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TARGETING THE POSTERIOR KINETIC CHAIN: COMPARATIVE EFFECT OF NEURODYNAMIC SLIDING TECHNIQUE VERSUS KINETIC CHAIN ACTIVATION TECHNIQUE, BOTH COMBINED WITH THORACIC MOBILITY EXERCISES, IN RECEPTIONISTS WITH HAMSTRING TIGHTNESS: A RANDOMISED CONTROL TRIAL

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ABSTRACT

Background: Hamstring tightness is common among individuals with prolonged sitting occupations, particularly receptionists, and may impair flexibility and lower-extremity function. Neurodynamic Sliding Technique (NST) and Kinetic Chain Activation Technique (KCAT), combined with Thoracic Mobility Exercises (TME), are used to improve posterior kinetic chain mobility; however, comparative evidence is limited.

Objective: To compare the effectiveness of NST and KCAT, both combined with TME, on hamstring flexibility and lower-extremity function in receptionists with hamstring tightness.

Methodology: Thirty receptionists aged 20–45 years with an Active Knee Extension Test (AKET) deficit ≥20° were randomly allocated into two groups (n = 15 each). Group A received NST with TME, and Group B received KCAT with TME, three sessions per week for four weeks. Outcome measures were AKET and the Lower Extremity Functional Scale (LEFS). Data were analyzed using paired and independent t-tests with $p < 0.05$.

Results: Both groups showed significant improvements in AKET and LEFS scores after intervention ($p < 0.001$). Group A demonstrated greater improvement in hamstring flexibility (19.47 ± 1.25° vs. 10.87 ± 1.18°) and LEFS scores (18.60 ± 1.30 vs. 11.27 ± 1.25 points) compared with Group B ($p<0.001$).

Conclusion: Both interventions were effective; however, NST combined with TME was significantly more effective than KCAT combined with TME in improving hamstring flexibility and lower-extremity function in receptionists with hamstring tightness.

Keywords: Neurodynamic Sliding Technique, Kinetic Chain Activation Technique, Thoracic Mobility Exercises, Hamstring Tightness, Active Knee Extension Test, Lower Extremity Functional Scale

INTRODUCTION

The human body functions as an integrated kinetic chain in which movement is produced through the coordinated interaction of muscles, fascia, joints, ligaments, and the nervous system rather than by isolated muscle activity **[1]**. Efficient movement depends on synchronized force transfer throughout this interconnected system, and dysfunction in one segment may influence adjacent or distant regions through the principle of regional interdependence, thereby increasing the risk of musculoskeletal disorders **[2]**.

The posterior kinetic chain includes the plantar fascia, gastrocnemius-soleus complex, hamstrings, gluteal muscles, thoracolumbar fascia, erector spinae, and cervical extensor muscles **[3]**. These structures collectively contribute to postural alignment, dynamic stability, force transmission, and functional activities such as standing, walking, running, bending, and lifting. Impairment in any component of this chain may alter normal biomechanics and increase mechanical stress on surrounding structures **[4]**.

Among these structures, the hamstring muscle group plays a crucial role in lower-extremity biomechanics because it crosses both the hip and knee joints. The hamstrings contribute to hip extension, knee flexion, pelvic stabilization, deceleration of knee extension during gait, shock absorption, and efficient transfer of forces between the trunk and lower limbs. Adequate hamstring flexibility is essential for maintaining normal lumbopelvic rhythm, optimal lower-extremity alignment, and efficient movement patterns, whereas reduced flexibility may increase lumbar mechanical stress and predispose individuals to musculoskeletal dysfunction **[3, 4]**.

Hamstring tightness refers to a reduction in the extensibility of the hamstring musculotendinous unit, resulting in decreased range of motion and increased

passive resistance during elongation. It is a common musculoskeletal impairment observed in both active and sedentary populations. Prolonged sitting, repetitive static postures, reduced physical activity, fascial stiffness, altered neural mechanosensitivity, and repetitive occupational loading have all been identified as contributing factors **[5]**.

Sedentary occupations have increased substantially with the widespread use of computer-based workstations. Prolonged sitting has been associated with reduced hamstring extensibility, decreased spinal mobility, and increased risk of lumbar and lower-extremity discomfort. Receptionists are particularly vulnerable because their work typically involves prolonged sitting, continuous computer use, repetitive reaching, and maintenance of static postures for several hours each day, which may contribute to posterior kinetic chain dysfunction and progressive hamstring tightness **[5, 6]**.

Conventional management of hamstring tightness has primarily focused on stretching interventions; however, increasing evidence suggests that restricted neural mobility may also contribute to limited hamstring extensibility. Neurodynamic techniques are based on the principle that peripheral nerves require adequate mobility relative to their surrounding mechanical interfaces for normal physiological movement. Impaired neural excursion may increase mechano-sensitivity and restrict movement even in the absence of overt neurological pathology **[7]**.

Neurodynamic Sliding Technique (NST) restores physiological movement of the sciatic nerve by simultaneously lengthening the nerve bed at one joint while shortening it at another, thereby promoting neural excursion with minimal tensile stress. This mechanism is proposed to improve axoplasmic flow, intraneural circulation, and neural mobility while reducing neural mechanosensitivity. Recent systematic reviews and meta-analyses have reported significant immediate and short-term improvements in hamstring flexibility following neurodynamic interventions, particularly sliding techniques **[7]**.

Kinetic Chain Activation Technique (KCAT) is based on the concept that coordinated neuromuscular activation and fascial mobility are essential for efficient force transmission throughout the kinetic chain. The technique aims to reduce fascial tension, improve tissue mobility, and enhance posterior chain coordination, thereby increasing hamstring flexibility and movement efficiency **[8]**.

Thoracic spine mobility also plays an important role in spinal alignment, trunk rotation, rib cage mechanics, and lumbopelvic movement. Thoracic mobility

exercises are widely used in physiotherapy to improve spinal mobility, optimize posture, and enhance overall kinetic chain function. When combined with interventions targeting neural mobility or muscular activation, these exercises may further improve movement efficiency and reduce compensatory stress across the lumbar spine and lower extremities **[9]**.

Although previous studies have demonstrated beneficial effects of neurodynamic mobilization, stretching, myofascial release, and other physiotherapy interventions for hamstring flexibility, most investigations have been conducted in healthy young adults, university students, or athletic populations **[10]**. Evidence involving sedentary occupational groups, particularly receptionists exposed to prolonged sitting and static postures, remains limited. Furthermore, no study has directly compared Neurodynamic Sliding Technique and Kinetic Chain Activation Technique when both interventions are combined with Thoracic Mobility Exercises in receptionists with hamstring tightness.

Therefore, the present study aims to compare the effectiveness of Neurodynamic Sliding Technique versus Kinetic Chain Activation Technique, both combined with Thoracic Mobility Exercises, on hamstring flexibility and lower-extremity functional status in receptionists with hamstring tightness.

Objectives of the study:-

- To assess the impact of Neurodynamic Sliding Technique combined with Thoracic Mobility Exercises on hamstring flexibility using the Active Knee Extension Test (AKET).
- To assess the impact of Kinetic Chain Activation Technique combined with Thoracic Mobility Exercises on hamstring flexibility using the Active Knee Extension Test (AKET).
- To determine improvements in lower-extremity functional status using the Lower Extremity Functional Scale (LEFS) pre- and post-intervention.
- To compare the effectiveness of Neurodynamic Sliding Technique versus Kinetic Chain Activation Technique, both combined with Thoracic Mobility Exercises, on hamstring flexibility and lower-extremity function in receptionists with hamstring tightness.

METHODS

- **Study design:** Comparative study.
- **Study type:** RCT.
- **Sample size:** 30 Receptionists
- **Study population:** Male and Female receptionists aged 20 to 45 years
- **Study setting:** Reception sections of different clinical departments of

Sainath Hospital, including the Physiotherapy and Homeopathy departments.

- Sampling technique: Convenience sampling.
- Intervention frequency and duration: 3 sessions per week for 4 weeks (12 sessions), Each treatment session lasted approximately **30–40 minutes**.
- **Inclusion Criteria:-**

Both male and female receptionists aged 20–45 years **[3]**. Working as a receptionist for ≥6 months and spending ≥6 hours/day, ≥5 days/week in sitting work **[5]**. **Hamstring-tightness:** B/L Active Knee Extension (AKE) deficit ≥20° **[4]**. Mild to moderate non-specific posterior thigh, gluteal, lumbar, or lower limb discomfort **[3]**. Willing to participate and provide written informed consent

- **Exclusion Criteria:-**

Previous hamstring strain or injury (within the last year) **[3]**. History of lumbar disc herniation/radiculopathy or neurological disorders **[3]**. Orthopaedic disorders affecting the spine or lower limb. [3] Current low back pain (within the previous 6 months) **[3]**. Rheumatoid arthritis or other inflammatory/systemic musculoskeletal diseases **[4]**.

History of fracture or lower-limb surgery **[3]**. Regular lower-limb stretching programme or ongoing physiotherapy **[3]**. BMI outside 20–30 kg/m² **[3]**.

- **Outcome Measures:-**

1. Active Knee Extension Test (AKET)

The Active Knee Extension Test (AKET) was used as the primary objective outcome measure to assess hamstring flexibility. Participants were positioned in supine lying with the hip flexed to 90° and the opposite limb extended. They were instructed to actively extend the knee without pelvic compensation. The remaining knee flexion angle was measured using a universal goniometer and recorded as the AKET deficit. A higher deficit indicates greater hamstring tightness.

2. Lower Extremity Functional Scale (LEFS)

The Lower Extremity Functional Scale (LEFS) was used as the secondary subjective outcome measure to assess lower-extremity function. It is a 20-item self-reported questionnaire evaluating activities such as walking, stair climbing, squatting, sitting, standing, running, and work-related tasks. Each item is scored from 0 (extreme difficulty) to 4 (no difficulty), with a total score ranging from 0 to 80; higher scores indicate better function.

Each participant was informed about the study methodology, and written informed consent was obtained from all participants. Participants were blinded to the study hypothesis and were not informed about the

either intervention group in order to minimize performance and expectation bias. A detailed assessment was then carried out using the **Active Knee Extension Test (AKET)** to assess hamstring flexibility and the **Lower Extremity Functional Scale (LEFS)** to assess lower-extremity functional status before and after the intervention. A total of **30 receptionists** were selected using the **convenience sampling method** and were randomly allocated into two groups using the lottery method. Post-intervention assessment was performed using the same outcome measures, and confidentiality of the collected data was assured throughout the study.

INTERVENTION:-

Group A: Neurodynamic Sliding Technique:-

After completing the initial assessment prior to treatment, the participants were positioned in a seated position to undergo the NDST with their trunk in thoracic flexion and performed alternating movements of knee extension, ankle dorsiflexion with cervical extension, and knee flexion, ankle plantar flexion with cervical flexion for approximately 60 seconds for five times **[4, 5]**.

Group B: (Hamstring Fascia Activation through KCAT Technique).

The participant was positioned prone, lying on a plinth with the hip and knee in a neutral position. The therapist stood beside the leg to be tested. The therapist activated the hamstring fascia by tapping on the hamstring area for 7-8 seconds. After this, the patient was asked to flex the knee while the therapist applied pressure on the tendo Achillis until the patient could flex fully and then extend. This was done for 10 minutes. The same procedure was performed on the opposite lower extremity **[14]**.

Thoracic mobilization exercises:-

The exercises comprised 2 sets with 10 repetitions, once a day, 3 days a week, for 4 weeks. The exercise programs consisted of the cat/camel exercise, thoracic extension at a wall using bodyweight, half-kneeling chop/thrust, and side-lying thoracic rotation **[13]**.

RESULTS:-

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Table 1: Mean Age Distribution of Participants

Group N=15	Mean Age (Years)	SD	p-value
Group A	30.40	5.00	
Group B	31.30	5.20	0.612

The mean age of participants in Group A was 30.40 ± 5.00 years, whereas the mean age in Group B was 31.30 ± 5.20 years. The difference between groups was not statistically significant (p = 0.612), indicating that both groups were comparable with respect to age

Table 2: Mean scores of AKET Within Groups (Pre- and Post-intervention)

Group	Pre-test (Mean± SD)	Post-test (Mean± SD)	Mean Difference	t-value	p-value
Group A	**33.53 ±1.70**	**14.07 ±1.30**	**19.47 ±1.25**	**41.62**	**<0.001**
Group B	**33.07 ±1.60**	**22.20 ±1.50**	**10.87 ±1.18**	**27.48**	**<0.001**

There was a statistically significant improvement in hamstring flexibility in both groups after intervention ($p < 0.001$). Group A demonstrated a reduction in AKET deficit from 33.53 ± 1.70° to 14.07 ± 1.30°, representing a mean improvement of 19.47°. GroupB demonstrated a reduction from 33.07 ± 1.60° to 22.20 ± 1.50°, with a mean improvement of 10.87°. The improvement observed in Group A was substantially greater than that observed in Group B

Table 3: Mean scores of LEFS Within Groups (Pre- and Post-intervention)

Group	Pre-test (Mean± SD)	Post-test (Mean± SD)	Mean Difference	t-value	p-value
Group A	**55.33 ±1.60**	**73.93 ±1.70**	**18.60 ±1.30**	**38.74**	**<0.001**
Group B	**55.13 ±1.70**	**66.40 ±1.80**	**11.27 ±1.25**	**29.53**	**<0.001**

Both groups showed statistically significant improvements in LEFS scores following the four week intervention ($p < 0.001$). In Group A, the mean LEFS score improved from 55.33 ± 1.60 to 73.93 ± 1.70, with a mean improvement of 18.60 points. In Group B, the mean LEFS score improved from 55.13 ± 1.70 to 66.40 ± 1.80, with a mean improvement of 11.27 points. Although both interventions significantly improved lower-extremity function, the magnitude of improvement was greater in Group A.

Table 4: Between-Group Comparison of Post-intervention Outcome Measures

Outcome Measure	Group A (Mean ±SD)	Group B (Mean ± SD)	t-value	p-value
AKET Post (°)	**14.07 ±1.30**	**22.20 ±1.50**	**15.83**	**<0.001**
LEFS Post	**73.93 ±1.70**	**66.40 ±1.80**	**11.74**	**<0.001**

Post-intervention comparison revealed a statistically significant difference between the two groups for both outcome measures ($p < 0.001$). Participants in Group A demonstrated significantly lower AKET deficits (14.07 ± 1.30°) than participants in Group B (22.20 ± 1.50°), indicating superior improvement in hamstring flexibility. Similarly, the post-intervention LEFS score was significantly higher in Group A (73.93 ± 1.70) compared with Group B (66.40 ± 1.80), demonstrating greater improvement in lower-extremity functional status.

DISCUSSION

The present study compared the effectiveness of Neurodynamic Sliding

Technique and Kinetic Chain Activation Technique, both combined with Thoracic Mobility Exercises, on hamstring flexibility and lower-extremity function in receptionists with hamstring tightness. Both groups demonstrated statistically significant improvements in AKET and LEFS scores following four weeks of intervention; however, NST combined with TME produced significantly greater improvements than KCAT combined with TME. The superior improvement observed in Group A may be attributed to enhanced sciatic nerve excursion, reduced neural mechanosensitivity, improved intraneural circulation, and decreased tension within the neural–musculoskeletal interface. Neurodynamic sliding techniques improve neural mobility by alternately lengthening and shortening the nerve bed while minimizing excessive tensile stress, thereby increasing hamstring extensibility **[1, 2]**.

Group B also demonstrated significant improvement, which may be related to fascial de-tensioning, improved neuromuscular activation, enhanced posterior chain coordination, and restoration of efficient force transmission through the kinetic chain. Both groups showed functional improvement; however, the greater improvement in Group A suggests that improved hamstring flexibility may enhance lumbopelvic mobility, reduce mechanical stress on the posterior kinetic chain, and improve performance during walking, standing, stair climbing, and occupational activities **[8, 10]**.

Thoracic Mobility Exercises were administered equally to both groups to improve spinal mobility and lumbopelvic mechanics; therefore, the superior outcomes observed in Group A were likely attributable to the addition of Neurodynamic Sliding Technique. The study was limited by the small sample size, short intervention duration, and absence of long-term follow-up. Future studies with larger samples and longer follow-up periods are recommended to further investigate the long-term effectiveness of these interventions **[11, 12]**. Overall, the findings suggest that Neurodynamic Sliding Technique combined with Thoracic Mobility Exercises is a safe, feasible, and clinically effective intervention for improving hamstring flexibility and lower-extremity function in receptionists with hamstring tightness and may be incorporated into occupational physiotherapy programmes for sedentary work populations.

CONCLUSION

Both Neurodynamic Sliding Technique (NST) and Kinetic Chain Activation Technique (KCAT), when combined with Thoracic Mobility Exercises (TME), significantly improved hamstring flexibility and lower-extremity function in receptionists with hamstring tightness.

However, NST combined with TME produced greater improvements in AKET and LEFS scores and may be considered the more effective intervention for individuals exposed to prolonged sitting occupations.

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