI scores before and after the intervention for Group A and statistically significant improvements in all outcome measures following the intervention ($p < 0.001$). Pain intensity decreased (NPRS: 5.93 to 2.25), while muscle flexibility improved bilaterally. Lumbar range of motion improved in flexion, extension and lateral flexion. Functional disability also showed a significant reduction (MODI: 24.93 to 14.30), indicating overall enhancement in clinical and functional outcomes. Statistical analysis using a paired t-test revealed a p-value of 0.0001 indicating a highly significant reduction in pain levels post-intervention ($p < 0.05$).

Table 3 the results of the within-group comparison statistically significant improvements in all outcome measures following the intervention ($p < 0.001$). A significant reduction in pain intensity was observed (NPRS: 5.98 ± 0.95 to 1.85 ± 0.95). Muscle flexibility improved bilaterally, as evidenced by increase in Active Knee Extension Test values (right: 43.25 ± 4.60 to 62.43 ± 5.30; left: 42.08 ± 5.19 to 63.10 ± 6.69). Lumbar range of motion demonstrated significant enhancement in flexion (5.17 ± 1.03 to 7.25 ± 1.30), extension (1.98 ± 0.70 to 3.20 ± 0.91), and lateral flexion bilaterally (right: 23.90 ± 2.28 to 30.85 ± 3.13; left: 24.18 ± 1.75 to 30.93 ± 3.25). Functional disability significantly decreased (MODI: 24.73 ± 4.83 to 11.73±5.43), indicating improved functional capacity and clinical outcomes. Statistical analysis using a paired t-test revealed a p-value of 0.0001 indicating a highly significant reduction in pain levels post-intervention (p < 0.05).

Table 3. Within-Group Comparison of all the parameters in Group B (Core Stabilisation exercises and Muscle Energy Technique on Hamstrings

Outcome Measure Group B	Pre Intervention (Mean ± SD)	Post Intervention (Mean ± SD)	p-value
NPRS	5.98 ± 0.95	1.85 ± 0.95	.0001**
Active Knee Extension Test (in degrees) Right	43.25 ± 4.60	62.43 ± 5.30	.0001**
Active Knee Extension Test (in degrees) Left	42.08 ± 5.19	63.10 ± 6.69	.0001**
Lumbar flexion	5.17 ± 1.03	7.25 ± 1.30	.0001**
Lumbar Extension	1.98 ± 0.70	3.20 ± 0.91	.0001**
Lateral Lumbar Flexion- Right	23.90 ± 2.28	30.85 ± 3.13	.0001**
Lateral Lumbar Flexion- Left	24.18 ± 1.75	30.93 ± 3.25	.0001**
Modified Oswestry Disability Index (MODI)	24.73 ± 4.83	11.73 ± 5.43	.0001**

Table 4. Between-Group Comparison of all the parameters at the baseline

Outcome Measure	Group A Pre Intervention (Mean ± SD)	Group B Pre Intervention (Mean ± SD)	p-value
NPRS	5.93 ± 1.02	5.98 ± 0.95	.888
Active Knee Extension Test (in degrees) Right	43.55 ± 4.74	43.25 ± 4.60	.775
Active Knee Extension Test (in degrees) Left	41.60 ± 5.55	42.08 ± 5.19	.694
Lumbar flexion	5.38 ± 0.93	5.17 ± 1.03	.430
Lumbar Extension	2.00 ± 0.85	1.98 ± 0.70	.894
Lateral Lumbar Flexion- Right	24.43 ± 2.01	23.90 ± 2.28	.279
Lateral Lumbar Flexion- Left	24.53 ± 2.18	24.18 ± 1.75	.432
Modified Oswestry Disability Index (MODI)	24.93 ± 4.30	24.73 ± 4.83	.845

Table 5. Between-Group Comparison of all the parameters after3 weeks of treatment

Outcome Measure	Group A Post Intervention (Mean ± SD)	Group B Post Intervention (Mean ± SD)	p-value
NPRS	2.25 ± 0.78	1.85 ± 0.95	.038*
Active Knee Extension Test (in degrees) Right	52.68 ± 6.12	62.43 ± 5.30	.0001**
Active Knee Extension Test (in degrees) Left	50.93 ± 7.58	63.10 ± 6.69	.0001**
Lumbar flexion	7.00 ± 1.18	7.25 ± 1.30	.412
Lumbar Extension	2.75 ± 0.90	3.20 ± 0.91	.045*
Lateral Lumbar Flexion- Right	28.93± 2.71	30.85 ± 3.13	.004*
Lateral Lumbar Flexion- Left	29.20 ± 3.11	30.93 ± 3.25	.018*
Modified Oswestry Disability Index (MODI)	14.30 ± 2.68	11.73 ± 5.43	.009*

Table 4 represents the baseline comparison of outcome measures between Group A and Group B included NPRS score, Active Knee Extension Test score for right and left side, Lumbar range of motion including flexion, extension, right and left lateral flexion and MODI score among participants in Group A and Group B prior to the intervention. No statistically significant differences were observed between the groups across all variables (p>0.05), Both groups demonstrated comparable values in pain intensity (NPRS: 5.93 ± 1.02 vs 5.98 ±0.95 , muscle flexibility (Active Knee Extension

Test—right: 43.55± 4.74 vs 43.25 ± 4.60; left: 41.60 ± 5.55 vs 42.08 ± 5.19), Lumbar range of motion, including flexion, extension, and bilateral lateral flexion, was also comparable between groups. Functional disability scores (MODI: 24.93 ± 4.30 vs 24.73 ± 4.83) showed no significant difference.

Table 5 represents the post-intervention comparison of outcome measure NPRS score, Active Knee Extension test score for right and left side, Lumbar range of motion including flexion, extension, right and left lateral flexion and MODI score among participants in Group A and Group B after the intervention, statistical analysis revealed a significant between-group difference across all variables ($p < 0.05$), except lumbar flexion indicating differential treatment effects. Group B demonstrated lower pain intensity (NPRS: 5.98 ± 0.95 vs 1.85 ± 0.95) and greater improvement in muscle flexibility, as evidenced by reduced Active Knee Extension Test values. Lumbar range of motion parameters, including flexion, extension, and bilateral lateral flexion, were comparatively greater in group B. Additionally, functional disability scores were lower in Group B (MODI): 24.73 ± 4.83 vs 11.73 ±5.43), indicating superior functional outcomes. The difference between the two groups was statistically significant ($p<0.05$).

DISCUSSION

The present study compared the effectiveness of Core Stabilization Exercises (CSE) combined with Positional Release Technique (PRT) versus CSE combined with Muscle Energy Technique (MET) on hamstring tightness, pain intensity, functional disability, and lumbar range of motion in college students with non-specific low back pain (NSLBP). Both interventions produced significant improvements; however, the CSE+MET group (Group B) showed statistically superior results across all outcome measures.

Pain reduction observed in both groups can be attributed to enhanced activation and coordination of deep core stabilizers, particularly the transversus abdominis and multifidus. These muscles increase intra-abdominal pressure, reducing mechanical load on spinal structures[1]. Core stabilization exercises improve neuromuscular control and segmental stability, thereby decreasing nociceptive input and pain perception[8]. Our findings align with study who reported significant pain reduction following core stabilization training in NSLBP. Retraining of transversus abdominis and multifidus likely increases muscle spindle and joint receptor activity, improving sensorimotor integration and joint repositioning[15]. CSE reduces pain and improves proprioception in subacute NSLBP, and Selkow et al. confirmed that core stability training enhances transversus abdominis timing and activation, crucial for spinal support[16–18].

Improvement in hamstring tightness highlights its role in NSLBP persistence. Tight hamstrings cause posterior pelvic tilt, altered lumbopelvic rhythm, and increased lumbar stress. PRT improves flexibility by placing the muscle in a shortened “position of ease” for 90 seconds, reducing abnormal muscle spindle activity and gamma motor neuron firing, thereby decreasing reflex muscle guarding and restoring normal length .MET, conversely, utilizes post-isometric relaxation and reciprocal inhibition. Isometric contraction activates Golgi tendon organs, sending inhibitory signals that reduce alpha motor neuron activity, allowing greater stretch. Sustained stretching after contraction induces viscoelastic changes in the muscle-tendon unit The superior effect of MET in our study may reflect its active, patient-engaged nature, which produces greater immediate and retained flexibility gains[18].

Functional disability improved in both groups due to the combined effect of reduced pain, increased hamstring flexibility, and enhanced core stability. As pain diminishes and movement becomes easier, daily activities are performed with less discomfort. Core stabilization exercises improve trunk endurance and postural control, essential for functional tasks.

Lumbar range of motion also increased in both groups, attributable to reduced hamstring tightness and improved pelvic mobility. PRT contributes passive muscle relaxation, while MET enhances active mobility through neuromuscular facilitation. Together with CSE, these mechanisms restore proper muscle activation patterns, improve spinal alignment, and optimize load distribution across the lumbar spine.

In conclusion, both multimodal approaches are effective, but CSE combined with MET produced statistically greater improvements in all outcomes. Early intervention with targeted exercise and manual therapy may prevent progression to chronic low back pain and improve quality of life.

CONCLUSION

The present study concluded that both intervention protocols were Core Stabilization Exercises combined with Positional Release Technique (Group A) and Core Stabilization Exercises combined with Muscle Energy Technique (Group B) were effective in reducing pain intensity, improving functional disability, decreasing hamstring muscle tightness, and enhancing lumbar range of motion in college-going students with non-specific low back pain. However, Group B demonstrated statistically significant greater improvement across all outcome measures compared to Group A, indicating that Muscle Energy Technique is more effective than Positional Release Technique when combined with core stabilization exercises for managing non-specific low back pain associated with hamstring tightness.

Therefore, early intervention using a combination of core stabilization exercises and Muscle Energy Technique on hamstring muscles is recommended as an effective rehabilitation strategy to prevent progression to chronic low back pain and improve overall quality of life in college students

Declaration by Authors

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