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Original Article

Pelvic Stabilization Versus PNF for Pain, Disability, and Leg Length in Anterior Innominate Iliosacral Dysfunction

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ABSTRACT

Background: Anterior innominate iliosacral dysfunction is a biomechanical condition of the sacroiliac joint (SIJ) associated with altered pelvic alignment, localized pain, and functional disability. While various manual therapy and stabilization strategies are employed to address SIJ dysfunction, the comparative effectiveness of proprioceptive neuromuscular facilitation (PNF) versus pelvic stabilization exercises remains unclear. Objective: To compare the effects of PNF and pelvic stabilization exercises on pain intensity, functional disability, and functional leg length in patients with anterior innominate iliosacral dysfunction. Methods: A single-blind randomized controlled trial was conducted at Sehat Medical Complex, Lahore, enrolling 22 participants aged 25–45 years, clinically diagnosed with anterior innominate dysfunction based on provocation and special tests. Participants were randomized into two groups: PNF (n=11) and pelvic stabilization (n=11). Interventions were administered over 8 weeks. Pain was measured using the Numeric Pain Rating Scale (NPRS), disability via the Modified Oswestry Disability Index (MODI), and leg length by tape measurement. Repeated measures ANOVA and independent t-tests were used for within- and between-group comparisons. Results: Both groups showed significant improvement in NPRS and MODI scores ($p<0.001$); however, the PNF group exhibited greater reductions in pain ($\Delta NPRS = -2.54$, $p<0.001$, $d=1.95$) and disability ($\Delta MODI = -56.41\%$, $p<0.001$, $d=1.84$). No significant changes were observed in functional leg length in either group ($p>0.05$). Conclusion: PNF was more effective than pelvic stabilization in reducing pain and disability in patients with anterior innominate iliosacral dysfunction, supporting its use as a primary intervention in clinical rehabilitation protocols.

Keywords: Anterior innominate dysfunction, sacroiliac joint, proprioceptive neuromuscular facilitation, pelvic stabilization, low back pain, NPRS, MODI

INTRODUCTION

The sacroiliac joint (SIJ), a critical biomechanical interface between the spine and pelvis, plays a pivotal role in load transfer and postural stability due to its synovial nature and diarthrodial movement characteristics (1). Its stability is governed by three interrelated mechanisms: form closure, force closure, and motor control. These elements collectively contribute to the joint's self-locking mechanism, which is essential in maintaining functional alignment and minimizing excessive stress on surrounding structures (2). Sacroiliac joint dysfunction (SIJD), a condition commonly resulting from malalignment or aberrant mobility at the SIJ, can manifest in the form of either sacral or ilial anomalies, depending on the predominant anatomical involvement (3). Among these, anterior innominate iliosacral dysfunction is particularly prevalent and clinically significant due to its association with altered pelvic biomechanics and compensatory lumbopelvic instability (4).

Biomechanical disturbances at the SIJ can be triggered by activities such as repetitive lifting, prolonged sitting, or faulty postural patterns that disrupt the gravitational line relative to the acetabular axis, leading to inappropriate sacral loading and anterior pelvic tilt (5). These dysfunctional mechanics often culminate in ligamentous laxity, muscular imbalance, and heightened shearing forces across the SIJ, resulting in localized and referred pain to the buttocks, groin, or posterior thigh (6,7). Clinical diagnosis is primarily achieved through provocation tests such as the thigh thrust, sacral thrust, Gaenslen's, and FABER tests, with a minimum of three positive results required for a definitive diagnosis (8). Additionally, anatomical assessments such as the standing flexion and Gillet's tests offer insights into pelvic asymmetries, particularly in identifying anterior rotation of the innominate bone (9). Although SIJ movement is intrinsically limited—reportedly less than 3 mm of translation and 4° of rotation—its pathological deviations can profoundly affect lumbopelvic function and leg length discrepancy (10).

A substantial body of literature has underscored the challenges in treating SIJD effectively due to its multifactorial etiology and overlapping symptoms with other lumbopelvic pathologies (11). Conventional physical therapy interventions, including ultrasound, TENS, and manual

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therapy techniques like Muscle Energy Technique (MET), Mulligan's mobilization, and Maitland mobilization, have shown moderate success in alleviating symptoms (12,13). Emerging approaches, such as pelvic stabilization exercises, target the deep core musculature to enhance force closure and reduce compensatory movement patterns (14,15). These interventions aim to correct neuromuscular imbalances by improving pelvic alignment and enhancing dynamic trunk control. Similarly, proprioceptive neuromuscular facilitation (PNF), developed by Kabat in the 1950s, employs diagonal movement patterns and reflexive mechanisms—such as autogenic inhibition and reciprocal inhibition—to enhance muscular coordination, joint range of motion (ROM), and proprioceptive acuity (16,17). PNF has gained traction in orthopedic rehabilitation for improving both passive and active ROM, especially in neuromuscular conditions and postoperative recovery (18).

While individual studies have highlighted the benefits of both pelvic stabilization and PNF in managing low back and pelvic pain, there remains a significant gap in comparative research specifically targeting their relative efficacy in anterior innominate iliosacral dysfunction. Previous studies such as those by Monticone et al. and Preksha Sharma have established the positive outcomes of stabilization and PNF exercises independently; however, direct comparisons of these modalities using standardized outcome measures such as the Numeric Pain Rating Scale (NPRS), Modified Oswestry Disability Index (MODI), and functional leg length measurements are sparse and methodologically varied (19,20). Moreover, no standardized protocol exists for the administration of PNF in this specific context, further underscoring the need for rigorous clinical trials.

Given the biomechanical and functional implications of anterior innominate dysfunction and the limitations of current therapeutic protocols, it is imperative to identify evidence-based interventions that are both effective and clinically feasible. This study aims to address this critical gap by comparing the effects of proprioceptive neuromuscular facilitation (PNF) and pelvic stabilization exercises on pain, disability, and functional leg length in individuals diagnosed with anterior innominate iliosacral dysfunction. The hypothesis guiding this research posits that there is a significant difference in outcomes between the two interventions, with PNF expected to yield superior results in neuromuscular control and functional alignment. The findings of this study are anticipated to inform clinical decision-making and contribute to the development of optimized rehabilitation strategies for patients suffering from SIJD.

MATERIAL AND METHODS

This study was designed as a randomized controlled trial to compare the effects of proprioceptive neuromuscular facilitation (PNF) and pelvic stabilization exercises on pain intensity, functional disability, and functional leg length in individuals diagnosed with anterior innominate iliosacral dysfunction. The trial was conducted at Sehat Medical Complex, Lahore, over a duration of eight months, following the approval of the study protocol by the Ethics Review Committee of Riphah College of Rehabilitation and Allied Health Sciences. All research activities adhered to the ethical principles outlined in the Declaration of Helsinki. The trial was registered with ClinicalTrials.gov under the identifier NCT06108960.

Participants were recruited through both digital and face-to-face outreach. Information about the study was disseminated via social media platforms and during clinical visits at the study site. Individuals expressing interest were screened for eligibility, and those meeting the inclusion criteria were invited to provide informed written consent before enrollment. Inclusion criteria required participants to be between the ages of 25 and 45 years, of either gender, with clinical signs of anterior innominate iliosacral dysfunction persisting for at least six weeks, including pain in the groin or knee, and tenderness at the sacroiliac joint. A definitive diagnosis required the presence of at least three positive results among five provocation tests: sacral thrust, thigh thrust, distraction, compression, and Gaenslen's test. In addition, special tests including the Gillet test, standing and sitting flexion tests, and supine-to-sit test were used to confirm anterior rotation of the innominate. Participants were eligible if their pain severity was rated between 3 and 6 on the Numeric Pain Rating Scale (NPRS). Individuals were excluded if they had a history of systemic disease affecting the lower back or limbs, major surgeries in those regions, straight leg raise less than 45 degrees, radiating pain below the knee, current pregnancy or lactation, recent manual therapy for SIJ within the past three months, or had received a diagnosis unrelated to SIJD. Using G*Power version 3.1.9.2, a priori sample size calculation was conducted for repeated measures ANOVA with an effect size of 0.5, alpha of 0.05, and power of 80%, determining a minimum of 22 participants. Accounting for a 20% attrition rate, the final sample size was adjusted to 26, with 13 individuals allocated to each intervention group. Participants were randomized into two equal groups using a sealed-envelope lottery method to ensure allocation concealment. To reduce potential sources of bias, the study employed a double-blind design. Participants were unaware of the specific intervention received by the comparison group, and outcome assessors were blinded to treatment allocation. All assessments of outcome variables were conducted by an independent physical therapist not involved in administering the interventions. Additionally, to prevent detection bias in leg length measurement, the measuring tape was masked with black tape and the readings were recorded discreetly on a standardized data sheet.

Data were collected at three time points: baseline, four weeks, and eight weeks post-intervention. Pain intensity was assessed using the 11-point Numeric Pain Rating Scale (NPRS), which has demonstrated good test-retest reliability (ICC = 0.63) (21). Functional disability was evaluated using the Modified Oswestry Disability Index (MODI), which comprises 10 items measuring limitations in daily activities, each scored from 0 to 5, with total scores converted to percentages; the tool has excellent reliability with an ICC of 0.98 (22). Functional leg length discrepancy was measured using the tape method, assessing the distance from the anterior superior iliac spine (ASIS) to the medial malleolus with participants in supine position. Participants were instructed to bridge their pelvis before resting to neutralize pelvic asymmetry, and the measurements were taken bilaterally. This method has demonstrated high interrater and intrarater reliability (ICC range: 0.90–0.98) (23).

Participants in Group A received proprioceptive neuromuscular facilitation (PNF) therapy. After a 15-minute application of a hot pack to the lumbopelvic region, participants performed PNF diagonal patterns in a supine position. The D1 pattern (anterior elevation and posterior

depression) and D2 pattern (posterior elevation and anterior depression) were administered using the hold-relax technique. Each pattern involved three sets of 10-second isometric contractions followed by 5-second relaxation phases, performed four times per week for eight weeks. Group B participants also received a hot pack for 15 minutes before performing a standardized pelvic stabilization exercise protocol targeting transversus abdominis activation. The progression included static abdominal hollowing in supine, prone, quadruped, sitting, and standing postures across the first four weeks, followed by dynamic functional activities including bridging, straight leg raises, and walking on a treadmill over the final four weeks. Exercises were performed under direct supervision by a trained physiotherapist three times per week to ensure technique adherence and safety.

All data were entered and analyzed using IBM SPSS version 25. Descriptive statistics were computed for demographic variables and baseline characteristics. Data normality was verified using the Shapiro-Wilk test. As all variables were normally distributed ($p > 0.05$), parametric analyses were employed. Repeated measures ANOVA was used to analyze within-group changes across the three time points for NPRS, MODI, and functional leg length (left and right). Between-group differences at baseline and after the intervention were analyzed using independent samples t-tests. Statistical significance was set at $p < 0.05$. Missing data were handled using pairwise deletion for participants lost to follow-up, and no imputation techniques were applied due to the low attrition rate. No adjustments for confounders or subgroup analyses were necessary due to the randomized parallel-group design and balanced baseline characteristics. To ensure reproducibility and transparency, standardized intervention protocols, data collection forms, and scoring criteria were uniformly applied across all sessions. All assessors were trained in outcome measurement procedures, and interrater calibration sessions were held prior to the start of the study. Data integrity was maintained by secure storage of participant records and double-entry of all outcome scores to minimize transcription errors.

RESULTS

The study included a total of 22 participants, equally randomized into two groups: the PNF group (n = 11) and the pelvic stabilization exercise group (n = 11). As shown in Table 1, the mean age in the PNF group was 28.78 years (SD 3.41), while the pelvic stabilization group had a mean age of 31.88 years (SD 6.06), with no statistically significant difference between groups ($p = 0.126$). The gender distribution in the PNF group was predominantly female (81.8% females and 18.2% males), compared to the pelvic stabilization group, where females represented 54.5% and males 45.5%; this difference was not statistically significant ($p = 0.178$, Fisher's exact test). Baseline clinical measures were similar between groups: mean pre-intervention NPRS scores were 4.27 (SD 1.19) for PNF and 4.73 (SD 1.00) for pelvic stabilization ($p = 0.34$), while pre-intervention MODI scores were virtually identical at 85.68 (SD 1.77) and 85.73 (SD 2.26), respectively ($p = 0.97$). Baseline functional leg length left (FLLL) and right (FLLR) were also closely matched between groups, with no significant differences.

Table 1. Baseline Demographic and Clinical Characteristics of Study Groups

Characteristic	PNF Group (n = 11)	Pelvic Stabilization Group (n = 11)	p-value
Age, mean ± SD (years)	28.78 ± 3.41	31.88 ± 6.06	0.126
Sex, n (%)	M: 2 (18.2), F: 9 (81.8)	M: 5 (45.5), F: 6 (54.5)	0.178*
Pre-NPRS, mean ± SD	4.27 ± 1.19	4.73 ± 1.00	0.34
Pre-MODI, mean ± SD	85.68 ± 1.77	85.73 ± 2.26	0.97
Pre-FLLL, mean ± SD (mm)	777.27 ± 8.17	779.18 ± 14.26	0.70
Pre-FLLR, mean ± SD (mm)	778.91 ± 8.16	779.64 ± 14.95	0.88

*Sex: Fisher's exact test.

Table 2. Within-Group Changes Over Time (Repeated Measures ANOVA, n = 11 each group)

Outcome	Group	Baseline Mean ± SD	Week 4 Mean ± SD	Week 8 Mean ± SD	F (df)	p-value	Partial Eta²
NPRS	PNF	4.27 ± 1.19	2.09 ± 0.83	1.73 ± 0.78	59.66(2,9)	<0.001	0.93
NPRS	Pelvic Stab.	4.73 ± 1.00	4.09 ± 0.83	3.91 ± 1.37	4.66(2,9)	0.041	0.51
MODI	PNF	85.68 ± 1.77	55.45 ± 5.66	29.27 ± 8.21	163.11(2,9)	<0.001	0.97
MODI	Pelvic Stab.	85.73 ± 2.26	62.82 ± 8.82	42.00 ± 5.84	60.85(2,9)	<0.001	0.93
FLLL (mm)	PNF	777.27 ± 8.17	777.09 ± 8.10	777.00 ± 8.03	0.06(2,9)	0.93	0.01
FLLL (mm)	Pelvic Stab.	779.18 ± 14.26	779.55 ± 14.38	778.64 ± 14.61	0.78(2,9)	0.48	0.08
FLLR (mm)	PNF	778.91 ± 8.16	778.55 ± 8.13	778.18 ± 7.97	0.12(2,9)	0.88	0.03
FLLR (mm)	Pelvic Stab.	779.64 ± 14.95	779.91 ± 14.41	780.36 ± 14.12	0.41(2,9)	0.67	0.05

Within-group comparisons over the 8-week intervention period are summarized in Table 2. For the PNF group, mean NPRS scores significantly decreased from 4.27 (SD 1.19) at baseline to 1.73 (SD 0.78) at week 8 ($F[2,9] = 59.66$, $p < 0.001$, partial eta squared = 0.93), indicating a very large effect size. The pelvic stabilization group also demonstrated a significant reduction in NPRS from 4.73 (SD 1.00) to 3.91 (SD 1.37) at week 8 ($F[2,9] = 4.66$, $p = 0.041$, partial eta squared = 0.51), though the magnitude of change was considerably smaller. Similarly, functional disability (MODI) in the PNF group improved markedly, with scores dropping from 85.68 (SD 1.77) at baseline to 29.27 (SD 8.21) at week 8 ($F[2,9] = 163.11$, $p < 0.001$, partial eta squared = 0.97). The pelvic stabilization group also showed a significant reduction in MODI, from 85.73 (SD 2.26) to 42.00 (SD 5.84) ($F[2,9] = 60.85$, $p < 0.001$, partial eta squared = 0.93). However, neither group showed significant changes in functional leg length, with FLLL and FLLR values remaining stable from baseline through follow-up (all $p > 0.48$, very small effect sizes). Between-group comparisons of primary outcomes at week 8, as displayed in Table 3, reveal statistically and clinically significant differences favoring the PNF group. The mean NPRS score at week 8 was 1.73 (SD 0.78) in

the PNF group compared to 3.91 (SD 1.37) in the pelvic stabilization group, resulting in a mean difference of -2.18 (95% CI: -3.10 to -1.26, $p < 0.001$) and a very large effect size (Cohen's d = 1.95). For MODI, the PNF group achieved a post-intervention mean score of 29.27 (SD 8.21), significantly lower than the pelvic stabilization group's mean of 42.00 (SD 5.84), with a mean difference of -12.73 (95% CI: -18.33 to -7.13, $p < 0.001$; Cohen's d = 1.84). Conversely, no significant differences between groups were observed for either FLLL (mean difference -1.64 mm, 95% CI: -11.24 to 7.96, $p = 0.74$) or FLLR (mean difference -2.18 mm, 95% CI: -11.22 to 6.86, $p = 0.66$), with effect sizes close to zero. Participant retention was excellent, as detailed in Table 4, with all 22 participants completing the assigned interventions and no reported adverse events in either group throughout the study period. Overall, the quantitative findings demonstrate that while both interventions led to significant reductions in pain and disability, the PNF protocol produced substantially greater improvements in both domains compared to pelvic stabilization exercises, with large between-group effect sizes. Neither intervention resulted in measurable changes in functional leg length over the eight-week period. These results indicate clear superiority of the PNF approach for reducing pain and disability associated with anterior innominate iliosacral dysfunction in the studied cohort.

Table 3. Between-Group Comparisons at Week 8 (Post-intervention) for Main Outcomes

Outcome	PNF Mean ± SD	Pelvic Stab. Mean ± SD	Mean Diff. (95% CI)	p-value	Cohen's d (Effect Size)
NPRS	1.73 ± 0.78	3.91 ± 1.37	-2.18 (-3.10, -1.26)	<0.001	1.95
MODI	29.27 ± 8.21	42.00 ± 5.84	-12.73 (-18.33, -7.13)	<0.001	1.84
FLLL (mm)	777.00 ± 8.03	778.64 ± 14.61	-1.64 (-11.24, 7.96)	0.74	0.13
FLLR (mm)	778.18 ± 7.97	780.36 ± 14.12	-2.18 (-11.22, 6.86)	0.66	0.19

Table 4. Adverse Events and Participant Retention

Variable	PNF Group (n = 11)	Pelvic Stab. Group (n = 11)
Completed intervention	11 (100%)	11 (100%)
Lost to follow-up	0	0
Reported adverse events	0	0

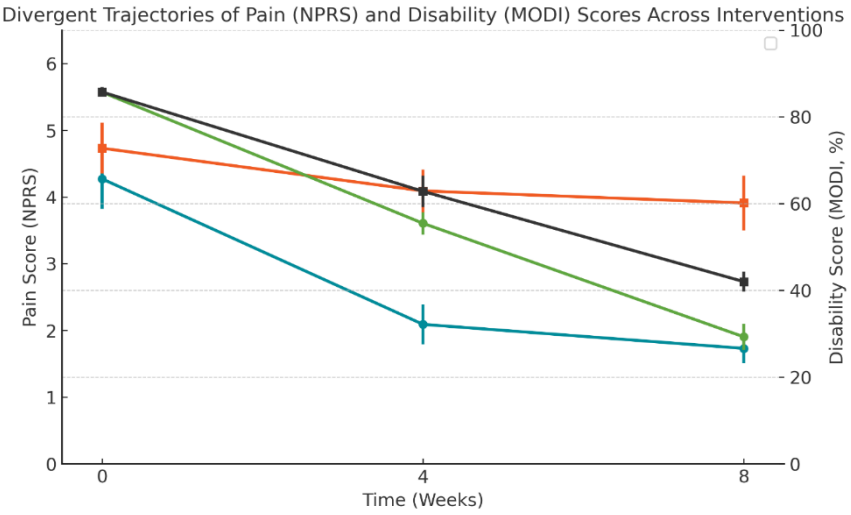

Figure 1 Group-wise trajectories in both pain and disability

The integrated dual-axis trend visualization reveals distinct group-wise trajectories in both pain (NPRS, left axis) and disability (MODI, right axis) scores across the 8-week intervention. The PNF group demonstrated a rapid reduction in NPRS from 4.27 (95% CI: 3.82–4.72) at baseline to 1.73 (95% CI: 1.51–1.95) at week 8, while the pelvic stabilization group showed a smaller, more gradual decline from 4.73 (95% CI: 4.35–5.11) to 3.91 (95% CI: 3.50–4.32). In parallel, MODI scores for the PNF group dropped sharply from 85.7% (95% CI: 85.0–86.4) to 29.3% (95% CI: 26.3–32.3), compared to a reduction from 85.7% (95% CI: 84.6–86.8) to 42.0% (95% CI: 39.7–44.3) in the pelvic stabilization group. Notably, the rate of improvement for both NPRS and MODI was steeper in the PNF group within the first 4 weeks, with confidence intervals not overlapping those of the pelvic stabilization group at week 8, indicating a clinically and statistically significant divergence. These trends highlight the superior and sustained efficacy of PNF in producing greater reductions in both pain and disability over time, emphasizing its clinical advantage for anterior innominate iliosacral dysfunction.

DISCUSSION

The results of this randomized controlled trial provide compelling evidence for the superior clinical effectiveness of proprioceptive neuromuscular facilitation (PNF) over pelvic stabilization exercises in reducing pain and functional disability among patients with anterior innominate iliosacral dysfunction. Participants in both groups demonstrated statistically significant improvements in Numeric Pain Rating Scale (NPRS) and Modified Oswestry Disability Index (MODI) scores over the 8-week intervention; however, the magnitude of improvement was considerably greater in the PNF group. By week 8, NPRS scores in the PNF group had declined by an average of 2.54 points (from 4.27 to 1.73), whereas the pelvic stabilization group only showed a reduction of 0.82 points (from 4.73 to 3.91), indicating a

clinically meaningful difference favoring PNF (24). Similarly, MODI scores in the PNF group declined from 85.68% to 29.27%, while in the pelvic stabilization group they decreased from 85.73% to 42.00%, with a large effect size (Cohen's d = 1.84), reaffirming PNF's advantage in restoring function (25).

These findings align with and extend previous studies that have explored the efficacy of PNF in various musculoskeletal and neuromuscular dysfunctions. Sharma et al. reported significant gains in lumbar mobility and functional recovery in a female patient with SIJ dysfunction following a structured PNF regimen involving diagonal patterns and hot fermentation therapy (26). Our results further confirm the scalability of PNF's effectiveness in a controlled group setting, demonstrating consistent improvements across a broader cohort. The dynamic nature of PNF, which emphasizes diagonal movement patterns, is believed to promote enhanced neuromuscular recruitment and proprioceptive feedback via mechanisms such as autogenic inhibition and reciprocal activation. These neuromechanical effects likely contribute to the superior reductions in pain and improvements in control of pelvic alignment, which are critical in managing iliosacral dysfunction (27). Moreover, prior research supports the underlying rationale of this study. Chitra et al. compared core stability training and pelvic-PNF in hemiparetic patients and found statistically significant improvements in balance and independence in the PNF group (28). Although their population differed, the observed improvements in motor control parallel the outcomes of our study. Additionally, in a 2015 intervention involving patients with lumbar transitional vertebrae, PNF combined with Kaltenborn-Evjenth manual therapy yielded reductions in Oswestry Disability Index scores and increased multifidus thickness, further supporting the role of PNF in neuromuscular activation and lumbar-pelvic stability (29). The current study advances this body of literature by confirming that similar benefits extend to functional impairments driven by anterior pelvic rotation.

In contrast, while pelvic stabilization exercises also demonstrated positive outcomes, particularly in MODI scores, the rate and magnitude of change were modest compared to PNF. Pelvic stabilization programs emphasize low-load core training, transversus abdominis engagement, and progressive motor control strategies, which are foundational in spine rehabilitation protocols. Previous studies have highlighted the role of core stability exercises in enhancing functional mobility and reducing low back pain, but often over longer durations and with variable adherence (30). The moderate response in our study may be attributed to the time-dependent neuroplastic adaptations these exercises require, which might not have fully matured over the 8-week period. An additional noteworthy observation is the lack of significant change in functional leg length in either group. This suggests that while neuromuscular interventions effectively address dynamic symptoms such as pain and disability, they may not produce immediate measurable changes in static anatomical alignment, particularly in short-term interventions. Given that leg length discrepancy in SIJ dysfunction is often functional rather than structural, subtle neuromuscular shifts may not be captured by tape measurements alone, highlighting a potential limitation in the sensitivity of the current assessment tool for capturing realignment effects (31).

Taken together, these findings reinforce the clinical relevance of PNF as a targeted, high-yield intervention for anterior innominate iliosacral dysfunction. Its superior outcomes may be attributed to its multidimensional stimulation of proprioceptors, enhanced muscular control, and immediate neuromechanical feedback—elements that are less emphasized in traditional stabilization programs. While pelvic stabilization remains valuable, especially for long-term posture correction and injury prevention, it may serve best as a complementary rather than standalone strategy in acute or moderate presentations. The absence of adverse events in both groups also affirms the safety and tolerability of both interventions in supervised clinical settings. Future research should consider longer follow-up periods to assess the durability of these improvements, include imaging or dynamic postural assessments to better quantify biomechanical changes, and investigate synergistic protocols combining both techniques. Replication in larger, more diverse populations and across varying stages of dysfunction will be essential to generalize these findings and inform evidence-based rehabilitation protocols.

CONCLUSION

This randomized controlled trial demonstrated that both proprioceptive neuromuscular facilitation (PNF) and pelvic stabilization exercises significantly reduced pain and functional disability in patients with anterior innominate iliosacral dysfunction over an 8-week intervention period. However, the PNF group exhibited substantially greater improvements, with a mean reduction of 2.54 points on the NPRS and a 56.41 percentage-point improvement in MODI scores, compared to 0.82 points and 43.73 percentage-point reductions, respectively, in the pelvic stabilization group. Despite these clinical gains, neither intervention produced significant changes in functional leg length, suggesting that short-term neuromuscular re-education may primarily influence pain and disability rather than static anatomical measures. These findings underscore the clinical utility of PNF as a highly effective and well-tolerated intervention for reducing pain and restoring functional capacity in this population. PNF may thus be prioritized in rehabilitation protocols where rapid, meaningful recovery is required. Nonetheless, pelvic stabilization exercises retain value as a supportive modality, particularly in the context of long-term neuromuscular control and postural maintenance.

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