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Original Article

Lower Cross Syndrome: Specific Treatment Protocol versus Generalized Treatment Protocol. A Randomized Single-Blinded Trial

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Abstract

Introduction: Lower crossed syndrome (LCS) is a biomechanical muscle imbalance causing low back pain.

Aim: This study aimed to compare specific treatment protocols versus generalized treatment protocols for managing low back pain associated with LCS.

Materials and methods: This randomized, single-blinded trial involved 200 patients (aged 20-40 years) with low back pain and LCS. Patients were divided into four groups: A1 and A2 (specific protocols for posterior and anterior LCS), and B1 and B2 (generalized protocols). Interventions were administered thrice weekly for two weeks. Outcome measures included Numerical Pain Rating Scale (NPRS), Modified Oswestry Disability Questionnaire (MODQ), Lumbar Lordosis Index (LLI), abdominal and gluteal muscle strength, and iliopsoas and back extensor flexibility.

Results: All groups showed significant improvements in all parameters ($p<0.01$). However, specific protocols demonstrated superior outcomes. Group A1 showed the greatest reductions in pain (median NPRS decrease: 5), disability (median MODQ decrease: 45), iliopsoas tightness (median decrease: 12°) and back extensor tightness (median decrease 6.5). Group A2 exhibited the highest improvements in abdominal strength (median increase: 8 kg) and gluteal muscle strength (median increase: 8 kg).

Conclusion: Specific treatment protocols were significantly more effective than generalized protocols in managing low back pain associated with LCS. These findings emphasize the importance of accurate LCS classification and tailored interventions for optimal therapeutic outcomes in patients with low back pain.

Keywords

lower crossed syndrome, low back pain, muscle imbalance, physiotherapy specific treatment

INTRODUCTION

In the modern era, every individual lives a busy life putting stress on their body which is considered trivial by human nature. This stress over some time rises to a level where it presents as pain primarily in the lower back region.

Non-specific low back pain is defined as low back pain not attributable to a known cause.[1] It represents 90% to 95% of the cases of LBP[2] and 85% of back pain is associated with myofascial pain syndrome (MPS).[3] LBP affects most people at some point in their lives, with up to an 84% lifetime prevalence.[4]

There are several factors that are responsible for the development of low back pain which includes increased lumber lordosis, reduced abdominal muscle length and strength, reduced endurance of back extensor muscle, back extensor muscle flexibility, length of the iliopsoas, hamstring muscle flexibility, and body composition.[5]

The lower crossed syndrome (LCS) is defined an "S" shaped posture of the lower back region characterized by weak abdominal muscle and gluteus maximus muscle paired with tight hip flexors and lower back muscles. It is also referred to as a distal or pelvic crossed syndrome.[6]

Low back pain (LBP) leads to impaired motor performance and causes difficulty in performing daily activities. It is a universal problem and lower crossed syndrome (LCS) is one of the conditions of biomechanical muscle imbalance due to extreme stress that is placed on the structures of the lower back. People with such postural imbalance often complain of lower back pain and when left untreated, this postural imbalance can lead to chronic lower back pain that becomes more difficult to correct.

There is a lack of literature, which shows the specific physiotherapy management for patients with type A and type B (predominant) lower crossed syndrome.

AIM

Hence, this study was designed to compare the specific treatment protocol versus generalized treatment protocol on pain and disability in low back pain with lower cross syndrome patients. It may provide appropriate corrective management of the specific affected musculatures. If it can be managed at an early stage, it will serve as a further prevention strategy in preventing the risk of developing chronic LBP.

MATERIALS AND METHODS

This is an interventional, randomized, single-blinded trial conducted at Rajkot, Gujarat, India on 200 eligible patients. Ethical clearance was obtained from the institutional ethics committee (human), PDU Medical College, Rajkot, vide reference number PDUMCR/IEC/19/2022, and a clinical trial registry was done for the study vide reference number CTRI/2022/07/044487. Written informed consent was obtained to participate in the study and use the data for research and educational purposes. The study was carried out according to the principles of the Declaration of Helsinki (2013) and good clinical practice (GCP).

The sample size was calculated using mean and standard deviation (SD) values from both groups, aiming for a 95% confidence level and 80% power. This resulted in a total of 200 subjects, divided equally into experimental and control groups. Inclusion criteria encompassed patients of both genders, male and female, between ages 20 to 40 years, clinically diagnosed with low back pain <6 months and lower cross syndrome. Exclusion criteria included subjects with spondylolisthesis, lumbar canal stenosis, recent history of trauma or fall, neurological deficits, history of corticosteroid injections in preceding 3 months, history of previous lower limb, hip, pelvis, and spine trauma or fracture, and patients with any recent medical treatment or physiotherapy.

A total of 200 patients were taken for the study and were allocated randomly using the envelope method to control and experimental group. Then patients in group A and group B were further divided based on lumbar lordosis index into: group A1 which administered a specific treatment protocol for posterior lower cross syndrome (lumbar hyperlordosis group), group A2 which administered a specific treatment protocol for anterior lower cross syndrome (lumbar hypolordosis group), group B1 which was administered generalized treatment protocol for posterior lower cross syndrome (lumbar hyperlordosis group), group B2 which was administered generalized treatment protocol for anterior lower cross syndrome (lumbar hypo lordosis group). Normal values for lumbar lordosis index are 6.50–17.80.[7] If the lumbar lordosis index of the patient was ≥17.80 then they were included in the lumbar hyperlordosis group (group A1/B1) and if the lumbar lordosis index of the patient was ≤6.50 then they were included in the lumbar hypolordosis group (group A2/B2). Demographic data including age, gender, height and weight, were collected from them. Outcome measures taken for the study were: The strength of abdominal[8] and gluteus maximus[9] muscles and it was measured using a hand-held dynamometer in terms of kg. The flexibility of back extensors was assessed by the modified Schober's test[10] using non-elastic measure tape and iliopsoas tightness was assessed by modified Thomas test[11] using a universal goniometer. The lumbar lordosis index was measured using a flexible ruler.[12] Numerical pain rating scale (NPRS) [13] was taken to measure pain intensity. Modified Oswestry Disability Questionnaire (MODQ) was used to measure disability due to low back pain.[14]

Group A1 (posterior lower cross syndrome) involved patients with lumbar hyperlordosis. The treatment combined stretching[15] and William's training[16] protocols to reduce lumbar hyperlordosis. Group A2 (anterior lower cross syndrome) involved patients with lumbar hypolordosis. The treatment focused on strengthening[15] abdominal and gluteal muscles, along with specific exercises to address lumbar hypolordosis. Groups B1 and B2 followed a generalized[15] treatment protocol aimed at overall muscle strengthening and stabilization, providing a balanced approach to address lower crossed syndromes. The intervention was given 3 times a week for 2 weeks. Then after 2 weeks, patients were assessed again. The dosage of the treatment protocol for each group is shown in **Fig. 1**.

The data including the demographic characteristics and the outcome parameters – measured both before and after intervention in each group were recorded and analyzed using Microsoft Excel (Microsoft® Corporation, Redmond, WA). Appropriate statistical tests were used to check for statistical significance. A *P*-value <0.05 was considered statistically significant.

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Figure 1. Treatment protocol for all groups.

RESULTS

As can be seen by **Table 1**, the age distribution of patients across the four groups (A1, A2, B1, and B2) is similar (p=0.85). Gender distribution across the groups is balanced, with no statistically significant differences (p=0.84). BMI distribution shows a statistically significant difference among the groups (p=0.0011). Groups A1, A2, and B2 have higher percentages of overweight or obese patients (BMI ≥25), while group B1 has a higher percentage of patients with a normal BMI. Overall, the groups are well-balanced in terms of age and gender, but there are significant differences in BMI distribution.

Table 2 and **Table 3** show that all groups (A1, A2, B1, and B2) exhibit significant reductions in Numerical Pain Rating Scale (NPRS) scores after the intervention (p<0.01), indicating statistically significant improvements in pain levels. Similarly, each group demonstrated significant decreases in Modified Oswestry Disability Questionnaire (MODQ) scores post-intervention (p<0.01), reflecting substantial improvements in functional ability and reductions in disability. Significant improvements in the lumbar lordosis index were also observed in all groups post-intervention (p<0.01), indicating positive changes towards normal spinal alignment. Significant improvements in abdominal strength after the intervention (p<0.01) were observed in all groups, indicating improved abdominal muscle strength. Similarly, each group demonstrated significant increases in gluteal muscle strength post-intervention (p<0.01), reflecting substantial improvements in gluteal muscle strength. Significant reductions in iliopsoas tightness were observed in all groups post-intervention (p<0.01), indicating improved muscle flexibility. Additionally, each group exhibited significant reductions in back extensor tightness after the intervention (p<0.01), reflecting enhanced back extensor muscle flexibility and strength.

Based on **Table 4** and **Fig. 2**, the comparison of differences in outcome parameters between the four groups after the interventions reveals that all groups showed significant improvements across all measured parameters (p<0.01). Group A1, which received the specific treatment protocol for posterior lower crossed syndrome/lumbar hyperlordosis, demonstrated the most pronounced reductions in pain levels, disability, and iliopsoas tightness. Additionally, group A1 showed the greatest increments in lumbar lordosis index and back extensor tightness. Conversely, group A2, which received the specific treatment protocol for anterior lower crossed syndrome/lumbar hypolordosis, exhibited the highest effectiveness in enhancing abdominal strength and gluteal muscle strength. The generalized treatment protocols (groups B1 and B2) also led to significant improvements across all parameters, but to a lesser extent compared to the specific protocols. These findings underscore the superior efficacy of specific treatment protocols in managing low back pain and lower crossed syndrome by effectively addressing specific muscular imbalances and enhancing overall muscle strength and flexibility.

DISCUSSION

This study aimed to evaluate the effectiveness of specific treatment protocols compared to generalized treatment protocols for patients with low back pain associated with

Table 1. Basic demographic characteristics of patients in all groups (N=200)

Age groups	**Group A_1 (n=50)**		**Group A_2 (n=50)**		**Group B_1 (n=50)**		**Group B_2 (n=50)**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
20-25	10	20	7	14	11	22	05	10
26-30	13	26	14	28	11	22	13	26
31-35	14	28	11	22	13	26	17	34
36-40	13	26	18	36	15	30	15	30
Fisher exact value=7.23, p=0.85								
Gender	**Group A_1 (n=50)**		**Group A_2 (n=50)**		**Group B_1 (n=50)**		**Group B_2 (n=50)**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Male	21	42	25	50	23	46	25	50
Female	29	58	25	50	27	54	25	50
χ^2 =0.88, df=1, p=0.84								
BMI kg/m²	**Group A_1 (n=50)**		**Group A_2 (n=50)**		**Group B_1 (n=50)**		**Group B_2 (n=50)**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
<18.5	01	2	2	4	3	6	2	4
18.5–22.9	14	28	16	32	25	50	14	28
23–24.9	12	24	4	8	5	10	11	22
≥25	23	46	28	56	17	34	23	46
Fisher exact value=0.99, p=0.0011								

Table 2. Comparison of outcome parameters (NPRS, MODQ, and lumbar lordosis index) within groups (N=200)

Group	Numerical pain rating scale (NPRS)								Wilcoxon signed rank test *P*-value
	Before intervention				After intervention				
	Median	IQR	Mean	SD	Median	IQR	Mean	SD	
Group A_1 (n=50)	7	2	6.9	1.01	1	1	1.42	1.05	<0.01
Group A_2 (n=50)	7	2	6.72	1.08	2.5	1	2.5	1.29	<0.01
Group B_1 (n=50)	6	2	6.14	0.99	4	2	3.78	1.31	<0.01
Group B_2 (n=50)	7	2	6.64	1.13	3	2	3.32	1.44	<0.01
Group	**Modified Oswestry disability questionnaire (MODQ)**								**Wilcoxon signed rank test *P*-value**
	Before intervention				**After intervention**				
Group A_1 (n=50)	64	54-70	62.8	10.6	18	12-27.5	19.4	9.14	<0.01
Group A_2 (n=50)	62	52-68	61.4	10.5	26	20-39.5	28.6	12.7	<0.01
Group B_1 (n=50)	58	52-66	58.8	9.74	33	26-40	35.3	12	<0.01
Group B_2 (n=50)	62	56.5-68	62.2	9.42	34	26-45.5	36.3	12.1	<0.01
Group	**Lumbar lordosis index**								**Wilcoxon signed rank test *P*-value**
	Before intervention				**After intervention**				
Group A_1 (n=50)	22.3	19.5-24.2	22	3.48	10.5	9.7-12.3	10.9	1.75	<0.01
Group A_2 (n=50)	6.3	5.3-7.07	6.26	1.2	13.6	12.3-14.9	13.9	2.35	<0.01
Group B_1 (n=50)	20.2	18.9-23.4	21.5	3.62	17.4	15.4-18.8	17.7	3.37	<0.01
Group B_2 (n=50)	6.4	5.28-7.07	6.32	1.13	9.2	8.3-11	9.71	1.98	<0.01

Table 3. Comparison of outcome parameters (abdominal and gluteal strength, iliopsoas and back extensor tightness) within groups (N=200)

Group	Abdominal strength (Kg)								Wilcoxon signed rank test *P*-value
	Before intervention				After intervention				
	Median	IQR	Mean	SD	Median	IQR	Mean	SD	
Group A_1 (n=50)	4	3-5	4.38	1.32	7	6-8	7.26	1.55	<0.01
Group A_2 (n=50)	2	2-3	2.42	1.11	10	9-12	10.3	1.62	<0.01
Group B_1 (n=50)	4	3-4	3.5	1.34	5	3-5	4.26	1.41	<0.01
Group B_2 (n=50)	3.5	3-5	3.54	1.39	5	4-6	4.78	1.42	<0.01
Group	**Gluteal muscle strength of right-left (Kg)**								**Wilcoxon signed rank test *P*-value**
	Before intervention				**After intervention**				
Group A_1 (n=50)	4	3-5	4.17	1.56	7	5.13-8	6.62	1.56	<0.01
Group A_2 (n=50)	2	1.5-2.88	2	0.75	10.3	9-11	10.2	1.13	<0.01
Group B_1 (n=50)	2.5	2-3	2.37	0.69	3.5	3-3.5	3.3	0.66	<0.01
Group B_2 (n=50)	2.75	2.5-3	2.67	0.81	4.5	3.5-5	4.34	0.98	<0.01
Group	**Iliopsoas tightness of right-left side (degrees)**								**Wilcoxon signed rank test *P*-value**
	Before intervention				**After intervention**				
Group A_1 (n=50)	22	19.6-25	22.5	4.17	10	9-10.9	10	2.02	<0.01
Group A_2 (n=50)	19	18-20	19	2.22	17	15-19	17	2.18	<0.01
Group B_1 (n=50)	20	17.3-23	20.1	3.8	19	17-22	19.6	3.86	<0.01
Group B_2 (n=50)	20	17.3-22.4	20.1	3.36	18.3	17-21	19	3.22	<0.01
Group	**Back extensor tightness (degrees)**								**Wilcoxon signed rank test *P*-value**
	Before intervention				**After intervention**				
Group A_1 (n=50)	5	5-6	5.36	1.08	12	10.3-13	11.8	1.53	<0.01
Group A_2 (n=50)	5	4-6	4.98	0.97	6	6-7	6.24	0.89	<0.01
Group B_1 (n=50)	5.5	5-6	5.38	1.1	6	6-7	6.2	1.03	<0.01
Group B_2 (n=50)	5	4-6	5.02	1.22	7	6-7	6.56	1.09	<0.01

Table 4. Comparison of difference in outcome parameters (NPRS, MODQ, lumbar lordosis index, abdominal and gluteal strength, iliopsoas and back extensor tightness) between groups (N=200)

Difference in	Groups								Kruskal-Wallis test
	Group A_1 (n=50)		Group A_2 (n=50)		Group B_1 (n=50)		Group B_2 (n=50)		
	Median	IQR	Median	IQR	Median	IQR	Median	IQR	*P*-value
NPRS	5	5-6	4	4-5	3	2-3	3.5	3-4	<0.01
MODQ	45	34-52	28	22.5-43.5	21	12-32	25	18-30	<0.01
Lumbar lordosis index	10.9	9.13-12.8	7.7	6-9.2	2.9	2-4.38	3.1	2.1-4.5	<0.01
Abdominal strength (kg)	3	2-4	8	7-9	1	0-1	1	1-2	<0.01
Gluteal muscle strength of right-left (kg)	2.5	2-3	8	7.13-9	1	0.5-1.38	1.5	1.5-2	<0.01
Iliopsoas tightness (degrees)	12	10-15	2	1.13-2.5	0.5	0-1	1	0.5-1.88	<0.01
Back extensor tightness (degrees)	6.5	5-7	1	1-2	1	0-1	2	1-2	<0.01

lower cross syndrome (LCS). The results demonstrate significant improvements in pain intensity, disability levels, and lumbar lordosis index across all intervention groups, with specific protocols showing superior outcomes.

Pain reduction

All four groups experienced statistically significant reductions in pain levels as measured by the Numerical Pain Rating Scale (NPRS). However, the specific treatment protocols (groups A1 and A2) resulted in more substantial pain reductions compared to the generalized protocols (groups B1 and B2). Group A1, which received the specific protocol for posterior LCS/lumbar hyperlordosis, showed the greatest median reduction in NPRS scores (5 points), followed by group A2 (4 points).

These findings align with previous studies that have highlighted the importance of targeted interventions for specific postural imbalances in managing low back pain. For instance, Kim et al.[17] found that a lumbar stabilization exercise program significantly reduced pain and improved function in patients with chronic low back pain and lumbar instability. Similarly, Cho et al.[18] reported that a selective core exercise program was more effective in reducing pain and improving balance in patients with chronic low back pain compared to a general trunk exercise program.

The superior pain reduction in specific protocols may be attributed to the tailored approach addressing the specific muscle imbalances associated with each type of LCS. This targeted approach likely led to better neuromuscular balance and reduced stress on the lumbar spine, resulting in more effective pain relief. These results are consistent with the findings of Jeong et al.[19] who demonstrated that a customized exercise program based on individual muscle imbalances was more effective in reducing pain and improving function compared to a generalized exercise program in patients with chronic low back pain.

Disability improvement

Similar to pain outcomes, all groups showed significant improvements in disability levels as measured by the Modified Oswestry Disability Questionnaire (MODQ). Again, the specific protocols demonstrated superior results, with group A1 achieving the highest median reduction in MODQ scores (45 points), followed by group A2 (28 points). These findings are consistent with previous research indicating that addressing specific postural imbalances can lead to improved functional outcomes in patients with low back pain.

For example, Paungmali et al.[20] found that a specific stabilization exercise program targeting the *transversus abdominis* and *multifidus* muscles led to significant improvements in disability scores and pain reduction in patients with chronic low back pain. Similarly, Javadian et al.[21] reported that a core stabilization exercise program was more effective in improving functional disability compared to general exercises in patients with non-specific chronic low back pain.

The greater improvement in disability scores for specific protocols may be due to the comprehensive approach targeting both muscle length and strength imbalances characteristic of each LCS type. By addressing these imbalances, patients likely experienced improved movement patterns and reduced compensatory strategies, leading to enhanced functional capacity.

Lumbar lordosis index

The study also revealed significant changes in the lumbar lordosis index (LLI) across all groups. Notably, group A1 showed a substantial median decrease in LLI from 22.3 to 10.5, indicating a reduction in lumbar hyperlordosis. Conversely, group A2 demonstrated an increase in LLI from 6.3 to 13.6, suggesting an improvement in lumbar hypolordosis. These

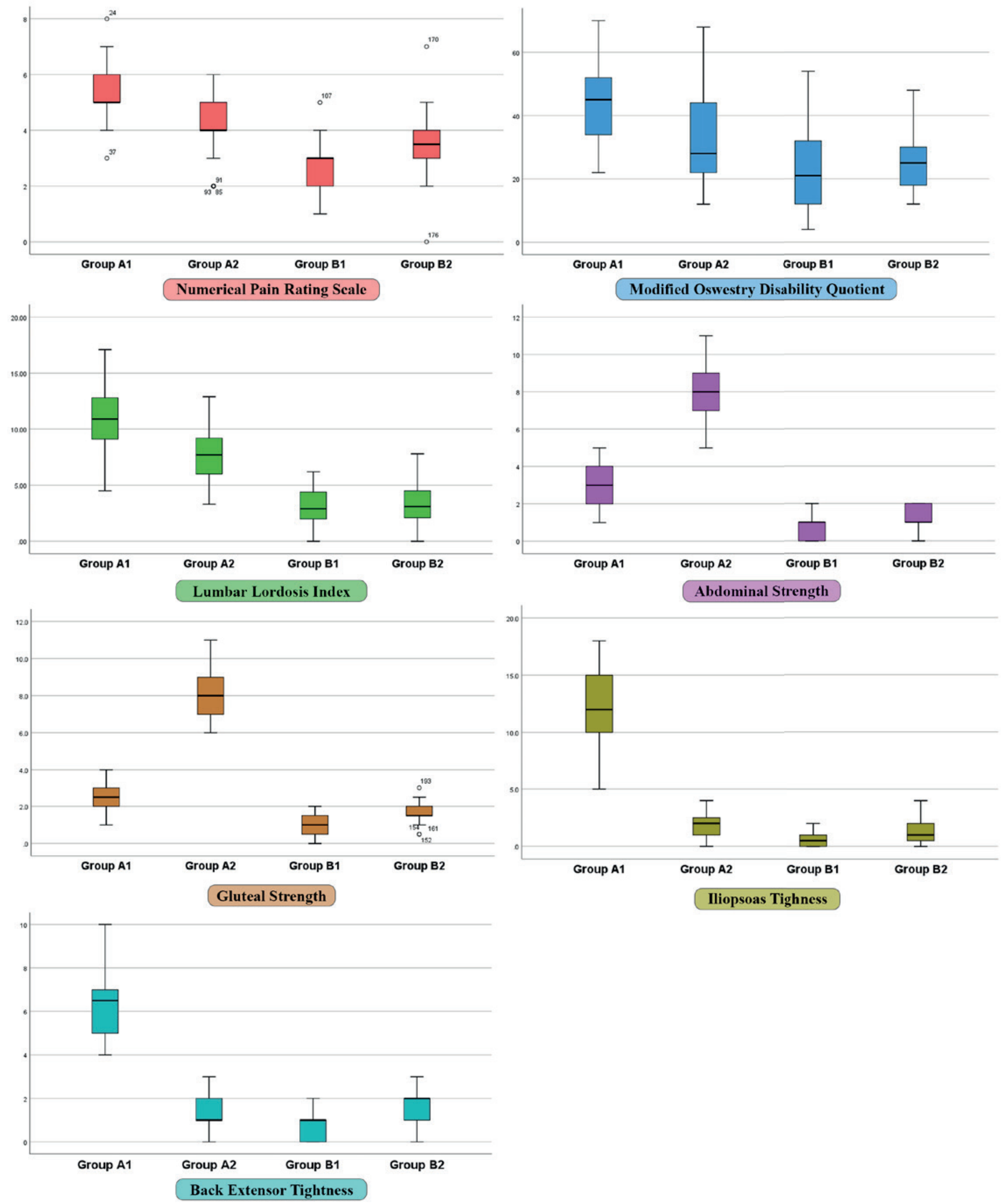

Figure 2. Comparison of difference in outcome parameters between groups.

changes in LLI were more pronounced in the specific protocol groups compared to the generalized protocol groups.

These findings highlight the efficacy of specific exercises in modifying lumbar curvature, which is crucial in addressing the underlying postural imbalances associated with LCS. The targeted approach of stretching and strengthening exercises likely contributed to the restoration of a more neutral spinal alignment. This is in line with the work of Kim et al.[17] and Yoo et al.[22] who found that a lumbar stabilization exercise program effectively reduced lumbar lordosis angle and improved pain and function in patients with chronic low back pain and excessive lumbar lordosis.

Abdominal muscle strength

The results revealed significant improvements in abdominal muscle strength across all groups, with specific protocols yielding superior outcomes. Group A2, which received the specific protocol for anterior LCS/lumbar hypolordosis, demonstrated the most substantial improvement in abdominal strength (median increase of 8 kg). These findings support the importance of core strengthening in the management of low back pain, as highlighted by Akuthota et al.[23]

The superior results observed in the specific protocols, particularly for anterior LCS, underscore the effectiveness of targeted interventions in addressing specific muscle weaknesses associated with different types of LCS. This aligns with the findings of Hlaing et al.[24] who reported that core stabilization exercises were more effective than conventional exercises in improving abdominal muscle strength and reducing pain in patients with chronic low back pain.

Muscle strength

The results showed significant improvements in both abdominal and gluteal muscle strength across all groups, with specific protocols demonstrating superior outcomes. Group A2 exhibited the most substantial improvements in abdominal strength (median increase of 8 kg) and gluteal muscle strength (median increase of 8 kg for both right and left sides). These findings are particularly noteworthy, as weak abdominal and gluteal muscles are key components of lower crossed syndrome.[25]

The significant improvements observed in the specific protocol groups suggest that these interventions effectively addressed the muscle imbalances characteristic of LCS. This is consistent with the work of Searle et al.[26] and Hlaing et al.[24] who found that a targeted exercise program focusing on strength/resistance and coordination/stabilization was effective in improving muscle balance and reducing pain in individuals with postural dysfunction.

Iliopsoas tightness

The study demonstrated significant improvements in iliopsoas tightness across all groups, with specific protocols showing superior results. Group A1, which received the specific protocol for posterior LCS/lumbar hyperlordosis, exhibited the greatest median reduction in iliopsoas tightness (12 degrees for both right and left sides), followed by group A2 (2 degrees for both sides). These findings align with previous research by Malai et al.[27] who reported that specific stretching exercises effectively reduced iliopsoas tightness in individuals with the lower crossed syndrome.

The more substantial improvements observed in the specific protocol groups, particularly group A1, suggest that tailored interventions are more effective in addressing the specific muscle imbalances associated with LCS. This is consistent with the work of Kim et al.[28] who found that a customized stretching program was more effective in improving hip flexor flexibility compared to a general stretching program in individuals with lower crossed syndrome.

Back extensor tightness

Interestingly, the study revealed a significant reduction in back extensor tightness across all groups, with group A1 showing the most substantial median increase (6.5 degrees). This finding may seem counterintuitive at first, but it could be explained by the concept of adaptive shortening of the antagonist muscles as proposed by Janda et al.[29] As the iliopsoas muscles are stretched and the abdominal muscles are strengthened, the back extensors may initially exhibit decreased tightness as they adapt to the new postural alignment.

This phenomenon is supported by the work of Page et al.[30] who discussed the importance of addressing both tight and weak muscles in postural syndromes to achieve optimal results. The increase in back extensor tightness observed in this study, particularly in group A1, may represent a transitional phase in the rebalancing of the muscular system.

CONCLUSION

This study provides compelling evidence for the superiority of specific treatment protocols over generalized protocols in the management of low back pain associated with lower cross syndrome (LCS). The findings demonstrate that tailored interventions addressing the specific postural imbalances present in each type of LCS lead to significantly better outcomes across multiple parameters, including pain reduction, disability improvement, lumbar lordosis correction, muscle strength enhancement, and flexibility improvement.

The specific treatment protocols, particularly for posterior LCS/lumbar hyperlordosis (group A1) and anterior LCS/lumbar hypolordosis (group A2), consistently outperformed the generalized treatment protocols in all measured outcomes. This highlights the critical importance of accurate assessment and classification of LCS types in patients presenting with low back pain.

Clinical implications

The superior outcomes achieved with specific protocols across all measured parameters (pain, disability, lumbar lordosis index, muscle strength, and muscle tightness) reinforce the importance of accurate assessment and classification of LCS types in patients with low back pain. This approach aligns with the concept of classification-based treatment for low back pain, which has shown promising results in previous studies.[31,32]

The findings suggest that clinicians should consider tailoring their treatment approaches based on the specific postural imbalances present in each patient with LCS. This individualized approach may lead to more effective management of low back pain associated with LCS and potentially faster recovery times. The results also highlight the potential limitations of generalized exercise protocols in addressing the specific needs of patients with different types of LCS.

Furthermore, the significant improvements in muscle strength and flexibility observed in the specific protocol groups emphasize the importance of targeted strengthening and stretching exercises in the management of LCS. This is consistent with the findings of Liebenson[33], who emphasized the importance of addressing both tight and weak muscles in the treatment of musculoskeletal imbalances.

Limitations and future directions

While the study provides valuable insights into the effectiveness of specific treatment protocols for LCS, some limitations should be considered. The relatively short intervention period of two weeks may not fully capture the long-term effects of these treatment protocols. Future studies should consider longer follow-up periods to assess the sustainability of the observed improvements and to monitor the potential normalization of back extensor tightness over time.

Additionally, investigating the potential influence of factors such as age, gender, and BMI on treatment outcomes could provide valuable insights for tailoring interventions to specific patient populations. Future research could also explore the combination of specific exercise protocols with other interventions, such as manual therapy or ergonomic modifications, to potentially enhance treatment outcomes further.

Acknowledgements and conflicts of interest

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All authors declare no conflicts of interest related to this manuscript.

Ethical approval and consent of participants

Ethical clearance was obtained from the institutional ethics committee (human), PDU Medical College, Rajkot, vide reference number PDUMCR/IEC/19/2022, and a clinical trial registry was done for the study vide reference number CTRI/2022/07/044487.

Written informed consent was obtained to participate in the study and use the data for research and educational purposes.

We hereby confirm that the manuscript has been read and approved by all the authors. Each author believes that the manuscript represents honest and accurate work.

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Нижний перекрёстный синдром: специфический протокол лечения против обобщённого протокола лечения. Рандомизированное одностороннее слепое исследование

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Резюме

Введение: Нижний перекрёстный синдром (НПС) – это биомеханический мышечный дисбаланс, вызывающий боль в пояснице.

Цель: Целью данного исследования было сравнение конкретных протоколов лечения с обобщёнными протоколами лечения для лечения боли в пояснице, связанной с НПС.

Материалы и методы: В этом рандомизированном одностороннем слепом исследовании приняли участие 200 пациентов (в возрасте 20–40 лет) с болью в пояснице и НПС. Пациенты были разделены на четыре группы: A1 и A2 (специальные протоколы для задней и передней НПС) и B1 и B2 (обобщённые протоколы). Вмешательства проводились три раза в неделю в течение двух недель. Показатели результатов включали числовую шкалу оценки боли (NPRS), модифицированный опросник по инвалидности Oswestry (MODQ), индекс поясничного лордоза (LLI), силу мышц живота и ягодиц, а также подвздошно-поясничную мышцу и гибкость разгибателей спины.

Результаты: Во всех группах наблюдалось значительное улучшение всех параметров ($p < 0.01$). Однако конкретные протоколы продемонстрировали превосходные результаты. Группа A1 показала наибольшее снижение боли (медианное снижение NPRS: 5), инвалидности (медианное снижение MODQ: 45), напряженности подвздошно-поясничной мышцы (медианное снижение: 12°) и напряженности разгибателей спины (медианное снижение 6.5). Группа A2 показала наибольшее улучшение силы брюшного пресса (медианное увеличение: 8 кг) и силы ягодичных мышц (медианное увеличение: 8 кг).

Заключение: Конкретные протоколы лечения были значительно более эффективны, чем обобщённые протоколы, при лечении боли в пояснице, связанной с НПС. Эти результаты подчёркивают важность точной классификации НПС и индивидуальных вмешательств для оптимальных терапевтических результатов у пациентов с болью в пояснице.

Ключевые слова

нижний перекрёстный синдром, боль в пояснице, мышечный дисбаланс, физиотерапевтическое лечение