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Comparative Effectiveness of the Mckenzie Method and Williams Flexion Exercises in Muscular Imbalance and Pain in Lower Cross Syndrome

Rimsha Sadiq[1], Areej Akram[1], Muhammad Akmal Nawaz[2], Mehnoor Gul[3], Nimra Amjad[1], Muhammad Abbas[4]

[1]Department of Rehabilitation Sciences, Riphah International University, Islamabad, Pakistan
[2]Sahet Medical Complex Hanjarwal, University of Lahore, Lahore, Pakistan
[3]Northwest Institute of Health Sciences, Peshawar, Pakistan
[4]Faculty of Medical Sciences, Government College University Faisalabad (GCUF), Faisalabad, Pakistan

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Correspondence to: Muhammad Abbas, Faculty of Medical Sciences, Government College University Faisalabad (GCUF), Faisalabad, Pakistan.
Email: m.abbasilyas@gcuf.edu.pk

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ABSTRACT

Background: Lower Cross Syndrome (LCS) is a muscular imbalance marked by tight hip flexors and lumbar extensors and simultaneous weakness of abdominal and gluteal muscles and it is usually accompanied by chronic low back pain (LBP). McKenzie Method and Williams Flexion Exercises have been extensively deployed in mechanical LBP but the comparative effectiveness of both techniques in clinical defined LCS has not been investigated before. Methods: 56 participants over the age of 18 and 45 years of age with clinically diagnosed LCS and chronic non-specific LBP were randomized (1:1) into McKenzie (n=28) or Williams (n=28) groups. The two groups were given supervised exercises in three sessions per week and lasted eight weeks. The pain (VAS) and functional disability (ODI) were the primary outcomes. Secondary outcomes were hip flexor (Modified Thomas Test) and core endurance (plank and bridge tests). The results were measured at the pre-intervention and post-intervention. **Results**: Both of the groups showed high within-group changes in the results ($p<0.05$). however, Williams group demonstrated much better post intervention results than McKenzie group such as better VAS scores, more ODI improvement, more increase in hip flexor ROM and better plank and bridge endurance ($p<0.05$). **Conclusion**: The Williams Flexion Exercises showed more effective than the modified McKenzie protocol in pain reduction, disability, flexion, and core endurance of LCS patients. Muscle-balancing interventions are flexion-based and seem more biomechanically suitable in LCS and could be regarded as the most appropriate exercise strategy during the clinical management.

INTRODUCTION

Low back pain (LBP) is one of the most common musculoskeletal disorders in the world and is always the highest cause of disability in all age groups. Its prevalence in lifetime is estimated to be over 70% with a significant percentage of the affected individuals developing recurrent or chronic symptoms that continue to stay on months and years.(1)

The imbalance of lumbopelvic musculature in Lower Cross Syndrome (LCS) is predictable: tight or overactive hip flexors (especially iliopsoas and rectus femoris) and lumbar erector spinae, and inhibited or weak abdominal and glutus muscles.(2) The effect of this imbalance is likely to result in an augmented lumbar lordosis, anterior pelvic tilt, and change in the load distribution among the segments of the spine and the lack of control over the lumbopelvic movements.(3) Patients often complain of pain during extended periods of standing, walking, or postural maneuvers and often present with impaired functionality that impacts both the overall movement and quality of life of the patient. A combination of postural examination, muscle length measures (e.g., modified Thomas test), manual muscle testing of abdominals and gluteals, and inclinometer measures of pelvic tilt are generally used to operationally define the syndrome in practice and research.(4)

Considering the mechanical aspects of LCS, the treatment of the condition usually centers on the changes in the relationship between short and lengthened muscles, re-establishing the lumbopelvic position, and changing movement strategies. Commonly used methods are the application of targeted stretching of tight structures, inhibited muscle strengthening and postural retraining (5). Some interventions that have been studied clinically include Janda-based exercises of corrective intervention, core stability programs and muscle energy techniques. Although these interventions show positive results on pain, flexibility and functional outcomes, studies show evidence on which therapeutic modality with the multi-muscle imbalance pattern that is complex in LCS. (6) Also,

most of the current research is small sampling, mixed diagnosis criteria, or only looking at either posture correction or symptomatic treatment instead of both approaches.

Unlike the LCS-specific programs, two long-standing exercise-based interventions of LBP the McKenzie Method and Williams Flexion Exercises have been in use during decades across a wide range of clinical populations. McKenzie Method (Mechanically Diagnosed Therapy; MDT) focuses on directional preference testing, repeated movements testing and determining the movements that cause centralization or reduction of pain.(7) Lumbar extension-based protocols are often suggested to most patients with mechanical LBP, because of their effects on disc-mechanics, peripheral symptom-reducing-effectiveness and spinal stability potential. It is also a well-supported intervention since the approach also includes self-management techniques, education of posture, and load management principles, which support the approach in diverse low back pain subgroups.

Instead, Williams Flexion Exercises are foundationally based on the assumption that flexion exercises relieve compressive loads on the posterior musculature of the spine, minimize lordosis of the lumbar spinal region, and enhance abdominal and gluteal activation.(8) The goals of these exercises are to stretch tight hip flexors and enhance trunk flexors and hip extensors, which are elements that coincide with the corrective concepts that are frequently used in LCS. The exercises that Williams goes through are usually pelvic tilts with one or two knees to the chest, partial curls, hamstring and hip stretches and controlled functional strengthening.(9) Although widely used in the past, their application has been fluctuating over the years, in part, because of the transition toward modern stabilization-based methodologies. However, they can still be applied as a treatment to patients with more lordosis or flexion patterns of preference.

Some randomized and quasi-experiments have been conducted to compare McKenzie and Williams exercises in patients with non-specific low back pain, acute /sub-acute pain or mechanical LBP.(10) Other reports indicate the McKenzie exercises to have better short term results in terms of pain and disability whereas other researchers show slight differences amongst the two therapies. Nevertheless, they have been mainly comparative with regards to general LBP populations and not on patients with specific postural-muscular phenotype like LCS. Notably, most past studies have measured only the symptomatic outcomes of pain and disability, but they seldom measured the biomechanical measures e.g. pelvic tilt, lumbar lordosis, or muscle imbalance.(11) Since LCS is essentially a neuromuscular imbalance and postural deviation unlike simple symptomatic LBP, the lack of biomechanical outcome measures inhibits the extrapolation of the past data to LCS populations.

Such a gap demonstrates a significant opportunity of specific research. McKenzie and Williams exercises are both commonplace in clinical practice but their relative efficacy in a well-defined LCS population is yet to be properly tested in a randomized controlled trial. Clinicians regularly come across patients with an appearance of LCS and low back pain, but there is no evidence-based practice on whether an extension-based protocol (McKenzie) or flexion-biased, muscle-correction protocol (Williams) proves to be more relevant in treating the muscular and postural aberrations of the syndrome. Since previous studies have varied in their outcomes with generic LBP and there is theoretical evidence of the connection between Williams exercises and LCS correction, it is not possible to assume that one technique is necessarily better or worse without making a direct empirical comparison.

Besides, in under-resourced healthcare systems, which most physiotherapy departments in Pakistan are, the most feasible and cost-effective interventions to LBP are simple, therapist-supervised exercise programs. In case a given exercise method proves to have obvious benefits to LCS, then it may inform physiotherapists about the interventions that are likely to maximize functional outcome, minimize chronicity, and enhance patient compliance.

Combining the measurement of both symptomatic and biomechanical outcomes, the study is aimed at identifying the method that provides better correction of the typical muscle-length and strength imbalances of LCS and the physiological processes that are similar in both techniques. The results can be used to facilitate more personalized clinical decision-making and add to the scarce pool of high-quality research that addresses therapeutic interventions of Lower Cross Syndrome specifically.

METHODOLOGY

Study Design

This research was a single-centered, parallel-group, randomized controlled clinical trial followed CONSORT guidelines and research protocol. The Research and Ethics Committee (REC), College of Physical Therapy, Government College University Faisalabad granted ethical approval of the study with Ref. No. GCUF/ERC/25/15.

Study Setting and Duration

The study was conducted in the outpatient department of physiotherapy of Ahmad poly clinic Faisalabad, Pakistan. The process of recruitment and collection of data occurred between February 2025 and July 2025 to provide enough time to conduct screening of participants, provide interventions and conduct follow ups.

Eligibility Criteria

Inclusion Criteria:

- Adults aged 18–45 years.
- Operationally defined: Lower Cross Syndrome Clinical diagnosis:
- Hypodontosis of the lumbar lordosis ascertained either by inclinometer or photogrammetric examination.
- Anterior pelvic tilt of greater than normative values (>10 15 o/s).
- Hip flexors that were shortened as evidenced by positive modified Thomas test.(2)
- Chronic non-specific low back pain of more than 3 months.

Exclusion Criteria

- Lumbar radiculopathy, neurological injury or red-flag spinal pathology.

- Past vertebral fracture, spinal surgery or inflammatory spinal disease.
- During pregnancy or post-partum less than 6 months.
- HIP/Knee: Severe restrictions to performing exercises.
- Being involved in organized physiotherapy/physical exercise, in the last 3 months.

Sample Size

The sample size estimation was based on anticipated between-group differences in pain reduction (VAS) and functional disability (ODI), informed by effect estimates reported in a previous randomized trial comparing McKenzie and Williams exercise protocols. Assuming a medium effect size (f = 0.25), an alpha level of 0.05, statistical power of 0.80, and a repeated-measures design with three assessment points (baseline, mid-treatment, and post-treatment), power analysis indicated that a minimum of 48 participants (24 per group) was required. To account for potential attrition, the recruitment target was increased to 56 participants.(12)

Recruitment and Screening Procedures

The participants were contacted by way of outpatient referrals, and recommendations by clinicians. The screening was done in two stages:

1. **Preliminary examination**: Demographic information, history of pain, and history.
2. **Physical examination**: postural examination, Modified Thomas Test, MMT of abdominal and gluteal muscles, and lumbar lordosis measurement using inclinometer.

The allocation concealment

The participants that met the criteria of eligibility were randomly assigned to either the McKenzie Method group or Williams Flexion group in equal ratio of 1:1. It was a computer generated random sequence and the block sizes were used. The allocation concealment was obtained through the use of opaque and sealed sequentially numbered envelopes that were prepared by another researcher who did not participate in the recruitment and intervention delivery.

Blinding

Participant blinding was also not possible because of the nature of the interventions. The assessor in the process of measuring outcomes was unaware of group assignment. Statistical analysis also had the blindness of group labels to the data analyst.

Interventions

The interventions were carried out in a period of 8 weeks consisting of three supervised sessions in a week (24 sessions in total). The sessions took place in a 30-40 minute period.

McKenzie Method Group (MDT)

The participants belonging to this group were treated as per the standardized lumbar spine Mechanical Diagnosis and Therapy (MDT) protocol. Since people with Lower Cross Syndrome generally have excess lumbar lordosis, short hip flexors and inhibited abdominals/gluteals, the common McKenzie lumbar extension regime potentially poses a hypothetical risk of overlordosis especially when end-range extension is performed aggressively. So It focused more on the mid-range repeated movements, and the directional preference results without forcing the patients to exceed the neutral range of the spine.

- Prone lying with pillow support under abdomen (to reduce lumbar lordosis and more focus on hip flexors stretch)
- Prone on elbows (POE) with neutral pelvis, ensuring no sagging of the lumbar spine
- Modified extension in lying (EIL) stopping at neutral to slight extension, without forcing the pelvis into anterior tilt maintaining stretch on hip flexors
- Extension in standing with hand support but performed gently, avoiding end-range lumbar hinging.
- Flexion in lying with bilateral knee to chest, flexion in sitting on the chair with wide base of support and touch the ground by complete bending the lumber and flexion in standing with the effort of touching the ground

Williams Flexion Exercise Group

Participants in this group were administered the Williams Flexion Exercise Program, which aims at lumbar flexion, abdominal emotions, and stretching of hip flexor muscles. The conventional pattern entailed:

- Pelvic tilting maneuvers
- Single knee to chest and double knee to chest stretches.
- Particular curl-ups with emphasis on rectus abdominis.
- Hamstring stretching
- Half-kneeling Iliopsoas extension.
- Bridging progressions in gluteal strengthening.
- Squat patterns with abdominal other-activity.

Both exercise regimens were done in 2-3 series of 10- 15 repetitions. It was stressed to focus on the correction of lumbopelvic mechanics, excessive lordosis, and muscle balance that is typical of LCS.

Outcome Measures

All the results were measured at baseline and after the intervention (Week 8).

Primary Outcomes

- **Pain**: assessed by The VAS (0-10 cm)
- **Functional Disability**: Assessed in the Oswestry Disability Index (ODI)

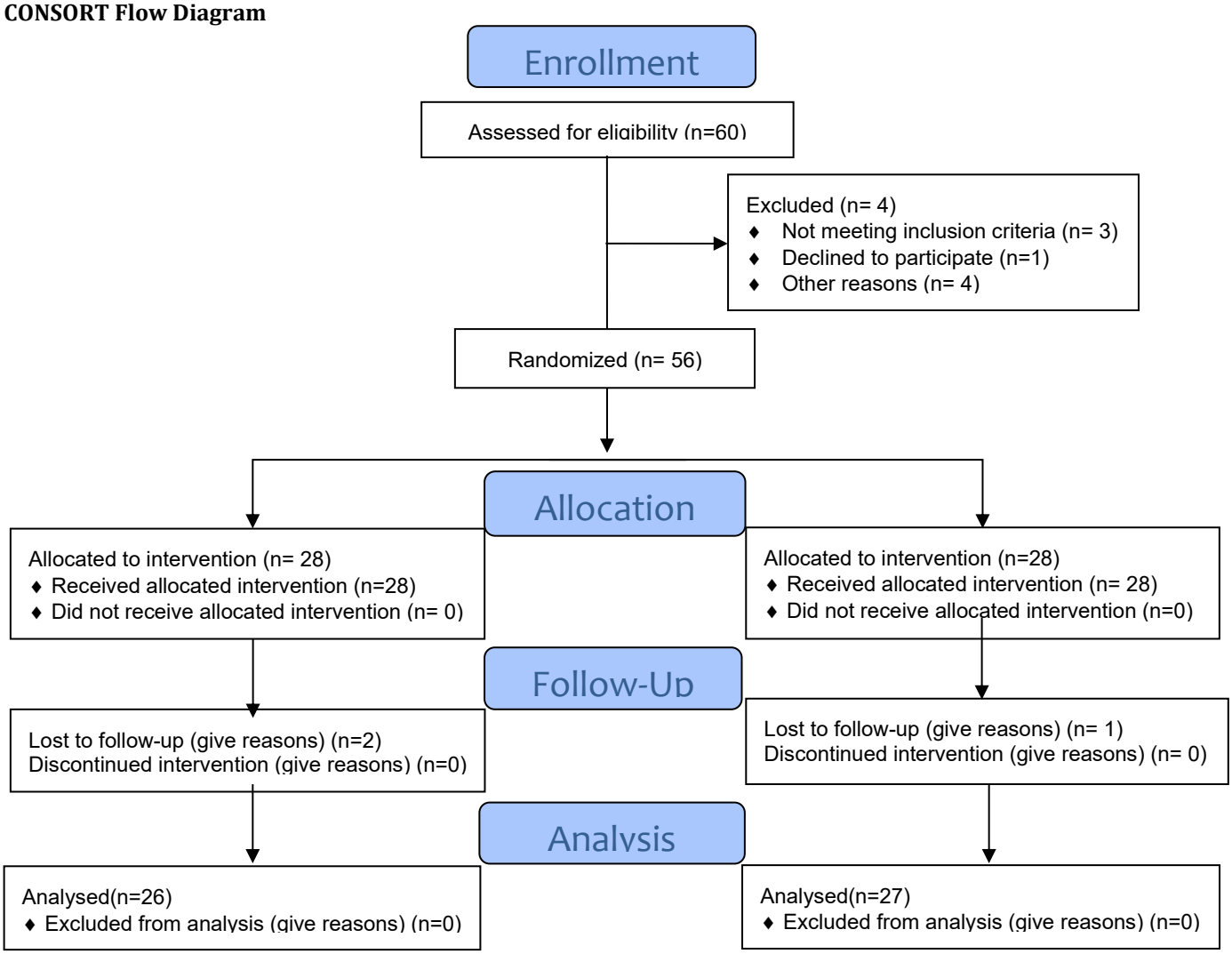
Secondary Outcomes

- Flexor tightness of hips using modified Thomas Test (hip extension angle)
- Core endurance were assessed with plank and supine bridge in seconds

Statistical Analysis

The data was analyzed with SPSS version 25. Baseline demographics and outcome measures were described using descriptive statistics (mean + SD). At the baseline independent t-tests or chi-square tested group equivalence. Paired t test was used to compare means of within groups.

CONSORT Flow Diagram



RESULTS

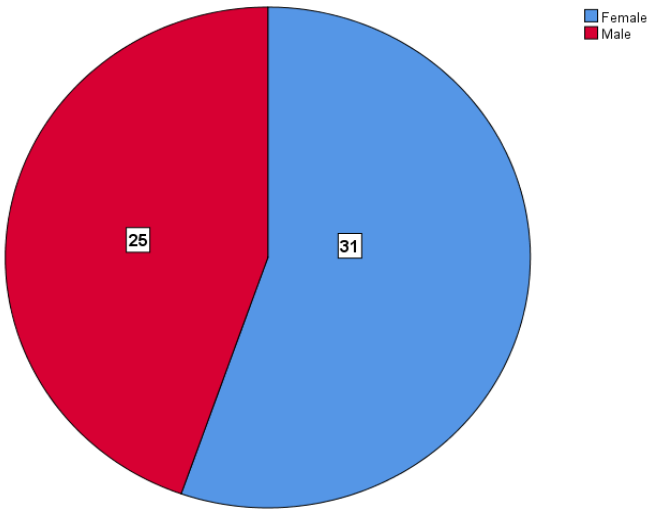
Table 1

Descriptive Statistics for Age and BMI

Variable	N	Mean	Std. Deviation	Minimum	Maximum
Age in years	56	30.06	5.64	16.60	39.60
BMI	56	25.72	3.21	20.50	35.00

Figure 1

Gender Distribution



The mean age of the 56 participants is 30.06±5.64 BMI score is 25.72±3.21, and the pie chart showing the gender distribution is 31 females and 25 males.

Table 2

Within Group's Comparison of all Characteristics of Both Groups

Characteristics	Group A (McKenzie)			Group B (Williams)		
	Mean	SD	P-value	Mean	SD	P-value
VAS Baseline	6.26	.64	0.000	5.94	.90	.000
VAS at Post intervention	2.86	1.13		2.22	.70	
ODI score Baseline	41.59	5.89	0.000	42.13	7.65	.000
ODI score at Post intervention	28.02	7.10		20.97	7.27	
hip flexor ROM AT Baseline	-9.71	3.12	0.000	-9.07	2.74	.000
hip flexor ROM POST intervention	-5.46	3.08		-3.28	2.90	
Plank in seconds at baseline	38.98	10.22	0.000	41.47	11.22	.000
Plank in seconds after intervention	63.08	13.61		81.18	12.04	.000
Bridge hold in seconds at baseline	31.02	6.99	0.000	32.31	9.11	.000
Bridge hold in seconds after intervention	51.18	10.43		67.86	10.44	.000

Table 3
Between Groups' Comparison in all Characteristics

Outcomes	Groups	Mean	SD	P value
VAS Post intervention	McKenzie Williams	2.86 2.22	1.13 .70	0.015
ODI Post-intervention	McKenzie Williams	28.02 20.97	7.10 7.27	0.001
hip flexor ROM Post intervention	McKenzie Williams	-5.4 -3.28	3.08 2.90	0.009
Plank in seconds after intervention	McKenzie Williams	63.08 81.18	13.61 12.04	0.000
Bridge hold in seconds after intervention	McKenzie Williams	51.18 67.86	10.43 10.44	0.000

DISCUSSION

Both groups demonstrated significant improvements in pain, disability, hip flexor flexibility, and core endurance from baseline to post-intervention, confirming that both McKenzie and Williams exercises were effective. However, the between-group analysis showed that Williams Flexion Exercises produced significantly greater improvements across all outcomes, including lower VAS pain scores, better ODI functional status, greater hip flexor ROM gains, and markedly higher plank and bridge endurance. Williams exercises were superior in correcting muscular imbalance and enhancing functional performance in patients with lower-cross-syndrome–related low back pain.

This is the first randomized comparison is specifically aimed at patients with clinically defined LCS. Previous comparative studies primarily used heterogeneous non-specific LBP groups and this could be the reason behind inconsistent results that have been documented in the past. Certain researches supported the use of McKenzie therapy in mechanical or acute LBP cases where it was observed that short-term pain and disability were better in comparison to the use of Williams exercises. So McKenzie exercises prove more effective in pain relief and improvement in functional abilities (13). On the other hand, there were no significant differences between the two in other studies, particularly in non-specific or adolescent LBP cohorts, which further supports the heterogeneity of patient presentation in previous studies.(10)

Importantly, the majority of the past research only examined symptomatic outcomes and not underlying muscular or biomechanical factors. Due to the underlying nature of LCS, as a postural-muscular imbalance syndrome, the generic LBP research results cannot be easily generalized. The current trial fills a major gap in the literature by paying special attention to LCS and adding such measures as muscle flexibility and endurance. The study findings are consistent with those studies which have directly focused on muscle imbalance. Fatemia et al. (2015) showed the improvement of lumbosacral muscle functioning, decreased lordosis, and decreased chronic LBP after Williams exercises, which reflected our results.(14)

Altogether, the current research supports the concept that exercise therapy should be specific to the biomechanical phenotype. In the case of LCS, (i.e. anterior pelvic tilt, reduced hip flexors and weak abdominals/gluteals), flexion-based strengthening and stretching program seems more physiological as compared to extension-intensive program.(15)

McKenzie approach on the other hand has its basis on directional preference theory and is mainly indicated in discogenic or extension responsive LBP.(16) Because LCS is associated with a spine that is already in an over-extended posture, the use of extension-based therapy would not directly target the etiological factors of the condition but can even worsen hyperlordosis when done excessively. Even though modified McKenzie protocol did not entail the extension of the end range to avoid the worsening of lordosis, it lacked the level of flexion-based stretching and strengthening that LCS patients need. This is probably the reason why the improvements in the McKenzie group were relatively smaller.

These results also support the original theory by Janda which states that chronic postural syndromes should be cured by deliberately fixing tightness and weakness instead of exercising in general.(17) Modern evidence confirms this opinion: recent randomized trials and systematic reviews indicate that core strengthening, muscle-balancing and flexibility focused programs outperform extension-biased programs in chronic LBP and imbalance syndromes.(18, 19) The current trial introduces additional evidence on a case-specific trial of LCS, which proves that flexion-biased regimen provides better functional and symptomatic outcomes.

One of the strongest aspects of this study was that the identified population of LCS patients was relatively narrow, which guaranteed the clinical homogeneity. Symptomatic as well as biomechanical domains were evaluated through the use of objective assessment tools; such as VAS, ODI, flexibility measures, and endurance tests. The supervised interventions were standardized and randomized with the use of a randomized controlled design that improves internal validity as well as a blinding of the assessors. Moreover, this is the first study that directly compares flexion- vs. extension-based protocols in LCS, which has a direct clinical implication since it was previously only possible to extrapolate generalized LBP studies.

Limitations

Although the sample size used, which is sufficient to identify moderate-to-large treatment effects, might be limiting to the accuracy of subgroup analysis. The post intervention was limited to eight weeks; it is not known whether the improvements are sustainable in the long run. Moreover, it is that there is no no-treatment control group, so it is not possible to measure absolute effect sizes relative to natural recovery, but it is ethical to have made this decision. The interviewees were not blinded to the intervention, which increases the possibility of bias in performance, but objective measures are helpful to eliminate it.

Study significance

The results have a significant implication on the practice of physiotherapy, particularly in the low and middle-income nations whereby the costs of technology or multidisciplinary care are costly. Williams exercises are easy, cheap to administer, and need very little equipment and therefore can be used in environments with limited

resources. However, a first-line treatment with flexion-oriented protocols should be considered by clinicians dealing with the LCS presentations due to their better results in this trial. Such exercises have a direct impact on the biomechanical aspects that cause LCS and can improve patient compliance by offering instant postural relief, especially those people who feel discomfort during lumbar extension or standing.

In an environment where therapists tend to follow conventional exercise therapy because of the lack of resources, an apparent evidence-based suggestion, the preferential use of Williams exercises to LCS, would contribute greatly to the effectiveness of the treatment and functional outcomes without extra expenses.

CONCLUSION

This randomized controlled trial directly compared Williams Flexion Exercises and McKenzie Method in patients with clinically defined Lower Cross Syndrome. The benefits of both interventions were similar to reduce pain, disability, hip flexor tightness, and core endurance but Williams exercises showed a lot more improvement in all the outcomes. These findings showed that LCS as an essentially a postural-muscular imbalance syndrome is more responsive to flexion-based strengthening and specific strength-stretching interventions which directly affect shortened hip flexors and weak abdominal-gluteal muscles.

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