International Journal of Research in Medical Sciences
Pragassame SA et al. Int J Res Med Sci. 2026 Sep;14(9):3912-3918
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20263105

Original Research Article

Effectiveness of Mulligan bent leg raise and instrument-assisted soft tissue mobilization techniques on hamstring flexibility and functional disability in non-specific low back pain: a randomized controlled trial

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Received: 24 June 2026
Accepted: 10 August 2026

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ABSTRACT

Background: Non-specific low back pain or NSLBP, a musculoskeletal condition that results in pain, decreased flexibility, and functional impairment, is commonly associated with hamstring tightness. Manual therapy techniques like Mulligan Bent Leg Raise (BLR) and IASTM, or Instrument-Assisted Soft Tissue Mobilization are frequently used to improve hamstring flexibility and alleviate discomfort. However, there isn't much information comparing their effectiveness in individuals with NSLBP.
Methods: A randomized comparison study was conducted with forty male volunteers, ages 18 to 40, who had tight hamstrings with NSLBP. Each of the two randomly allocated groups, Group A (Mulligan BLR) and Group B (IASTM), had 20 participants. Interventions were administered three times a week for two weeks. The outcomes were evaluated using the Numerical Pain Rating Scale (NPRS), the Quebec Back Pain Disability Scale (QBPDS), and Active Knee Extension Test (AKET).
Results: Both groups' functional impairment, hamstring flexibility, and pain significantly improved after treatment (p=0.001). Between-group analysis revealed that the Mulligan BLR group had better reductions in NPRS scores (mean difference=2.00), better improvements in left and right AKET scores (mean differences=10.45° and 10.55°, respectively), and a greater reduction in QBPDS scores (mean difference=12.90) (p=0.001).
Conclusions: Both Mulligan BLR and IASTM were effective in reducing pain, improving hamstring flexibility, and reducing functional impairment. However, Mulligan BLR demonstrated significantly better outcomes on all end measures and may be a more effective treatment for hamstring tightness associated with NSLBP.

Keywords: Functional disability, Hamstring tightness, Instrument-assisted soft tissue mobilization, Non-specific low back pain, Mulligan bent leg raise

INTRODUCTION

Muscle flexibility is one of the most important aspects of normal human function. Reduced muscle flexibility is a common problem that impacts both healthy individuals and a variety of patients. One muscle group that has a tendency to shorten is the hamstring muscle. Hamstring tightness is one risk factor for low back pain. Limited

flexibility is a major risk factor for low back pain. The term "low back pain" refers to pain and discomfort that is localized above the inferior gluteal folds and below the costal border, either with or without leg pain.[1] The symptoms of chronic nonspecific low back pain include pain, limited mobility, and impairment that persists for at least 12 weeks.[2] A decrease in a muscle's capacity to deform is referred to as loss of flexibility.[3] Flexibility is the ability to move one or more joints over an infinite, pain-free range of motion. Maintaining flexibility is essential to any conditioning program in order to improve performance, increase mobility, and prevent injuries. A relatively new development in the management of hamstring tightness is BLR, a Mulligan stretching technique. The painless and beneficial Straight Leg Raise (SLR) technique is recommended for hamstring strain. Patients with low back issues who have limited or painful SLR may also benefit from it.[4] It is believed that the length of muscle tissue is crucial to the effectiveness and efficiency of human movement. For biomechanical functioning to be proper, flexibility is a necessary component.[5]

The Mulligan bent leg raise increases hamstring flexibility and active knee extension range of motion without producing pain by progressively increasing hip flexion and stretching the hamstrings.[6] Muscular flexibility is a physiological term for joint excursion along its range of motion, incorporating contributions from both joint and soft tissue components, whereas tightness is the decreased ability of a muscle to expand from its neutral position. Since hamstring strain or injury can arise from decreased hamstring flexibility, encouraging hamstring stretching is essential to preventing musculoskeletal problems. The Mulligan Bent Leg Raise (BLR) technique is used to improve hamstring flexibility in those with tight hamstrings and to increase the range of straight leg raise in those with low back pain or referred thigh discomfort. Using this technique, the hamstring muscles are contracted isometrically at different knee flexion angles within pain-free ranges.[7,8]

Round 60-85% of people will experience low back discomfort in their lifetime. Low back pain may be exacerbated by decreased hamstring flexibility, which also decreases pelvic mobility. Low back discomfort may result from any tightness or sudden functioning of the hamstring due to its strong attachment to the sacrotuberous ligament.[9] While shortened or tight hamstring muscles negatively impact spinal mechanics, hamstring flexibility offers a functional mechanical benefit. Patients with hamstring tightness, low back pain, and restricted straight leg raise can benefit from BLR technique, which is painless.[10] A common musculoskeletal ailment that contributes significantly to disability globally is LBP, or low back pain. Changes in lumbopelvic mechanics and lower back pain have been linked to decreased flexibility of the surrounding muscles, particularly the hamstrings. To enhance pain, flexibility, and functional outcomes, a variety of conservative treatment modalities are commonly employed, including manual therapy techniques like Mulligan techniques and Instrument Assisted Soft Tissue Mobilization (IASTM).[11] Tight hamstrings and weak core muscles can limit pelvic movement, which can lead to changes in lumbar pelvic rhythm. These changes in biomechanics could increase lumbar strain, which could lead to the development or exacerbation of LBP.[12]

To improve function, hamstring flexibility must be increased. In recent years, muscular flexibility has been increased by the use of Instrument Assisted Soft Tissue Mobilization (IASTM). IASTM has been shown to produce notable results and adhere to a particular treatment plan when paired with exercise therapy.[13] In the general population, low back pain is one common musculoskeletal problem. Pain, functional impairment, and lumbar range have all been shown to improve with IASTM for people with chronic low back pain.[14] Using skilled hands-on movements, manual therapy aims to increase range of motion, encourage tissue flexibility, and reduce pain. It is one of the most widely used therapy methods for musculoskeletal conditions, including low back pain. To restore normal joint movement, a particular manual therapy technique called Mobilization with movement was created by Mulligan. Active and/or passive physiological motions are combined with a pain-free accessory mobilization in this treatment approach, and all Mulligan procedures must produce symptom-free movement.[15] Using a method known as instrument-assisted soft tissue mobilization (IASTM), clinicians can successfully diagnose and treat patients with soft tissue dysfunction.[16,19] The use of IASTM is believed to encourage connective tissue remodeling by resorbing excessive fibrosis and attracting fibroblasts to induce collagen repair and regeneration.[17] IASTM is widely used in clinical practice despite continuous study on its exact physiological principles.[18]

Hamstring flexibility is important because reduced extensibility has been associated with changes in lumbopelvic rhythm and non-specific low back pain. IASTM improves range of motion and mobilizes soft tissue. The BLR technique has been demonstrated to increase hamstring flexibility, although there is little data to compare it with IASTM.[20-22] Several studies show that IASTM can improve function and lessen discomfort in both acute and chronic musculoskeletal ailments.[23] Although both BLR and IASTM have been demonstrated to improve hamstring flexibility and reduce symptoms associated with musculoskeletal dysfunction, there is little information directly comparing their effectiveness for individuals with non-specific low back pain and hamstring tightness. Furthermore, the effects of these techniques on hamstring flexibility, pain intensity, and functional impairment are still unknown. Therefore, the aim of this study was to examine the effects of BLR and IASTM on pain, hamstring flexibility, and functional impairment in people with hamstring tightness and non-specific low back pain.

METHODS

This study used a randomized parallel-group comparative trial with a 1:1 allocation ratio and was carried out at the Department of Physiotherapy, Government Cuddalore Medical College and Hospital, Chidambaram, on participants who had non-specific low back pain (NSLBP) and hamstring tightness. A total of 40 male participants aged 18 to 40 were recruited using simple random sampling with predetermined inclusion and exclusion criteria. Participants were recruited between June 2025 to December 2025. The study terminated when the targeted sample size and follow-up period were attained. Participants with NSLBP and hamstring tightness confirmed by an Active Knee Extension Test (AKET) knee extension lag of more than 20° were included in the study. Individuals who had low back pain caused by trauma or particular spinal pathology, a history of spinal surgery, radiating pain, neurological impairments or contraindications to manual therapy were excluded. The Institutional Ethics Committee provided ethical approval and each subjects provided written informed consent prior to participation. After the study began, there were no major changes made to the methodology, interventions, outcome measures, or statistical analysis. All procedures were performed by certified physiotherapists who had received training in the relevant therapeutic techniques. Patients or the general public were not involved in the design, execution, reporting, or distribution of this study.

Forty participants were randomly allocated into two groups of twenty each. The random allocation sequence was generated using a simple randomization technique. Simple randomization was used without stratification or blocking. Sealed opaque envelopes were used to conceal allocation assignments until group assignment. Participant enrollment and intervention assignment were completed by an investigator who was not involved in outcome evaluation. Neither stopping guidelines nor interim analyses were planned during the study. Group A underwent the Mulligan Bent Leg Raise (BLR) technique, while Group B received Instrument-Assisted Soft Tissue Mobilisation. Both groups also received conventional physiotherapy, which included 15-20 minutes of wax therapy applied to the lumbar and posterior thigh regions, as well as static hamstring stretching (3 repetitions with a 30-second hold). The intervention was delivered over two weeks, with three sessions per week, for a total of six therapy sessions.

Group A: BLR technique

Participants in the Group A BLR technique were placed in a supine position close to the edge of the treatment couch with their knees and hips extended at a 90-degree angle. Grasping the distal thigh with both hands, the therapist positioned the inner shoulder beneath the participant's popliteal fossa while standing on the affected side. After applying longitudinal tension along the femur's long axis, the hip was gradually pushed into flexion until resistance or discomfort was felt. Participants were instructed to push against the therapist's shoulder for five seconds in order to execute a mild isometric contraction at the site of restriction. The therapist-maintained traction while increasing hip flexion after relaxation. To accomplish a pain-free movement, minor modifications in hip abduction, external rotation or extra traction were used if discomfort continued. The procedure was performed three to five times per session on each leg while the final position was held for twenty seconds.

Group B: IASTM

Participants in the Group B IASTM were placed in a prone position with their posterior thighs exposed. During therapy, a thin layer of aqua gel or Vaseline was applied to the hamstring area to minimise skin irritation and eliminate friction. To put the hamstring muscles in a relaxed condition, the knee was kept between 25° and 45° of flexion. Light to moderate pressure was given over the hamstring muscle belly while the IASTM tool was held at a 45° angle to the skin's surface. To alleviate soft tissue restrictions and enhance tissue mobility, continuous linear and sweeping strokes were applied over the length of the hamstring musculature. The affected limb received treatment for five to eight minutes each session. No adverse effects were reported throughout the intervention.

Both groups underwent conventional physiotherapy, which included static hamstring stretching and wax therapy. The individual was placed in a prone position while wax therapy was administered to the lumbar area and posterior thigh. The therapy was given for 15 to 20 minutes each session and the wax was kept between 40 and 45 degrees Celsius. Static hamstring stretching was done after wax therapy. With one foot of the limb to be stretched on a chair or plinth and the other foot on the ground, participants stood upright. The knee was kept fully extended and the elevated limb's toes were pointed toward the ceiling. In order to achieve a mild stretch in the posterior area of the thigh, participants were told to flex forward at the hip while keeping their spines neutral and extending their arms forward. For every session, the stretch was performed three times while being held for thirty seconds.

The primary outcomes of the study were pain intensity as determined by the Numerical Pain Rating Scale (NPRS) and hamstring flexibility as determined by the Active Knee Extension Test (AKET). A secondary outcome was functional disability as determined by the Quebec Back Pain Disability Scale (QBPDS). The outcome evaluation was completed by an independent, blinded assessor. Assessment was performed at the baseline and at the end of the 2 weeks of the intervention period.

Data analysis was performed using SPSS version 21.0. Descriptive data were expressed using mean±standard deviation. Within-group comparisons were performed using paired sample t-tests, while between-group

comparisons were performed using independent sample t-tests. A p value of less than 0.05 was considered to be statistically significant. After the study was completed, every randomized participant was taken into account for the final analysis. No sensitivity or subgroup analyses were carried out.

RESULTS

Forty men with non-specific low back pain participated in the trial. No adverse events or treatment-related issues were recorded during the study. The average age of the participants was 30.20±5.32. Age differences between Group A (BLR) and Group B (IASTM) were not statistically significant, indicating baseline comparability as shown in (Table 1). The study's participant flow is shown in Figure 1.

Within-group analysis revealed that both groups significantly improved hamstring flexibility, pain intensity, and functional impairment after therapy as shown in (Table 2 and Figure 2). The Numerical Pain Rating Scale (NPRS) scores of both groups significantly decreased after the intervention (p=0.001). Similar improvements in hamstring flexibility were found on both the left and right sides of the Active Knee Extension Test (AKET) (p=0.001). Following treatment, both groups showed a considerable improvement on the Quebec back pain handicap scale, which gauges functional handicap (p=0.001).

Table 1: Baseline comparison of age between groups (Mean±SD).

Variable	Group A[a]	Group B[b]	P value
Age	30.70±5.29	29.70±5.35	0.556

[a]Mulligan Bent Leg Raise (BLR) group; [b]Instrument-Assisted Soft Tissue Mobilization (IASTM) group

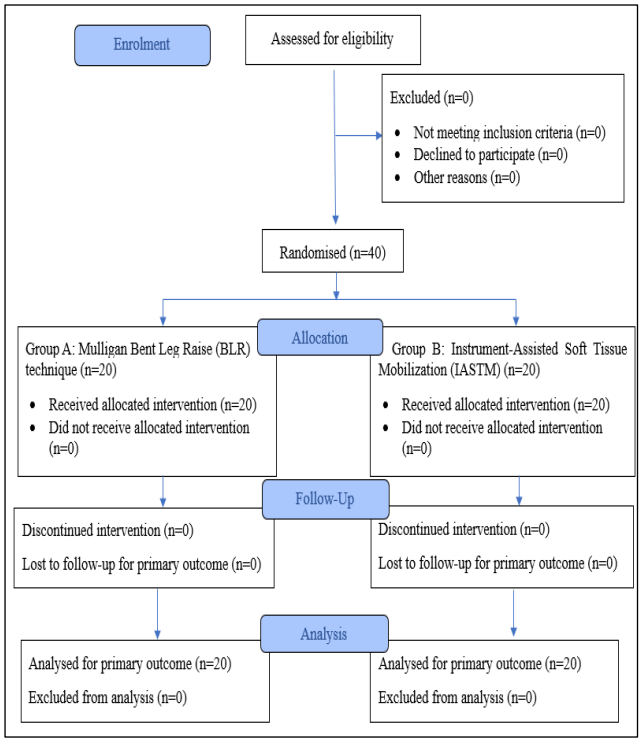

Figure 1: CONSORT participant flow diagram.

Table 2: Within-group comparison of outcome measures before and after intervention (Mean±SD).

Outcome	Group	Pre		Post		Mean difference		P value
		Mean	SD	Mean	SD	Mean	SD	
NPRS[a]	A	6.65	1.22	1.95	0.76	4.70	0.86	0.001
	B	6.80	0.77	4.10	0.55	2.70	0.47	0.001
AKET[b] left	A	61.65	3.42	29.35	1.78	32.30	3.61	0.001
	B	60.93	3.42	39.05	2.96	21.85	3.51	0.001
AKET[b] right	A	61.25	2.86	29.00	1.78	32.25	3.91	0.001
	B	60.75	3.04	39.05	2.06	21.70	3.11	0.001
QUEBEC[c]	A	50.50	4.48	23.35	2.56	27.15	4.94	0.001
	B	53.65	4.68	39.40	3.44	14.25	4.15	0.001

[a]Numerical Pain Rating Scale; [b]Active Knee Extension Test; [c]Quebec Back Pain Disability Scale

Table 3: Between group comparison of outcomes measures following intervention.

Outcome	Mean difference	P value
NPRS[a]	2.00	0.001
AKET[b] left	10.45	0.001
AKET[b] right	10.55	0.001
QUEBEC[c]	12.90	0.001

[a]Numerical Pain Rating Scale; [b]Active Knee Extension Test; [c]Quebec Back Pain Disability Scale

Between-group comparison revealed that Group A significantly outperformed Group B on all outcome measures as shown in (Table 3 and Figure 3). Group A demonstrated a much greater reduction in pain intensity, with a mean difference of 2.00 points on the NPRS (p=0.001). Additionally, Group A had significantly greater gains in hamstring flexibility, with mean differences for left and right AKET of 10.45° and 10.55°, respectively (p=0.001). Furthermore, Group A showed a much greater decrease in functional disability, with a mean difference of

12.90 points on the Quebec back pain disability scale (p=0.001). These findings demonstrate that both interventions were effective in reducing pain, increasing hamstring flexibility, and decreasing functional disability in individuals with non-specific low back pain; however, the Mulligan bent leg raise technique produced significantly better results than instrument-assisted soft tissue mobilization.

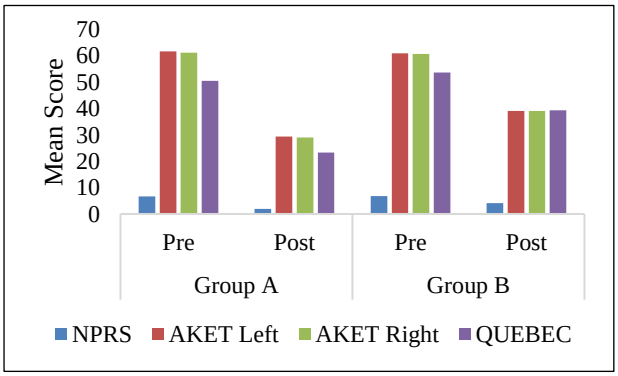

Figure 2: Pre and post test comparison of outcome measures in Group A and Group B.

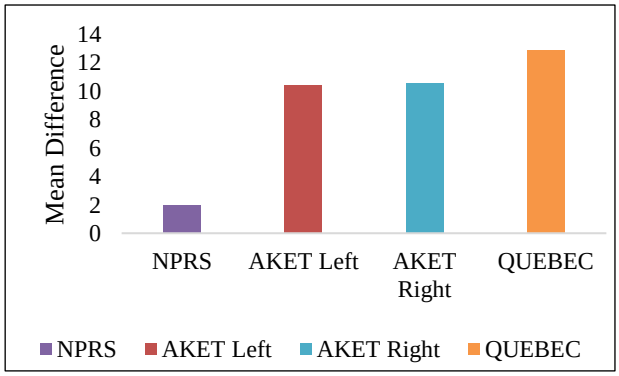

Figure 3: Between group comparison of mean difference in outcome measures following intervention.

DISCUSSION

This randomised trial examined the effects of Mulligan bent leg raise and instrument assisted soft tissue mobilisation techniques on hamstring flexibility, pain severity and functional impairment in participants with non-specific low back pain. Both therapies significantly improved hamstring flexibility, decreased discomfort and improved functional outcomes after therapy ($p<0.001$). The Mulligan BLR group showed significant improvements in pain intensity (NPRS), hamstring flexibility (AKET) and functional disability (Quebec Back Pain Disability Scale) compared to the IASTM group ($p<0.001$). These data imply that while both therapies are helpful in treating non-specific low back pain caused by hamstring tightness, Mulligan BLR may provide more clinical advantages in terms of flexibility, pain reduction and functional capacity.

The considerable increase in hamstring flexibility seen in the current study may have contributed to improved lumbopelvic mobility and reduced mechanical load on the lumbar spine. Esola et al (1996) published similar findings, demonstrating that hamstring flexibility effects hip and lumbar spine motion coordination during forward bending in low back pain patients.[24] As a result, the improvement in active knee extension test scores seen in the current study could have contributed to pain relief and improved functional performance. The current study's significant improvement in hamstring flexibility may have contributed to a reduction in pain and functional disability in people with non-specific low back pain.

The present study's IASTM group showed an improvement in hamstring flexibility which is corroborated by the findings of Erol and Bulut (2024), who evaluated the effects of instrument-assisted soft tissue mobilisation on hamstring flexibility through the fascia. Although their study found no substantial advantage of a single IASTM session over the control condition, there were gains in flexibility after the intervention.[25] These data indicate that IASTM may help to improve hamstring extensibility and support its usage as a flexibility intervention.

The improvement in hamstring flexibility seen in the current study is consistent with the findings of Subramanian and Shenbaga (2020), who found a significant increase in hamstring flexibility in futsal players after using muscle energy technique. The authors' active knee extension test scores improved following the intervention, demonstrating the usefulness of manual approaches in increasing hamstring extensibility.[26] The current study's findings are congruent with those of Sorathiya et al (2024), who found significant increases in hamstring flexibility after both muscle energy technique and instrument-assisted soft tissue mobilisation therapies. The authors concluded that both treatments improved hamstring extensibility in subjects with hamstring tightness.[27]

The considerable improvement in functional impairment observed in the current study can be attributable to pain relief and increased hamstring flexibility following both therapies. Improved hamstring extensibility can relieve excessive mechanical stress on the lumbo pelvic region, allowing for more efficient movement patterns during daily tasks and reducing disability caused by non-specific low back pain. Furthermore, participants in the Mulligan BLR group showed better improvement in Quebec Back Pain Disability Scale scores than in the IASTM group, indicating stronger functional recovery. These findings are clinically relevant, as Demoulin et al found that the Quebec back pain disability scale is a responsive and interpretable outcome measure capable of detecting significant changes in functional status among people with chronic low back pain after rehabilitation interventions.[28] As a result, the decrease in Quebec disability scores found in the current study suggests a significant improvement in

patient's functional capacities and general quality of movement.

The reduction in pain and functional disability shown in the current study is clinically noteworthy, given the enormous burden associated with low back pain. Andersson stated that chronic low back pain is a prevalent musculoskeletal ailment that contributes significantly to disability and activity restrictions.[29] As a result, the present study's reduction in pain and disability scores may contribute to improved functional performance and quality of life in those with non-specific low back pain. Despite the positive outcomes, there are some restrictions to be aware of. The results may not be as broadly applicable as they could be due to the tiny sample size. Furthermore, the long-term benefits of Mulligan BLR and IASTM procedures are yet unknown because only short-term findings were looked at. Furthermore, the results may not be as applicable to other lumbar disorders because the study only included individuals with non-specific low back pain. Future research should employ bigger sample numbers and longer follow-up periods to determine the longevity of treatment benefits. To improve the body of evidence supporting therapeutic practice, more research is advised to examine the efficacy of these therapies in a range of patient demographics and lumbar diseases.

CONCLUSION

Both BLR and IASTM were effective in reducing pain, improving hamstring flexibility, and lessening functional impairment in individuals with non-specific low back pain. However, Mulligan BLR demonstrated significantly greater increases in all outcome metrics when compared to IASTM. These findings suggest that for people with non-specific low back pain, Mulligan BLR may be a more effective treatment for hamstring tightness and associated functional deficits. Larger sample sizes and long-term monitoring are required for further study to confirm these findings.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Sivaraman AP, Krishnaraj BM, Subash P, Manshi N, Sreekumaran A, Srinivasan V. Effectiveness of Mulligan bent leg raise and instrument-assisted soft tissue mobilization techniques on hamstring flexibility and functional disability in non-specific low back pain: a randomized controlled trial. Int J Res Med Sci 2026;14:3912-8.