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EFFECTS OF CORE MUSCLE STRENGTHENING EXERCISES AND PELVIC PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION TECHNIQUES ON PAIN, FUNCTION AND QUALITY OF LIFE AMONG PATIENTS WITH SACROILIAC DYSFUNCTION

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Sacroiliac joint dysfunction; core strengthening; pelvic PNF; pain; functional disability; quality of life; physiotherapy

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Abstract

Background: *Sacroiliac joint dysfunction (SIJD) is a musculoskeletal problem associated with low back and pelvic pain, functional limitation, and reduced quality of life. This study compared core muscle strengthening exercises combined with pelvic proprioceptive neuromuscular facilitation (PNF) and conventional physiotherapy with pelvic PNF and conventional physiotherapy alone.*

Objective: *To compare the effects of adding core muscle strengthening exercises to pelvic PNF and conventional physiotherapy on pain, functional disability, and quality of life in patients with SIJD.*

Methodology: *A randomized controlled trial was conducted among 42 recruited participants; 40 participants completed the study, with 20 participants in each group. Participants were recruited through non-probability convenient sampling and randomly allocated to control or experimental treatment. The experimental group received pelvic PNF, core muscle strengthening exercises, and conventional physiotherapy, whereas the control group received pelvic PNF and conventional physiotherapy. Treatment was provided three times weekly for six weeks. Pain, functional disability, and quality of life were assessed using the Visual Analogue Scale (VAS), Oswestry Disability Index (ODI), and Short Form-36 Health Survey (SF-36), respectively. Data were analyzed using SPSS version 26.0.*

Results: *Both groups demonstrated statistically significant within-group improvements in all outcomes ($p < 0.001$). Between-group comparisons also showed statistically significant differences in change scores for VAS (U =*

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370.00, p < 0.001), ODI (t(38) = 7.54, p < 0.001), and SF-36 (t(38) = -24.09, p < 0.001), with greater improvement in the experimental group. ***Conclusion:*** *Adding core muscle strengthening exercises to pelvic PNF and conventional physiotherapy was associated with greater improvements in pain, functional disability, and quality of life over six weeks than pelvic PNF with conventional physiotherapy alone.*

1.INTRODUCTION

Sacroiliac joint dysfunction (SIJD) is associated with pain and functional limitations in the lumbopelvic region. The sacroiliac joint contributes to force transfer, shock absorption, postural stability, and coordinated movement. Altered movement control and impaired neuromuscular coordination may contribute to symptoms and activity limitations [1,2].

Active rehabilitation is an important component of conservative physiotherapy management. Core muscle strengthening targets trunk and pelvic stabilization, whereas pelvic proprioceptive neuromuscular facilitation (PNF) emphasizes proprioceptive input, coordinated pelvic movement, and neuromuscular activation [3,4,5,6,7]. Previous research has examined these approaches separately, while evidence regarding their combined use in patients with SIJD remains limited.

The present study therefore examined whether adding a structured core muscle strengthening program to pelvic PNF and conventional physiotherapy produced additional improvements in pain, functional disability, and quality of life.

Objective

To compare the effects of core muscle strengthening exercises combined with pelvic PNF techniques versus pelvic PNF with conventional physiotherapy alone on pain, functional disability, and quality of life among patients with SIJD.

Stabilization-focused rehabilitation has also been investigated in pelvic girdle pain, including randomized controlled research and longer-term follow-up [8,9]. A randomized controlled study has specifically examined pelvic PNF techniques in patients with SIJD [7]. Broader evidence syntheses have reviewed exercise and manual manipulation for SIJD [10] and various therapeutic interventions for SIJD [11]. Together, these studies provide a rationale for examining the additional contribution of core muscle strengthening when pelvic PNF and conventional physiotherapy are already provided.

Previous SIJD-focused research has also evaluated Mulligan mobilization and core stability exercise approaches [4,5]. Comparative research has examined Mulligan mobilization and pelvic proprioceptive neuromuscular facilitation for pain and disability in patients with SIJD [6], while other work has compared muscle energy techniques with core muscle strengthening exercises [3]. Beales et al. reported effects of manual pelvic compression on trunk motor control during the active straight leg raise in individuals with chronic pelvic girdle pain [2]. O'Sullivan et al. described altered motor control strategies in subjects with SIJ pain during the active straight-leg-raise test [1].

Several studies have examined exercise-based and manual rehabilitation approaches for sacroiliac joint dysfunction and related lumbopelvic conditions. Abbas et al. compared muscle energy technique with core stabilization exercises and stretching in females with sacroiliac joint dysfunction, providing evidence for exercise-based management [12]. Ali et al. examined the association between low back pain intensity and core muscle strength in postpartum women, supporting the relevance of core muscle function to lumbopelvic symptoms [13]. Ghorbani et al. investigated relationships involving core muscle strength and functional performance in young females, providing additional background on core muscle function [14]. Eraky et al. compared Mulligan technique with core stability exercises for low back pain in postmenopausal women [15].

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2. METHODOLOGY

2.1 Study Design and Setting

A randomized controlled trial was conducted in the Department of Physical Therapy at Basic Health Unit (BHU) Dobli, Chunian. The total study period was approximately six months after approval of the research synopsis and ethical clearance.

2.2 Participants and Sample Size

The study population comprised male and female patients diagnosed with SIJD who attended physiotherapy outpatient services. Sample size was calculated using EpiTools at a 95% confidence level and 80% statistical power, resulting in 38 participants. Allowing for a 10% dropout rate, 42 participants were recruited, with 21 allocated to each group. One participant from each group was lost to follow-up, leaving 40 participants for final analysis.

2.3 Sampling and Randomization

Participants were recruited using non-probability convenient sampling. Eligible participants were randomly allocated to the experimental or control group using simple randomization.

2.4 Eligibility Criteria

Inclusion criteria included:

- Diagnosis of sacroiliac joint dysfunction.
- Age between 20 and 50 years.
- Male or female participants.
- Chronic low back pain for more than 3 months, with VAS pain intensity of 4–10.
- Pain localized to the lumbopelvic or sacroiliac region.
- Positive results on at least two SIJ special tests, such as Active Straight Leg Raise or Prone Instability Test.
- Willingness to participate and provide informed consent.

Exclusion criteria included:

- History of spinal or pelvic surgery.
- Fracture, tumor, or infection involving the spine or pelvic region.
- Diagnosed neurological disorders such as nerve root compression or paralysis.
- Pregnancy.
- Systemic inflammatory conditions such as rheumatoid arthritis or ankylosing spondylitis.
- Concurrent participation in another structured physiotherapy program for low back pain.
- Unwillingness or inability to complete the treatment protocol.

2.5 Ethical Considerations

Ethical approval was obtained from the Ethical Research Board and Advanced Research Committee of the Department of Physical Therapy and Rehabilitation Sciences, The Superior University Lahore. Participants were informed about the study objectives, treatment procedures, possible benefits, and their right to withdraw at any time without consequences. Written informed consent was obtained before enrollment.

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2.6 Intervention Protocol

Control group: Participants received pelvic PNF techniques and conventional physiotherapy.
Experimental group: Participants received pelvic PNF techniques, core muscle strengthening exercises, and conventional physiotherapy.
Pelvic PNF included rhythmic stabilization, slow reversal, and combination of isotonic contractions. Pelvic patterns included anterior elevation and posterior depression, with 10 repetitions per pattern for 2–3 sets using therapist-applied manual resistance.
Core muscle strengthening included the structured strengthening approach described in the thesis, including abdominal drawing-in, pelvic tilts, bridging, quadruped exercises, and progressive plank variations, progressed according to patient tolerance.
Conventional physiotherapy included hot pack application for 10–15 minutes, stretching of the hamstrings, hip flexors, and piriformis muscles, and general mobility exercises. Both groups received three sessions per week for six weeks, with each session lasting approximately 30–45 minutes.

2.7 Outcome Measures

Outcome	Instrument	Purpose
Pain	Visual Analogue Scale (VAS)	Assessment of pain intensity
Functional disability	Oswestry Disability Index (ODI)	Assessment of functional limitation
Quality of life	Short Form-36 Health Survey (SF-36)	Assessment of health-related quality of life

2.8 Data Collection and Statistical Analysis

Baseline measurements were recorded before treatment and the same outcome measures were repeated after six weeks. Data were analyzed using SPSS Statistics version 26.0. Means and standard deviations were calculated for quantitative variables and frequencies and percentages for categorical variables. Baseline continuous variables were compared using independent-samples t-tests, while gender distribution was assessed using the chi-square test. The Shapiro–Wilk test was used to assess normality of change scores. Paired-samples t-tests were used for normally distributed within-group data and the Wilcoxon signed-rank test for non-normal data. Independent-samples t-tests were used for between-group ODI and SF-36 change scores, and the Mann–Whitney U test was used for VAS change scores. A p-value ≤ 0.05 was considered statistically significant.

3. RESULTS

Forty-two participants were enrolled, with 21 allocated to each group. One participant from each group was lost to follow-up; therefore, 40 participants (20 per group) completed the study and were included in the final analysis.

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3.1 Within-Group Outcomes

Outcome	Group	Pre-treatment Mean ± SD	Post-treatment Mean ± SD	Test	p-value
VAS	Control (n=20)	7.20 ± 0.95	3.60 ± 0.94	Wilcoxon signed-rank	<0.001
VAS	Experimental (n=20)	7.50 ± 1.15	2.50 ± 1.15	Wilcoxon signed-rank	<0.001
ODI	Control (n=20)	44.10 ± 5.14	28.90 ± 8.03	Paired t-test, t(19)=10.77	<0.001
ODI	Experimental (n=20)	44.45 ± 5.50	17.65 ± 3.00	Paired t-test, t(19)=43.66	<0.001
SF-36	Control (n=20)	47.95 ± 3.09	57.10 ± 4.48	Paired t-test, t(19)=-14.84	<0.001
SF-36	Experimental (n=20)	49.05 ± 3.30	75.65 ± 4.49	Paired t-test, t(19)=-70.05	<0.001

Pain intensity decreased significantly in both groups. VAS decreased by 3.60 points in the control group and by 5.00 points in the experimental group. Functional disability also decreased significantly, with ODI reductions of 15.20 points and 26.80 points in the control and experimental groups, respectively. SF-36 scores increased by 9.15 points in the control group and 26.60 points in the experimental group. Similar pain-related outcomes have been examined in previous SIJD rehabilitation studies [3,4,5,6,7,12,15].

3.2 Between-Group Comparison

Outcome	Control Change Mean ± SD	Experimental Change Mean ± SD	Test	p-value
VAS	-3.60 ± 0.82	-5.00 ± 0.00	Mann–Whitney U = 370.00	<0.001
ODI	-15.20 ± 6.31	-26.80 ± 2.75	Independent t-test, t(38)=7.54	<0.001
SF-36	+9.15 ± 2.76	+26.60 ± 1.70	Independent t-test, t(38)=-24.09	<0.001

Between-group comparisons demonstrated statistically significant differences in all three change scores. The experimental group showed a greater reduction in VAS and ODI and a greater increase in SF-36 than the control group ($p < 0.001$ for all outcomes).

3.3 CONSORT-Style Participant Flow

Study stage	Participants
Assessed/enrolled	42
Allocated to control group	21
Allocated to experimental group	21
Lost to follow-up: control	1
Lost to follow-up: experimental	1
Analyzed: control	20
Analyzed: experimental	20

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4. DISCUSSION

The present randomized controlled trial examined whether adding core muscle strengthening exercises to pelvic PNF and conventional physiotherapy provided additional benefits for patients with SIJD. Both groups improved after six weeks, while the experimental group demonstrated greater changes in pain, functional disability, and quality of life.

4.1 Pain

Pain intensity decreased significantly in both groups. The improvement in the control group may be related to the combined effects of pelvic PNF and conventional physiotherapy, including repeated movement patterns, manual resistance, proprioceptive input, heat, stretching, and mobility exercises. The greater reduction in the experimental group suggests that the added core strengthening component may have supported improved lumbopelvic control and reduced mechanical stress during movement. Similar pain-related outcomes have been examined in previous SIJD rehabilitation studies [3,4,5,6,7,12,15].

These findings are consistent with previous SIJD research reporting improvements with core-focused rehabilitation and pelvic PNF. Studies have reported improvements with core stability exercise and manual mobilization [3,4,5,6,12,15], while pelvic PNF has also been investigated in SIJD [6,7].

4.2 Functional Disability

ODI scores decreased significantly in both groups, with a larger reduction in the experimental group. The improvement in the control group may reflect pelvic PNF, stretching, mobility work, and other conventional physiotherapy components. The additional reduction in the experimental group may reflect improved trunk strength and lumbopelvic control, which can support daily functional activities. Previous research on exercise and manual rehabilitation in SIJD has similarly examined functional disability outcomes [3,4,5,6,7].

4.3 Quality of Life

SF-36 scores increased significantly in both groups, with a larger improvement in the experimental group. Reduced pain and disability may allow participants to perform daily, work, and social activities more comfortably. The thesis discussion also relates these findings to prior stabilization-exercise research in pelvic girdle and lumbopelvic conditions. Stabilization-focused rehabilitation has also been associated with improvements in outcomes related to pelvic girdle and lumbopelvic function [8,9].

4.4 Contribution of Pelvic PNF and Combined Rehabilitation

Both groups received pelvic PNF and both demonstrated significant improvement. Because pelvic PNF and conventional physiotherapy were common to both groups, the between-group difference is interpreted in the thesis as the additional effect associated with adding core muscle strengthening. The combination targets complementary aspects of lumbopelvic rehabilitation: neuromuscular coordination through PNF and active stabilization through strengthening. The rationale for combining neuromuscular facilitation with active stabilization is supported by previous investigations of PNF, core strengthening, and related rehabilitation approaches [3,4,5,6,7].

4.5 Limitations

The final sample consisted of 40 participants after two dropouts, limiting precision and generalizability. Convenient sampling may reduce representativeness. The intervention lasted six weeks, and outcomes were measured only at baseline and immediately after treatment, so long-term maintenance of benefits cannot be confirmed. The study was also conducted in selected clinical settings, which may limit generalizability.

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5. CONCLUSION

Both pelvic PNF with conventional physiotherapy and the combined program including core muscle strengthening produced significant improvements in pain, functional disability, and quality of life over six weeks. The experimental group demonstrated significantly greater changes in VAS, ODI, and SF-36 scores. These findings support consideration of core muscle strengthening as an additional component of rehabilitation programs that include pelvic PNF and conventional physiotherapy for SIJD.

6. CLINICAL IMPLICATIONS

Clinicians may consider incorporating progressive core muscle strengthening exercises into rehabilitation programs that already include pelvic PNF and conventional physiotherapy. The thesis describes examples such as abdominal drawing-in, pelvic tilts, bridging, quadruped exercises, and progressive plank variations, progressed according to patient tolerance. Assessment of pain, disability, and quality of life may provide a broader picture of treatment response than pain assessment alone.

7. RECOMMENDATIONS

- Conduct studies with larger samples.
- Use probability-based recruitment where feasible.
- Include longer follow-up periods to determine whether improvements are maintained.
- Compare different core strengthening progressions and pelvic PNF protocols.
- Include objective measures of neuromuscular performance.
- Assess adherence to home exercise programs.
- Conduct multicenter studies to improve generalizability.

8. DECLARATIONS

Ethics approval: Ethical approval was obtained from the Ethical Research Board and Advanced Research Committee of the Department of Physical Therapy and Rehabilitation Sciences, The Superior University Lahore. Written informed consent was obtained from all participants before enrollment.

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Conflict of interest: No conflict-of-interest information was reported in the thesis.

Trial registration: No trial registration number was reported in the thesis.

Author contributions: Misbah Hanif conducted the study and prepared the manuscript under the supervision and academic guidance of Dr. Sahar Aslam.

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