

Research Paper

Effects of Mulligan Mobilization and Transverse Friction Massage on Pain, Ranges and Functional Activities in Patients With Rotator Cuff Syndrome: A Randomized Clinical Trial

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ABSTRACT

Objectives: Rotator cuff syndrome (RCS) is a common upper extremity musculoskeletal condition in the working population, often leading to prolonged work absences. This study assesses and contrasts the impacts of Mulligan mobilization (MWM) and transverse friction massage in individuals with RCS.

Methods: A randomized clinical trial was conducted at Northwest General Hospital and Research Centre in Peshawar from January to June 2023. The trial involved 42 participants in the age range of 30 and 70 years who had grade I/II rotator cuff tear and pain. These participants were randomly divided into two groups. Group A was administered MWM, while group B received transverse friction massage in addition to standard care. Both groups received a six-week treatment and were evaluated at the beginning, third and sixth weeks using the visual analogue scale to measure pain, goniometry to assess shoulder range, and the disabilities of the arm, shoulder and hand (DASH) questionnaire to evaluate physical function.

Results: The between-group comparison showed a significant difference in VAS, shoulder ranges, and DASH scores in both groups in the third and sixth weeks ($P < 0.05$). The pairwise comparisons within group A indicated a significant difference in VAS, shoulder ranges and DASH scores at baseline, the third week and the sixth week with $P < 0.05$. Similarly, pairwise comparisons within group B showed a significant difference in VAS, shoulder ranges and DASH scores at the baseline, third week, and sixth week, with a value of $P < 0.05$.

Discussion: The study concluded that MWM with movement and transverse friction massage can improve pain intensity, shoulder ranges, and physical function in people with grade (I) or grade (II) RSC.

Keywords:

Rotator cuff syndrome (RCS), Mobilization, Mulligan, Massage, Transverse friction

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Highlights

- Mulligan mobilization (MWM) with movement and transverse friction massage can reduce pain intensity in people with grade I or II rotator cuff syndrome (RCS).
- MWM with movement and transverse friction massage can improve shoulder ranges and physical function in people with grade I or II rotator cuff syndrome.
- These results seem more favorable in the MWM group compared to the transverse friction massage group.

Plain Language Summary

Shoulder pain is a widespread issue known as RCS, especially in the working population. It often keeps people away from work for extended periods. There are several surgical and non-surgical options for treating RCS; however, physiotherapy is a more economical choice with fewer side effects. This study explored the impact of two manual therapy treatments, MWM, and transverse friction massage, on 42 participants with grade I/II rotator cuff tear and pain. The findings revealed that both treatments, MWM with movement and transverse friction massage, effectively reduced pain, improved shoulder movement, and enhanced physical function in individuals with grade (I) or grade (II) RCS. The MWM group showed slightly better results than the transverse friction massage group. If an individual is dealing with shoulder pain, such treatments could be beneficial. Physiotherapy, especially MWM, proves to be a cost-effective and positive approach to managing RCS. Accordingly, it offers practical solutions for improving the daily lives of individuals dealing with shoulder pain, potentially reducing work absences and enhancing overall well-being.

Introduction

Rotator cuff syndrome (RCS) is a prevalent musculoskeletal condition impacting the upper extremities, especially among the working population, often resulting in prolonged work absences [1]. Statistics reveal that approximately 30% to 34% of adults experience shoulder pain, with 9% facing shoulder disability and around 2% diagnosed with rotator cuff tendinitis based on clinical assessments [2]. Supraspinatus tendinitis is notably common in occupations involving heavy or repetitive arm work, with prevalence rates ranging from 2% to 9%. Moreover, beyond the immediate impact, more than 30% of clinical patients with unilateral shoulder discomfort progress to bilateral tears by age 67 years, and the prevalence of rotator cuff tears rises significantly, reaching about 50% with age [3]. The rotator cuff encompasses the tendons and muscle bellies of the infraspinatus, supraspinatus, subscapularis, and teres minor muscles. Any injury or degenerative condition affecting this structure collectively falls under the umbrella term RCS [4]. Neer defined RCS as a mechanical compression of rotator cuff tendons under the coracoacromial ligament, the acromion process, and frequently the acromioclavicular joint [5]. The supraspinatus and infraspinatus tendons, part of the poster superior rotator cuff, are particularly susceptible to rotator cuff injuries

[6]. Etiological factors include extrinsic elements, such as direct trauma to the rotator cuff, and intrinsic factors, including impaired dynamic stability, causing the humeral head to move superiorly and the subacromial gap to shrink [7]. Hypo-vascularity in the rotator cuff, smoking, medical comorbidities, and environmental factors may also contribute to RCS [7]. The diagnosis of the patient is based on a thorough physical examination, review of medical history and assessment of symptoms, including pain exacerbated by overhead activities, difficulty sleeping on the affected side, reduced strength and restricted range of motion [8].

Various surgical and non-surgical treatments exist for managing the RCS [9]. Among them, physiotherapy has been demonstrated to be more economical with fewer negative outcomes; therefore, it is recommended that a course of physiotherapy be completed before surgery is contemplated [10]. Mulligan's mobilization (MWM) is a joint mobilization treatment in which the patient actively engages while receiving a manual accessory glide to one of the joint surfaces [11]. Recent studies maintain that MWM can effectively reduce pain by stimulating the joint's mechanoreceptors and can increase afferent input, which in turn influences the efferent motor output to the surrounding muscles [3]. James Cyriax's transverse friction massage (TFM) is one of the first manual therapy treatment protocols for tendon diseases. This technique

is applied obliquely on the tendon back and forth, freeing the tissue from adhesions [5]. TFM leads to traumatic hyperemia by the removal of adhesions, which enhances the blood flow and lessens the discomfort. It also stimulates mechanoreceptors and improves tissue perfusion [12]. Despite the existing wealth of information, a significant research gap is evident in the literature concerning the comparative effects of MWM and TFM on RCS. Most previous research has predominantly delved into the efficacy of either MWM or TFM in isolation. This study addresses this research gap by directly comparing the impacts of MWM and TFM on key parameters, such as range of motion, pain, and functional activities in individuals diagnosed with RCS. By conducting this comparative analysis, we provide a more comprehensive understanding of the relative effectiveness of these two therapeutic approaches, contributing valuable insights to the existing body of knowledge on managing RCS. The outcomes of this study offer practical guidance for clinical physical therapists in making informed decisions about effective therapy options for individuals with RCS. This guidance has the potential to significantly enhance the management of a range of motion, pain intensity, and functional activities in patients, thereby improving the overall quality of care and treatment outcomes.

Materials and Methods

Study participants

A randomized clinical trial with single blinding was conducted at the Department of Physiotherapy in [North-west General Hospital and Research Centre](#), Peshawar, Pakistan, from January to June 2023. The sample size was determined using the G*Power software, version 3.1. The sample size calculation utilized the following parameters: Effect size=0.9, α error=0.05 and power=80 [11]. A total of forty-two participants were assigned to two groups using a random lottery method, with 21 participants in each group.

The inclusion criteria were as follows: Both males and females aged between 30 and 70 years, individuals with partial rupture and diagnosed with RCS (graded 0-III), those with known grade I or grade II tear, experiencing pain upon palpation of the rotator cuff muscle and having two or more positive results on provocative tests (empty cane test, lift-off test, neer test) [11]. Meanwhile, the exclusion criteria for this study were participants having multiple shoulder pathology, bursitis, used corticosteroid injections last month, orthopedic injury or cardiovascular problem, and recent myocardial infarction or major shoulder trauma [13].

Study procedure

Group B underwent TFM in addition to traditional therapy, while group A received MWM. In addition, both groups received the same conventional treatments, including ultrasound (pulsed ultrasound therapy, which lasts 7 min and alternates between periods of 1 min on and 1 min off at a rate of 3 MHz and intensity of (1.5 W/cm^2) [14], Codman exercises (2 sets of 10 repetitions) [12], active and active assisted range of motion exercises (1 set of 10 repetitions) (20) and scapular stabilization exercises (2 sets of 10 repetitions) for six weeks. The physical therapist who treated both groups had over six years of clinical experience and was a specialist in manual therapy. An additional physical therapist documented each assessment. Both groups were treated for six weeks.

Group A underwent the MWM intervention. The MWM technique was used to perform active accessory mobilizations of the humeral head in different directions, such as flexion, abduction, external rotation and internal rotation. During this procedure, the participants were placed in a seated position on a stretcher, while the physical therapist positioned themselves on the opposite side of the arm or leg being treated. The physical therapist used their non-dominant hand to stabilize the participants' shoulder girdle while applying a gentle sliding motion to the upper arm bone using the fleshy part at the base of their dominant hand's thumb. The selection of this glide direction was based on its maximum efficacy in addressing shoulder constraints. The participants were instructed to actively move their affected shoulder until they experienced pain, while the physical therapist applied a continuous and gentle sliding force on the upper arm bone. The physical therapist made a deliberate effort to keep the glide perpendicular to the plane of movement throughout the entire range of motion. The participants were instructed to engage in active movements, specifically ensuring that the MWM technique, which involves shoulder movement, is entirely devoid of pain. The participants were instructed to cease the treatment promptly if they experienced any discomfort or pain. A solitary MWM technique session had a duration of approximately 20 min and comprised 10 repetitions (3 sets), with a 30-s interval of rest between each set. MWM was administered every other day for six weeks [11].

The participants in group B received TFM. They were instructed to bend their elbows to 90 degrees, place their forearms behind their backs and lay back in a half-lying position. As a result, the arm's medial rotation and adduction are fixed. The middle finger and index finger

Table 1. Participants characteristics

Characteristics		Mean±SD/No. (%)	
		Group A (n=27)	Group B (n=27)
Age (y)		48±12.4	50.09±10.9
Sex	Male	15(71.4)	17(81)
	Female	6(28.6)	4(19)
Shoulder pain duration (weeks)		2.47±1.03	2.76±1.22

Iranian Rehabilitation Journal

were used to support the tip of the index finger, while a deep friction massage was applied to the rotator cuff tendon. It was administered for 10 to 12 min in a transverse direction. TFM was given twice a week for the first three weeks. Then, the repetition was increased, and the protocol was applied 3 to 4 times a week for the last three weeks [13, 14].

Outcome measures

Every participant was evaluated at the beginning, during the third week and after six weeks. The measured parameters encompass pain intensity, shoulder ranges, and physical function. The assessment of pain intensity employed the visual analogue scale (VAS), a scale measuring 10 cm in length. The participants assessed their level of pain using a range of measurements, ranging from “no pain” (0–4 mm), “mild pain” (5–44 mm), “moderate pain” (45–74 mm) and “The most extreme pain imaginable” (75–100 mm). The VAS demonstrated high reliability, as evidenced by an intraclass correlation coefficient (ICC) value of 0.97 (95% CI, 0.96%, 0.98%) [16].

Shoulder ranges were assessed using a goniometer to measure the joint range of motion. The universal goniometer is considered a reliable and cost-effective instrument, easy to use and requires minimal expertise [17]. During the measurement procedure, the fulcrum was positioned over the shoulder joint, aligned parallel to the sagittal axis for abduction and adduction, along the frontal axis for flexion and extension and set at a 90-degree angle of abduction in line with the humeral longitudinal axis for internal and external rotations.

The assessment of physical function was conducted using the disabilities of the arm, shoulder and hand (DASH) questionnaire, which is a self-report tool consisting of 30 items. The DASH questionnaire evaluates the physical abilities and symptoms of individuals with musculoskeletal issues in the upper limb. Its purpose is

to delineate disability associated with upper-limb disorders and monitor changes in symptoms and functionality over a period. The DASH questionnaire demonstrates high reliability, as indicated by an ICC of 0.96. Additionally, its validity is supported by the Pearson correlation coefficient that exceeds 0.70 [18].

Statistical analysis

The statistical analysis was conducted using SPSS software, version 22. The data's normality was assessed through the utilization of the Shapiro-Wilk test. Given that the data followed a normal distribution, we utilized independent sample t-tests to compare between groups and employed the repeated-measures analysis of variance for within-group analyses. The pairwise comparisons were conducted, and adjustments were made using the test of sphericity.

Results

Between January and June 2023, a total of 53 patients underwent screening for eligibility. Of these, 11 individuals did not meet the selection criteria and were consequently omitted from the study. The remaining 42 participants were randomly assigned to either group A or group B, with each group comprising 21 individuals (Figure 1). Out of the 42 participants who were enrolled, 32(72.6%) were male and 10(23.8%) were female. More specifically, in group A, there were 15(71.4%) males and 6(28.6%) females, with a mean age of 48±12.4 years. Meanwhile, group B consisted of 17(81%) males and 4(19%) females, with a mean age of 50.09±10.9 years. None of the participants withdrew from the study during its course. The characteristics of the participants at the baseline are given (Table 1).

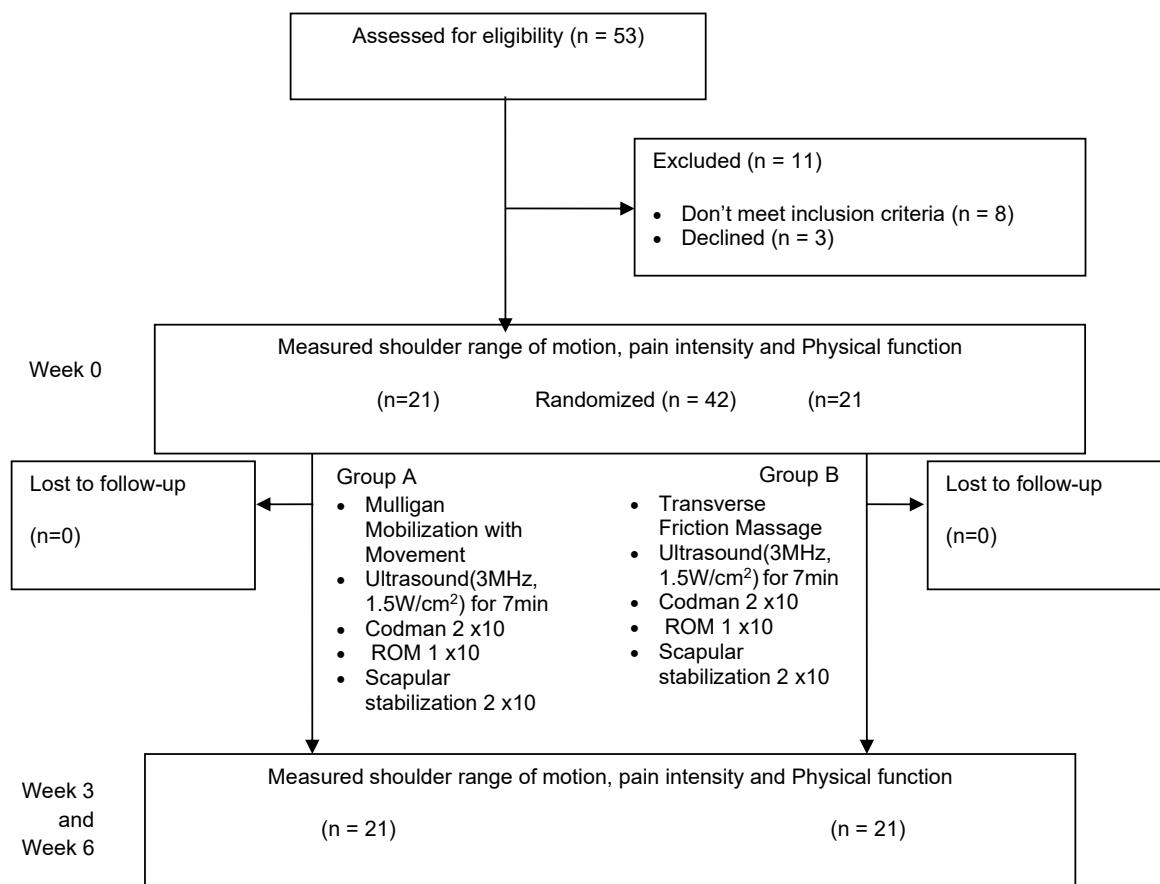


Figure 1. Flow chart of study

Effects of intervention

Table 2 shows the between-group comparison. The baseline comparison between group A and group B revealed no statistical difference in almost all variables ($P>0.05$) (Table 2). Comparison in the third week shows that statistical differences exist between group A and group B ($P<0.05$) except on the VAS ($P>0.05$) (Table 2), whereas between-group analysis of group A and group B in the sixth week of measurement showed a statistical difference among the variables with $P<0.05$, except for internal rotation ($P>0.05$) (Table 2).

Table 3 presents a within-group comparison of both groups. Group A showed that DASH, VAS and shoulder internal rotation are statistically significant from the baseline to the sixth week with a value of $P<0.05$, respectively. In contrast, shoulder flexion, extension and abduction are not statistically significant from the baseline to the sixth week with $P>0.05$. On the other hand, group B showed that VAS, shoulder flexion, abduction, and internal rotation variables are statistically significant from the baseline to sixth week with a value of $P<0.05$,

respectively, while DASH and shoulder extension are not statistically significant from the baseline to sixth week with $P>0.05$ (Table 3).

Table 4 presents the pairwise comparison of group A and group B using the test of sphericity adjustment. The pairwise comparison of group A reveals a significant difference in VAS at the baseline, third week and sixth week with $P<0.05$. Meanwhile, DASH scores in group A also show significant differences at the baseline, third week, and sixth week with $P<0.05$. Similarly, shoulder ranges in group A show substantial differences at the baseline, third week and sixth week with $P<0.05$ (Table 4).

The pairwise comparison of group B reveals a significant difference in VAS at the baseline, third week and sixth week with $P<0.05$. At baseline, the third week, and the sixth week, group B's DASH scores likewise demonstrate a significant difference ($P<0.05$). Similarly, shoulder ranges in group B show substantial differences at the baseline, third week and sixth week with $P<0.05$ (Table 4).

Table 2. Between-group analysis of variables

Variables	Measurements	Groups	Mean±SD	MD	SE	P ^a
VAS	Baseline	A	60.66±16.16	-2.571	3.52	0.587
		B	63.23±14.15		3.08	
	3 rd week	A	33.47±13.00	-2.952	2.83	0.409
		B	36.42±9.69		2.11	
	6 th week	A	8.85±6.35	-5.000	1.38	0.009
		B	13.85±5.49		1.19	
DASH	Baseline	A	63.62±5.40	1.562	1.17	0.423
		B	62.81±3.22		0.70	
	3 rd week	A	32.14±3.82	-2.952	0.83	0.009
		B	33.09±3.91		0.85	
	6 th week	A	1.07±0.75	-0.969	0.16	0.040
		B	2.04±1.94		0.43	
Shoulder flexion	Baseline	A	97.14±14.71	8.571	3.21	0.044
		B	88.57±11.84		2.58	
	3 rd week	A	131.85±12.56	15.667	2.74	0.000
		B	116.19±10.47		2.28	
	6 th week	A	166.38±10.26	17.809	2.24	0.000
		B	148.57±12.36		2.69	
Shoulder extension	Baseline	A	38.95±6.15	4.714	1.34	0.009
		B	34.23±4.83		1.05	
	3 rd week	A	48.61±5.64	4.334	1.23	0.026
		B	44.28±6.44		1.40	
	6 th week	A	56.14±3.11	3.904	0.68	0.016
		B	52.23±6.40		1.39	
Shoulder abduction	Baseline	A	80.95±12.80	-4.476	2.79	0.188
		B	88.42±8.36		1.82	
	3 rd week	A	115.47±12.80	4.761	3.41	0.232
		B	88.42±8.84		1.92	
	6 th week	A	160.38±14.18	27.952	3.09	0.000
		B	88.42±8.84		2.33	
Shoulder internal rotation	Baseline	A	37.09±6.50	1.111	1.27	0.423
		B	34.57±4.99		1.31	
	3 rd week	A	49.90±6.37	4.047	3.41	0.028
		B	45.85±5.07			
	6 th week	A	64.76±5.03	-0.380	1.92	0.863
		B	65.14±8.71			

Abbreviations: DASH: Disabilities of the arm, shoulder, and hand; VAS: Visual analogue scale; MD: Mean difference; SE: Standard error. ^aTest of sphericity, independent t-test.

Table 3. Within-group analysis of group A and group B

Outcome	Mean±SD							
	A (n=21)				B (n=21)			
	Baseline	3 rd Week	6 th Week	P ^a	Baseline	3 rd Week	6 th Week	P ^a
VAS (0-100)	60.66±16.16	33.47±13.00	8.85±6.35	0.003	63.80±14.28	36.25±9.91	13.50±5.38	0.007
DASH (0-100)	63.92±5.40	32.14±3.82	1.07±0.75	0.000	62.79±3.30	32.91±3.93	2.04±1.94	0.537
Shoulder range of motion (degree) flexion	97.14±14.71	131.85±12.56	166.38±10.26	0.079	87.50±14.71	115.85±10.24	148.00±12.39	0.013
Extension	38.95±6.15	48.61±5.64	56.14±3.11	0.098	34.20±4.95	44.00±6.47	52.10±6.53	0.098
Abduction	80.95±12.80	115.47±15.64	160.38±14.18	0.155	84.95±8.28	110.25±8.80	131.80±10.56	0.000
Internal rotation	37.09±6.50	49.90±6.37	64.76±5.03	0.049	34.30±4.96	45.40±4.73	65.15±8.94	0.000

DASH: Disabilities of the arm, shoulder and hand; VAS: Visual analogue scale.

Iranian Rehabilitation Journal

^aTest of sphericity.

Notes: Repeated measure analysis of variance.

Table 4. Pairwise comparison of group A and B

Variables	A		B		
	MD	P ^a	MD	P ^a	
VAS	Baseline-3 rd week	27.190	0.000	27.550	0.000
	3 rd week-6 th week	24.619	0.000	22.750	0.000
	Baseline-6 th week	-51.810	0.000	-50.300	0.000
DASH	Baseline-3 rd week	31.786	0.000	29.875	0.000
	3 rd week-6 th week	31.071	0.000	30.877	0.000
	Baseline-6 th week	-62.858	0.000	-60.752	0.000
Shoulder flexion	Baseline-3 rd week	-34.714	0.000	-28.000	0.000
	3 rd week-6 th week	34.524	0.000	-32.500	0.000
	Baseline-6 th week	69.238	0.000	60.500	0.000
Shoulder extension	Baseline-3 rd week	-9.667	0.000	-9.800	0.000
	3 rd week-6 th week	-7.524	0.000	-8.100	0.000
	Baseline-6 th week	17.190	0.000	17.900	0.000
Shoulder abduction	Baseline-3 rd week	-34.254	0.000	-25.300	0.000
	3 rd week-6 th week	-44.905	0.000	-21.550	0.000
	Baseline-6 th week	79.429	0.000	46.850	0.000
Shoulder internal rotation	Baseline-3 rd week	-12.810	0.000	-11.100	0.000
	3 rd week-6 th week	-14.857	0.000	-19.750	0.000
	Baseline-6 th week	27.667	0.000	30.850	0.000

Iranian Rehabilitation Journal

Abbreviations: DASH: Disabilities of the arm, shoulder and hand; VAS: Visual analogue scale; MD: Mean difference.^aTest of sphericity.

Discussion

This study evaluated how TFM and MWM affected the patients' functional status, range of motion and discomfort in individuals with RCS. Both groups (MWM and TFM) exhibited improved pain intensity, range of motion, and functional status, with more favorable results observed in group A.

Menek et al.'s study in 2019 in Istanbul, Turkey, showed significant improvement in pain and range of motion in participants with RCS [11]. In this study, MWM showed substantial improvements in shoulder range of motion, in line with the findings from Yeole et al. where MWM reduced pain levels in individuals with adhesive capsulitis [19].

This study also indicated a more significant improvement in pain intensity with TFM. These findings are consistent with a previous study, which showed notable improvements in the range of motion and pain severity for patients with supraspinatus tendinitis, particularly when utilizing TFM [20].

Bodin J et al.'s study reported that TFM improved muscle integrity, activated mechanoreceptors, and removed adhesions [21]. Similar positive results were observed in our study for participants with RCS. According to existing literature, MWM significantly reduces VAS scores by correcting faulty shoulder positions during glenohumeral joint mobilization [22]. Our study also confirmed a reduction in VAS scores when adjusting shoulder position along with mobilization.

Delgado-Gil et al. (2015) and Guimarães et al. (2016) reported improved shoulder functional range of motion and reduced pain levels with MWM [6, 23]. Our study was in line with these findings, showing significant improvements in shoulder movement in the MWM group. Comparatively, in our research, mobilization demonstrated more meaningful results than friction massage. In Neelapala et al.'s study (2016), MWM significantly improved VAS scores in patients with shoulder pain [3]. In our research, MWM exhibited a more significant decrease in pain than TFM, emphasizing its effectiveness in managing RCS.

Conclusion

The study concluded that MWM and TFM can improve pain intensity, shoulder ranges, and physical function in people with grade (I) or grade II RCS. However,

these results seem more favorable in the Mulligan group than the TFM group.

Study limitations

This study faced some limitations, including a small sample size that may limit generalizability and not focus on the severity of RCS. Future research with larger sample sizes and consideration of syndrome severity is warranted to validate these findings further. Nonetheless, this study provides physical therapists with valuable insights for selecting treatments that yield better results in managing RCS and improving patients' quality of life.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of the [Riphah International University](#) (Code: RIPHAH/RCRS/REC/Letter-01401) and followed the Declaration of Helsinki. The clinical trial is registered by [Riphah International University](#) (No.: NCT05863806). Each participant in this study received written informed consent before their participation.

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Authors' contributions

Conceptualization and methodology: Asad Khan and Muhammad Affan Iqbal; Statistical analysis and interpretation: Muhammad Affan Iqbal; Investigation: Asad Khan; Writing the original draft: Uzair Ahmad; Review and editing: Uzair Ahmad.

Conflict of interest

The authors declared no conflict of interest.

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