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Effect of Scapular Stabilization in Improving Shoulder Range of Motion and Reducing Pain Among Patients with Upper Crossed Syndrome

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ABSTRACT
Introduction: Upper Crossed Syndrome is a common musculoskeletal condition characterized by muscle imbalances around the neck and shoulders, leading to poor posture and reduced shoulder range of motion (ROM). This study explores the effectiveness of scapular stabilization exercises in improving shoulder ROM and reducing pain in Upper Crossed Syndrome patients.
Aim: To evaluate the impact of scapular stabilization exercises on shoulder ROM and pain reduction in individuals with Upper Crossed Syndrome compared to conventional physiotherapy methods.
Methods: A randomized controlled trial was conducted with 61 participants diagnosed with Upper Crossed Syndrome, divided into a control group (n=30) receiving conventional physiotherapy and an experimental group (n=31) receiving scapular stabilization exercises. The interventions were performed three times a week for eight weeks. Pain was assessed using the Visual Analogue Scale (VAS), and shoulder ROM was measured using goniometry.
Results: Post-intervention, the experimental group showed a significant reduction in VAS scores (mean reduction of 2.84) and improvement in shoulder ROM across all movements, including flexion, extension, and internal rotation. The control group also demonstrated improvements, but the changes were less pronounced compared to the experimental group.
Discussion: The findings suggest that incorporating scapular stabilization exercises in Upper Crossed Syndrome rehabilitation leads to better outcomes in pain relief and shoulder mobility. The superior results in the experimental group highlight the importance of addressing scapular mechanics for optimal shoulder function.
Conclusion: Scapular stabilization exercises are more effective than conventional physiotherapy in managing Upper Crossed Syndrome, offering significant benefits in pain reduction and improving shoulder ROM. This approach should be considered for inclusion in standard Upper Crossed Syndrome rehabilitation protocols. Further research with larger sample sizes and extended follow-up periods is recommended to validate these findings.

Keywords: Upper Crossed Syndrome, scapular stabilization exercise, range of motion, trigger point release.

INTRODUCTION
Upper Crossed Syndrome is a common musculoskeletal condition characterized by the imbalance of muscles around the shoulder and neck, leading to a forward head posture and rounded shoulders. This condition affects a significant portion of the population, particularly individuals with sedentary lifestyles or those engaged in activities that promote poor posture, such as prolonged computer use. According to Janda (2010), in the study titled Upper Crossed Syndrome: Diagnosis and Management, the condition results in muscle tension and dysfunction in both the upper and lower body, affecting posture and movement patterns. Epidemiological data indicate that up to 60% of office workers experience symptoms related to Upper Crossed Syndrome at some point in their lives, highlighting the widespread nature of this issue (Kendall et al., 2017).
The importance of addressing Upper Crossed Syndrome lies in its impact on quality of life and functional mobility. Patients with Upper Crossed Syndrome often experience limited shoulder range of motion (ROM) and chronic pain, which can hinder daily activities and overall well-being. According to Page et al. (2013), in their study titled Assessment and Treatment of Muscle Imbalance: The Janda Approach, Upper Crossed Syndrome-related muscle imbalances can lead to significant restrictions in shoulder movement and persistent discomfort, underlining the need for effective intervention strategies. Despite the prevalence of Upper Crossed Syndrome, there are gaps in

knowledge regarding effective rehabilitation strategies, especially those targeting scapular stabilization. According to Kibler et al. (2017), in their study The Role of the Scapula in Athletic Shoulder Function, traditional approaches often focus on stretching and strengthening without addressing the underlying scapular mechanics, which are crucial for optimal shoulder function. Their study emphasized that improper scapular mechanics can exacerbate shoulder dysfunction if not properly managed.

This paper aims to fill these gaps by exploring the role of scapular stabilization exercises in improving shoulder ROM and reducing pain among patients with Upper Crossed Syndrome. Scapular stabilization is an important aspect of rehabilitation as it helps maintain the correct positioning of the scapula, ensuring proper biomechanics during shoulder movements. According to Ludewig and Braman (2011), in their publication Scapular Mechanics and Their Role in Shoulder Injury, proper scapular mechanics play a critical role in shoulder health, but the specific effects of scapular-focused interventions on Upper Crossed Syndrome patients have not been thoroughly investigated. This research is therefore crucial for advancing rehabilitation practices and providing targeted therapeutic interventions for Upper Crossed Syndrome.

The contributions of this study to the field of physical therapy are threefold. First, it provides evidence on the effectiveness of a scapular stabilization-focused program, offering a potential shift from conventional rehabilitation methods. Second, it presents a novel approach by integrating scapular stabilization into Upper Crossed Syndrome treatment, which could lead to improved patient outcomes. According to Ludewig and Cook (2013), in their study titled Rehabilitation of Scapular Dyskinesis in Athletes, integrating scapular-focused exercises significantly enhances shoulder mechanics and reduces pain in patients with shoulder dysfunctions. Third, this research addresses current limitations in the field, such as the lack of focus on scapular mechanics in existing Upper Crossed Syndrome management strategies, providing a more comprehensive approach to rehabilitation.

The motivation for this research stems from the need to provide evidence-based strategies that can be easily implemented in clinical practice, benefiting both patients and practitioners. The scope of this study includes evaluating the impact of a scapular stabilization program on shoulder ROM and pain reduction, thereby contributing to more effective Upper Crossed Syndrome management. Addressing this problem has significant implications, including the potential to reduce healthcare costs associated with chronic musculoskeletal pain and improve the quality of life for those affected (Page et al., 2013).

Current approaches to managing Upper Crossed Syndrome often emphasize postural correction and general strengthening exercises. While these methods have shown some benefits, they frequently overlook the importance of scapular stability in maintaining proper shoulder mechanics. According to Ludewig and Braman (2011), in their study Scapular Mechanics and Their Role in Shoulder Injury, scapular control is crucial for shoulder health but is often neglected in rehabilitation programs, leading to suboptimal recovery outcomes. Existing research highlights the importance of scapular control in shoulder health, yet there is a lack of direct application to Upper Crossed Syndrome rehabilitation. This study aims to bridge that gap by offering a focused analysis of how scapular stabilization can directly improve shoulder function and alleviate pain in Upper Crossed Syndrome patients.

The main objective of this study is to evaluate the effectiveness of a scapular stabilization program in improving shoulder ROM and reducing pain in patients with Upper Crossed Syndrome. Secondary objectives include comparing the outcomes of this targeted approach with more traditional rehabilitation methods and identifying key factors that contribute to the success of scapular stabilization in Upper Crossed Syndrome management. By achieving these objectives, the study seeks to provide a foundation for more tailored and effective treatment protocols for Upper Crossed Syndrome, ultimately improving patient care and outcomes.

The addition of trigger point release techniques to Upper Crossed Syndrome management is relatively underexplored in current literature, yet it holds significant potential for improving patient outcomes. This study aims to investigate how integrating trigger point release with scapular stabilization exercises can enhance the overall effectiveness of Upper Crossed Syndrome treatment. By addressing both the myofascial restrictions and underlying postural imbalances, this approach could provide a more comprehensive and effective strategy for managing Upper Crossed Syndrome, improving patients' quality of life and functionality.

METHODS

This study included individuals diagnosed with Upper Crossed Syndrome characterized by decreased shoulder range of motion (ROM) and pain. Participants were both male and female, aged between 30 to 55 years, recruited from AIMST University clinc, Kedah, Malaysia. According to Seidi et al. (2020), in the study titled Comprehensive Corrective Exercise Program Improves Alignment, Muscle Activation and Movement Pattern of Men with Upper Crossed Syndrome, the inclusion of this age range ensures the involvement of individuals most affected by posture-related issues, contributing to a better understanding of the efficacy of targeted interventions. The study was a randomized controlled trial with pre- and post-test design. Participants were randomly assigned into two groups: a control group (Group A) and an experimental group (Group B). According to Nitayarak et al. (2021), in their study titled Effects of Scapular Stabilization Exercises on Posture and Muscle Imbalances in

Women with Upper Crossed Syndrome, such a design allows for a direct comparison of outcomes between standard care and targeted intervention methods. Group A received ultrasound therapy and trigger point release, while Group B received ultrasound therapy along with scapular stabilization exercises. Each participant underwent their assigned intervention for 30 minutes per session, three times a week, over an eight-week period.

Assessment Tools and Measurements

Pre- and post-intervention assessments were conducted using standardized tools. The shoulder range of motion was measured using goniometry, a validated method with high reliability (Chi Ngai Lo et al., 2021). Pain levels were assessed using the Numerical Pain Rating Scale (NPRS), which is known for its validity and reliability in clinical settings, with interclass coefficients (ICC) between 0.81 and 0.95 (Wang et al., 2023). Functional disability was measured using the Shoulder Pain and Disability Index (SPADI), recognized for its excellent reliability and construct validity with an ICC of 0.989 (Venturin et al., 2023).

Intervention Protocol

Group A received ultrasound therapy applied in continuous mode at a frequency of 1 MHz and an intensity of 0.8 W/cm² for 10 minutes, targeting areas of reported pain (Swathi et al., 2022). This was followed by trigger point release techniques, where sustained deep pressure was applied to identify trigger points for 30-50 seconds. Group B received ultrasound therapy using the same parameters, followed by a structured scapular stabilization exercise program. According to Haifah et al. (2021), in the study Effects of Scapular Stabilization Exercises on Shoulder Function, these exercises focus on enhancing the strength and control of muscles surrounding the scapula, which is essential for improving the overall biomechanics of the shoulder.

The scapular stabilization program included exercises such as the "T to Y to W" movement, performed in a prone position using a Swiss ball. Participants were instructed to maintain scapular retraction while transitioning between arm positions, aimed at promoting scapular control and muscle activation. The intervention was tailored based on participants' initial assessment results, ensuring individualized progression over the eight weeks.

Statistical Analysis

The data collected from baseline and follow-up measurements were analyzed using the Statistical Package for the Social Sciences (SPSS) Version 26. Descriptive statistics, including means and standard deviations, were used to summarize demographic information and baseline scores. For comparing the pre- and post-intervention outcomes between the groups, paired t-tests were utilized for within-group comparisons. According to Chen et al. (2023), in their study titled *Scapular Stabilization Exercises for Shoulder Pain in Individuals with Upper Quadrant Syndrome*, this method effectively highlights changes due to intervention. Analysis of variance (ANOVA) was conducted to determine differences between groups, with significance set at $p < 0.05$. The reliability of measurement tools was also verified through ICC values, ensuring the precision of collected data.

Table 1: Baseline data of study samples (N=61)

	Mean (SD)	n	%
Study group			
Control		30	49.2
Experimental		31	50.8
Gender			
Male		30	49.2
Female		31	50.8
Ethnicity			
Malay		22	36.1
Chines		22	36.1
Indian		17	27.9
Age	38.2 (7.91)		
<30		4	6.6
31-40		29	63.9
41-50		10	16.4
>50		8	13.1

Note: SD: Standard deviation; Control group: Conventional physiotherapy; Experimental group Scapular stabilization

Table 1 provides a detailed overview of the characteristics of the study sample, which consists of 61 participants divided into two groups: a control group with 30 participants and an experimental group with 31 participants. The distribution between these groups is nearly equal, with 49.2% of the participants in the control group and 50.8% in the experimental group. This balanced distribution helps ensure comparability between the two groups. In terms of gender, the sample is evenly split, with 30 males (49.2%) and 31 females (50.8%), ensuring that gender does not bias the outcomes of the study. Ethnic diversity is also evident in the sample, as it includes 22 Malays (36.1%), 22 Chinese (36.1%), and 17 Indians (27.9%). This representation helps reflect a broader population and ensures that the findings of the study are applicable to different ethnic backgrounds.

The age distribution of the participants shows that the majority fall within the 31-40 years age group, accounting for 63.9% of the sample (29 participants). The representation of younger participants (under 30 years) is limited to 6.6% (4 participants), while those aged 41-50 years make up 16.4% (10 participants), and those over 50 years constitute 13.1% (8 participants). The average age of participants across the entire sample is 38.2 years, with a standard deviation of 7.91. This suggests a moderate spread around the mean age, indicating some variability in the ages of participants, but still clustering around middle-aged adults. This demographic profile offers context to the study, ensuring that the findings can be interpreted with an understanding of the diversity in age, gender, and ethnicity.

Table 2: Results of visual analogue scale, shoulder range of motion in flexion, extension, abduction, adduction, internal rotation and external rotation before and after intervention in control group (n=30)

	Mean (SD)	**SEM**	**95% CI of the difference**		**t**	**P**
			Lower	**Upper**		
VAS						
Pre-intervention	5.40 (1.13)	0.21	1.92	2.64	7.534	0.000
Post-intervention	3.70 (0.88)	0.16				
Shoulder flexion						
Pre-intervention	60.00 (7.82)	1.43	-11.88	-8.32	-5.895	0.000
Post-intervention	67.30 (7.71)	1.41				
Shoulder extension						
Pre-intervention	39.50 (9.13)	1.67	-8.78	-4.82	-7.009	0.000
Post-intervention	46.30 (9.51)	1.74				
Shoulder abduction						
Pre-intervention	37.50 (6.40)	1.17	-8.42	-3.91	-8.438	0.000
Post-intervention	42.67 (5.98)	1.09				
Shoulder adduction						
Pre-intervention	63.27 (5.81)	1.06	-13.28	-8.19	-8.630	0.000
Post-intervention	74.00 (7.98)	1.46				
Shoulder internal rotation						
Pre-intervention	12.83 (7.27)	1.33	-20.02	-11.32	-7.365	0.000
Post-intervention	28.50 (11.61)	2.12				
Shoulder external rotation						
Pre-intervention	12.67 (7.28)	1.33	-17.93	-10.07	-7.277	0.000
Post-intervention	26.67 (10.45)	1.91				

Note: SD: Standard deviation; SEM: Standard error of mean; CI: Confidence interval; VAS: Visual analogue scale.

Table 2 presents the outcomes for the control group (n=30) before and after the intervention, focusing on changes in pain levels as measured by the visual analogue scale (VAS) and the range of motion across various shoulder movements. Before the intervention, the mean VAS score for pain was 5.40 (SD = 1.13), indicating a moderate level of discomfort. Following the intervention, this score decreased significantly to 3.70 (SD = 0.88), suggesting a marked reduction in pain levels. The SEM values were 0.21 pre-intervention and 0.16 post-intervention, with a 95% confidence interval ranging from 1.92 to 2.64. The t-value was 7.534, and the p-value of 0.000 indicates that this reduction in pain is statistically significant, implying that the intervention had a meaningful impact on pain reduction in the control group.

The table also highlights improvements in shoulder range of motion. For shoulder flexion, the mean increased from 60.00° (SD = 7.82) pre-intervention to 67.30° (SD = 7.71) post-intervention. The negative t-value of -5.895, coupled with a p-value of 0.000, indicates a significant improvement in flexibility. Shoulder extension showed a similar trend, with a mean increase from 39.50° (SD = 9.13) to 46.30° (SD = 9.51) after the intervention, supported by a t-value of -7.009 and a p-value of 0.000. These results suggest that the control group benefited from the intervention, achieving better shoulder mobility in both flexion and extension.

Further improvements are seen in other aspects of shoulder movement. The mean shoulder abduction increased from 37.50° (SD = 6.40) to 42.67° (SD = 5.98), and shoulder adduction rose from 63.27° (SD = 5.81) to 74.00° (SD = 7.98). The t-values of -8.438 and -8.630, respectively, with p-values of 0.000 for both, confirm the statistical significance of these changes. Additionally, the most substantial gains were observed in shoulder internal and external rotation. Internal rotation improved from a mean of 12.83° (SD = 7.27) to 28.50° (SD = 11.61), while external rotation increased from 12.67° (SD = 7.28) to 26.67° (SD = 10.45). The t-values of -7.365 and -7.277 and the p-values of 0.000 indicate significant improvements in these areas. Collectively, these results suggest that the intervention was effective in enhancing shoulder mobility and reducing pain in the control group.

Table 3`: Results of visual analogue scale, shoulder range of motion in flexion, extension, abduction, adduction, internal rotation and external rotation before and after intervention in experimental group (n=31)

	Mean (SD)	**SEM**	**95% CI of the difference**		**t**	**P**
			Lower	**Upper**		
VAS Pre-intervention Post-intervention	3.81 (1.05) 0.97 (0.98)	0.19 0.18	2.35	3.32	-11.983	0.000
Shoulder flexion Pre-intervention Post-intervention	60.10 (7.47) 72.90 (7.72)	1.34 1.39	-15.03	-10.58	-11.771	0.000
Shoulder extension Pre-intervention Post-intervention	63.48 (8.69) 75.00 (7.85)	1.56 1.41	-13.49	-9.54	-11.922	0.000
Shoulder abduction Pre-intervention Post-intervention	59.81 (7.65) 70.74 (9.44)	1.37 1.70	-13.34	-8.53	-9.271	0.000
Shoulder adduction Pre-intervention Post-intervention	64.06 (5.69) 72.74 (6.03)	1.02 1.08	-10.24	-7.12	-11.359	0.000
Shoulder internal rotation Pre-intervention Post-intervention	14.52 (9.16) 44.52 (7.68)	1.65 1.38	-34.31	-25.69	-14.202	0.000
Shoulder external rotation Pre-intervention Post-intervention	15.48 (8.98) 44.52 (7.68)	1.61 1.38	-33.43	-24.63	-13.469	0.000

Note: SD: Standard deviation; SEM: Standard error of mean; CI: Confidence interval; VAS: Visual analogue scale.

Table 3 outlines the changes in the experimental group (n=31), focusing on pain levels and shoulder range of motion before and after the intervention. The pre-intervention mean VAS score was 3.81 (SD = 1.05), reflecting a lower baseline pain level compared to the control group. After the intervention, the VAS score dropped dramatically to 0.97 (SD = 0.98), indicating a substantial reduction in pain. The 95% confidence interval for this change ranged from 2.35 to 3.32, and the t-value of -11.983 with a p-value of 0.000 confirms that the reduction in pain was statistically significant. This suggests that the experimental group experienced a more pronounced decrease in pain following the intervention.

Significant improvements were also observed in shoulder range of motion. Shoulder flexion increased from a mean of 60.10° (SD = 7.47) to 72.90° (SD = 7.72) post-intervention, with a t-value of -11.771 and a p-value of 0.000, indicating a meaningful increase in flexibility. Similarly, shoulder extension improved from 63.48° (SD = 8.69) to 75.00° (SD = 7.85), with a 95% confidence interval between -13.49 and -9.54, a t-value of -11.922, and a p-value of 0.000. Abduction and adduction also showed significant gains, with abduction increasing from 59.81° (SD = 7.65) to 70.74° (SD = 9.44) and adduction rising from 64.06° (SD = 5.69) to 72.74° (SD = 6.03). The consistent statistical significance across all these measures (p = 0.000) indicates that the intervention was highly effective in improving shoulder function in the experimental group.

The most substantial improvements in the experimental group were observed in shoulder internal and external rotations. Internal rotation increased dramatically from 14.52° (SD = 9.16) to 44.52° (SD = 7.68), and external rotation rose from 15.48° (SD = 8.98) to 44.52° (SD = 7.68). These changes were supported by t-values of -14.202 and -13.469, with p-values of 0.000, confirming significant increases. This data indicates that the experimental group not only experienced a reduction in pain but also substantial gains in shoulder flexibility, particularly in rotational movements.

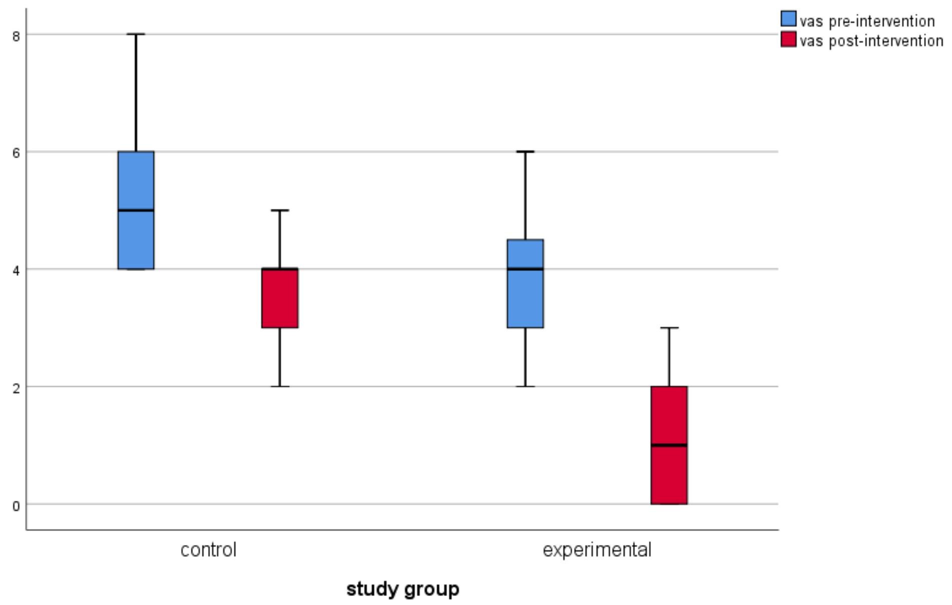
Table 4: Comparison in effect of visual analogue scale, shoulder range of motion in flexion, extension, abduction, adduction, internal rotation and external rotation between control group (n-30) and experimental group (n=31)

	Mean (SD)	**Mean difference**	**95% CI of the difference**		**t**	**P**
			Lower	**Upper**		
VAS difference Control group Experimental group	-1.70 (1.24) -2.84 (1.32)	1.14	0.48	1.79	3.477	0.001
Shoulder flexion difference Control group Experimental group	7.30 (6.78) 12.81 (6.06)	-5.051	-8.80	-2.21	-3.347	0.001
Shoulder extension difference Control group Experimental group	6.80 (5.31) 11.51 (5.38)	-4.72	-7.46	-1.98	-3.444	0.001
Shoulder abduction difference Control group Experimental group	5.17 (3.35) 10.94 (6.57)	-5.77	-8.45	-3.09	-4.341	0.000
Shoulder adduction difference Control group Experimental group	10.73 (6.81) 8.68 (4.25)	2.06	-0.88	4.99	1.408	0.165
Shoulder internal rotation difference Control group Experimental group	15.67 (11.65) 30.00 (11.76)	-14.33	-20.33	-8.33	-4.780	0.000
Shoulder external rotation difference Control group Experimental group	14.00 (10.54) 29.03 (12.00)	-15.03	-20.83	-9.24	-5.192	0.000

Note: SD: Standard deviation; SEM: Standard error of mean; CI: Confidence interval; VAS: Visual analogue scale

Table 4 compares the changes observed in the control and experimental groups, highlighting the differences in the effectiveness of the intervention. In terms of pain reduction, the experimental group showed a greater improvement, with a mean decrease of -2.84 (SD = 1.32) in VAS scores compared to -1.70 (SD = 1.24) in the control group. The mean difference between the groups was 1.14, with a 95% confidence interval of 0.48 to 1.79, and a t-value of 3.477, resulting in a p-value of 0.001. This indicates that the experimental group achieved a significantly greater reduction in pain compared to the control group.

Differences in shoulder mobility were also pronounced between the groups. For shoulder flexion, the experimental group showed a greater improvement (mean difference = -5.051°), with a p-value of 0.001, indicating that the intervention was more effective in enhancing this movement. Similar trends were seen in shoulder extension and abduction, where the experimental group achieved significantly larger gains. However, in shoulder adduction, the difference between the control and experimental groups was not statistically significant (p = 0.165), suggesting a comparable level of improvement between the two groups in this movement. In contrast, the differences in internal and external rotation were highly significant, with mean differences of -14.33° and -15.03°, respectively, in favor of the experimental group, and p-values of 0.000 for both. This comparison highlights that while both groups benefited from the intervention, the experimental group experienced superior outcomes, particularly in pain relief and rotational movements.



Note: vas: visual analogue scale

Figure 1: Visual analogue scale in pre and post intervention between control and experimental group

Figure 1 graphically represents the changes in VAS scores before and after the intervention for both the control and experimental groups. The graph shows a clear downward trend in pain levels for both groups after the intervention. However, the reduction is more substantial in the experimental group, where post-intervention VAS scores are nearly close to zero, compared to the moderate reduction observed in the control group. This visual representation underscores the data from Tables 2 and 3, illustrating that although both groups experienced pain relief, the experimental group achieved a more
significant decrease, aligning with the statistical results.

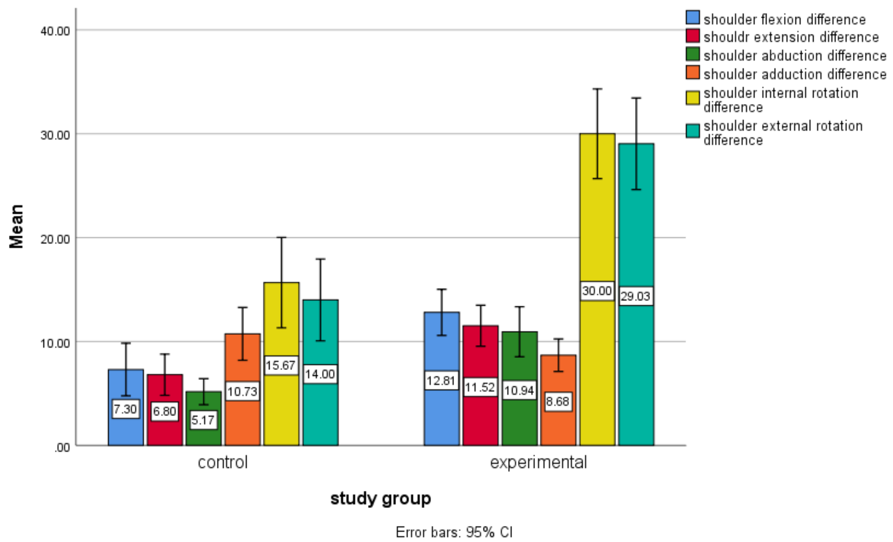


Figure 2: Shoulder range of motion difference in flexion, extension, abduction, adduction, internal rotation and external rotation between control and experimental group

Figure 2 provides a visual comparison of the differences in shoulder range of motion improvements between the control and experimental groups across various movements, including flexion, extension, abduction, adduction, internal rotation, and external rotation. The experimental group consistently shows greater improvements, particularly in internal and external rotations, where the differences are most pronounced. The graph highlights that while both groups experienced enhanced shoulder mobility after the intervention, the experimental group's gains were significantly larger, supporting the numerical findings in Table 4. This visual data reinforces the conclusion that the intervention was more effective for the experimental group, leading to greater overall functional improvements.

DISCUSSION

The primary findings of this study indicate that scapular stabilization exercises lead to significant improvements in shoulder function and pain reduction in patients with Upper Crossed Syndrome. Specifically, the study showed a substantial decrease in pain levels, as measured by the Visual Analogue Scale (VAS), in the experimental group, with scores dropping from a mean of 3.81 (SD = 1.05) before the intervention to 0.97 (SD = 0.98) after the intervention. This suggests that the scapular stabilization exercises provided effective relief from discomfort associated with Upper Crossed Syndrome, resulting in a highly significant difference (p = 0.000). In contrast, the control group, which received conventional physiotherapy without a focus on scapular stabilization, also saw a reduction in pain, with VAS scores decreasing from 5.40 (SD = 1.13) to 3.70 (SD = 0.88). However, the extent of pain relief was less pronounced compared to the experimental group, indicating that the inclusion of scapular stabilization may enhance the pain management process in Upper Crossed Syndrome rehabilitation.

In addition to pain reduction, the study highlighted notable improvements in shoulder range of motion (ROM) across multiple movements. The experimental group showed significant gains in flexion, extension, abduction, adduction, internal rotation, and external rotation. For example, shoulder flexion increased from 60.10° (SD = 7.47) pre-intervention to 72.90° (SD = 7.72) post-intervention, and internal rotation improved from 14.52° (SD = 9.16) to 44.52° (SD = 7.68). These results were statistically significant (p = 0.000), suggesting that the scapular stabilization exercises not only addressed pain but also enhanced the functional range of the shoulder, which is crucial for daily activities and overall mobility.

Comparatively, the control group, which received standard care, also demonstrated improvements in ROM but to a lesser extent. For instance, shoulder flexion in the control group increased from 60.00° (SD = 7.82) to 67.30° (SD = 7.71), and internal rotation rose from 12.83° (SD = 7.27) to 28.50° (SD = 11.61). Although these improvements were statistically significant, the differences between the two groups suggest that a focus on scapular stabilization provides a greater benefit in improving mobility in patients with Upper Crossed Syndrome. Notably, the experimental group exhibited better outcomes in internal and external rotations, movements that are often restricted in patients with Upper Crossed Syndrome due to poor scapular control. This suggests that scapular-focused exercises might be particularly effective for addressing the limitations in these specific ranges of motion, which are critical for functional tasks involving shoulder movement.

Overall, the study's findings demonstrate that incorporating scapular stabilization exercises into the treatment regimen for Upper Crossed Syndrome results in better outcomes in terms of both pain reduction and shoulder mobility compared to conventional physiotherapy alone. This points to the potential for a paradigm shift in how Upper Crossed Syndrome is managed, emphasizing the importance of addressing the role of the scapula in rehabilitation. The observed benefits of scapular stabilization could be attributed to improved muscle activation and control around the shoulder girdle, leading to a more balanced distribution of forces during movement and reducing compensatory patterns that contribute to pain. The results underscore the value of targeted, mechanism-specific interventions in achieving more effective rehabilitation outcomes for patients with Upper Crossed Syndrome.

The results of this study are consistent with prior research that emphasizes the importance of scapular mechanics in shoulder rehabilitation. For instance, Ludewig and Braman (2011) highlighted that proper scapular mechanics are crucial for maintaining optimal shoulder function and preventing pain. Their study, similar to the current findings, suggested that improving scapular control can lead to better outcomes in patients with shoulder dysfunctions. Additionally, Kibler et al. (2017) emphasized the role of the scapula in athletic shoulder function, noting that interventions targeting scapular stabilization could prevent injury and improve recovery. This aligns with the present study's finding that scapular-focused exercises can enhance shoulder mobility and reduce pain more effectively than traditional physiotherapy approaches.

CONCLUSION

This study demonstrates that scapular stabilization exercises offer significant benefits in the rehabilitation of patients with Upper Crossed Syndrome, particularly in terms of pain reduction and enhancement of shoulder range of motion (ROM). The findings show that the experimental group, which included scapular stabilization exercises, experienced a greater reduction in pain, with VAS scores dropping to near zero, and significant improvements in all measured ROM parameters compared to the control group. This suggests that incorporating specific exercises targeting the scapula can address the underlying muscle imbalances more effectively than conventional physiotherapy approaches, which often focus more generally on muscle strengthening and stretching.

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