Research Article

Effectiveness of scapular clock exercises in scapular dyskinesia in post-operative cardiac patients: A randomized clinical trial

Izza Ayub[1]*, Sana Zahir[2], Aqsa Shahid[2], Rohail Amir Babar[3], Amir Mushtaq[4]

Abstract

Background: Scapular dyskinesia is a frequent complication after cardiac surgery due to thoracic immobility, pectoral tightness, and muscle imbalances, contributing to persistent shoulder pain and functional deficits.

Objective: To evaluate the effectiveness of scapular clock exercises combined with conventional physiotherapy versus conventional physiotherapy alone in reducing pain, improving range of motion (ROM), and enhancing shoulder function in post-operative cardiac patients.

Material and Methods: This randomized clinical trial included n=28 post-cardiac surgery patients with scapular dyskinesia, who were allocated to either Group A (scapular clock exercises plus conventional physiotherapy) or Group B (conventional physiotherapy). Both groups were treated thrice weekly for 4 weeks. The primary outcome was the Numeric Pain Rating Scale (NPRS), and secondary outcomes included QuickDASH and shoulder ROM. Statistical analysis was conducted using RM-ANOVA and independent t-tests.

Results: The mean age of n=17(60%) male and n=11(40%) female subjects were 55.21±7 years. Both groups significantly improved pain, disability, and ROM over 4 weeks ($p<0.05$). Group A demonstrated markedly greater improvements in NPRS, QuickDASH, and all ROM directions at 2- and 4-week follow-ups compared to Group B, with large effect sizes.

Conclusion: Scapular clock exercises combined with conventional physiotherapy offer superior outcomes for pain, disability, and mobility compared to conventional physiotherapy alone. These findings highlight the importance of incorporating targeted scapular exercises into cardiac rehabilitation to address under-recognized musculoskeletal deficits.

Keywords: scapular clock exercises; postoperative rehabilitation; numeric pain rating scale (NPRS); quickdash; resistance training; post-sternotomy complications; physiotherapy; upper limb function.

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INTRODUCTION

Scapular dyskinesia is a condition that can significantly affect shoulder function, leading to pain, reduced range of motion, and impaired neuromuscular control [1]. Sternotomy can cause an alteration in thoracic mobility, pectoral muscle tightness, and weakening of scapular stabilizers such as the serratus anterior and lower trapezius. These factors contribute to abnormal scapular mechanics, potentially leading to secondary shoulder pain and movement limitations. Post-cardiac surgery, particularly following median sternotomy, patients often develop shoulder dysfunction due to prolonged immobility, protective postures, and muscle imbalances [2]. About 47% of patients report shoulder aches post-cardiac surgery and 91% remain symptomatic even after 14.6 months of operation.

Management of scapular dyskinesia involves various rehabilitation strategies aimed at improving muscle function and reducing disability [3]. Manual therapy combined with conventional physiotherapy has better results in post-surgical cancer patients, improving shoulder range of motion, pain levels, and muscle strength compared to scapular-focused exercises alone[4]. Furthermore, suspension-type exercises have demonstrated benefits in scapular muscle strength, although they did not significantly outperform traditional methods in pain relief or functional improvement[5].

The rehabilitation of post-cardiac surgery patients primarily focuses on cardiovascular recovery, often neglecting musculoskeletal complications such as scapular dyskinesia. Scapular clock exercises can strengthen the affected trapezius muscle and stretch the shortened pectoralis minor muscle which plays a vital role in normal positioning and function of the scapula[6]. The addition of this exercise regime in cardiac rehabilitation, it can reduce the incidence of scapular dyskinesis. It was hypothesized that scapular clock exercises are significantly effective in shoulder problems in postoperative cardiac patients. The aim of this research was to determine the effectiveness of scapular clock exercises for the management of scapular dyskinesia in postoperative cardiac patients.

METHODOLOGY

Study design and setting: This randomized clinical trial (NCT05426694) was carried out from May 2024 up to August 2024 in the Faisalabad Institute of Cardiology (FIC), Faisalabad, Pakistan, after the approval (Tuf/IRB/314/24) from institute's review board of The University of Faisalabad (TUF). The competent FIC authority signed the IRB to allow data collection from the institute. The protocols were conforming to the Helsinki Declaration and informed consent was taken from each subject prior to the commencement of treatment.

Participants: The inclusion criteria consisted of male and female subjects 35 to 65 years of age, post-cardiac surgery individuals with a minimum 6 weeks gap after surgery, a history of shoulder pain, and complaints of scapular region pain with ≤50% reduction of active range of motion (ROM) of shoulder abduction, external rotation, and flexion. Affirmative findings of Scapular assistance test (SAT) and Scapular retraction test. The prominence of any border of scapula on observation. The exclusion criteria included; the bilateral problem of the shoulder, account of prior operation or facture of the shoulder, neuromuscular disorders, Type-III dyskinesia of scapula, glenohumeral or acromioclavicular arthritis, and subject not willing to participate in the study.

Sample Size: The study design involves 2 groups and 3 repeated measurements. The sample size n=30 was calculated to achieve 82% power (1-β) to detect a medium effect size (f=0.25) at a significance level of α=0.05. The sample was collected by using a nonprobability purposive sampling technique. They were randomly and equally divided into two groups (n=15 each) Group A (scapular clock exercises with baseline exercises) and Group B (baseline exercises only). A total of n=39 individuals were assessed for eligibility. Of these, n=9 was excluded, n=7 did not meet inclusion criteria, and n=2 declined participation. So, the remaining n=30 participants randomized into Group A (n=15) received separate clock exercises combined with stretching and strengthening, while Group B (n=15) only focused on stretching and strengthening exercises for shoulder muscles. During follow-up, both groups experienced one participant loss each due to missed sessions at the 2nd and 4th weeks, resulting in n=14 participants analyzed per group. Ultimately, 28 participants (14 in each group) were included in the final analysis. (Figure 1)

Randomization: For this study, participant randomization was conducted using an online randomization generator to ensure impartial group allocation and internal validity. The process involved uploading a list of participant identification numbers (IDs 1–30) into the tool, which then allocated each ID to a group via a computer-generated random sequence with equal probability. This method guaranteed allocation concealment, preventing selection bias by ensuring researchers.

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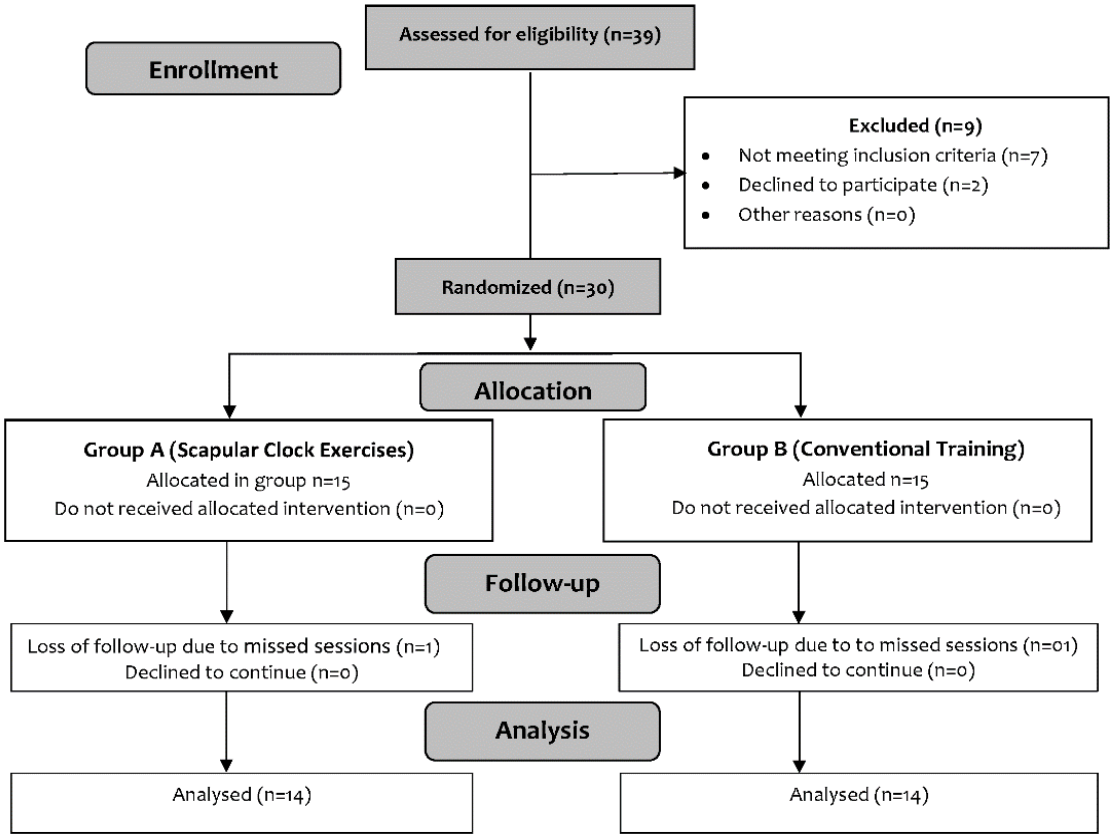

Figure 1: Consort diagram

Blinding: The outcome assessor was blinded to group allocation to minimize detection bias. Treating therapists administering the interventions could not be blinded due to the nature of the exercise-based interventions. These measures ensured that assessments were conducted without knowledge of group allocation, preserving the integrity of the results.

Intervention: Each session followed a structured protocol, ensuring progression based on individual tolerance and recovery status. All participants received conventional physical therapy (CPT) including infrared therapy for 10–15 minutes before engaging in therapeutic exercises. Patients were seated 60 cm away from the infrared source, ensuring optimal heat penetration for muscle relaxation and pain relief. The therapy was conducted under the supervision of a qualified therapist to ensure proper technique and prevent complications. Following infrared therapy, all patients performed stretching and strengthening exercises to enhance scapular mobility and shoulder function. These included wall washes, corner stretch, pectorals stretching, and sleeper stretch. Each stretch was held for 15-30 seconds and repeated up to 10 times. The treatment was given for three days per week for four weeks for both groups.

Group A was given scapular clock exercises along with CPT. The scapular clock exercises were progressed according to each week. For the scapular clock exercises, the therapist stood beside the patient, the patient placed their hand on the wall at shoulder level with the elbow extended, and performed scapular elevation as well as depression with fingers pointing toward 12 and 6 o'clock positions. After that participant performed scapular protraction and retraction with fingers at 3 o'clock and finally repeated scapular protraction and retraction with fingers at 9 o'clock. The hold time for each movement was 10 seconds. These exercises were performed in the initial two weeks and continued for four weeks with adding resistance with TheraBand. Group B only received CPT. (Figure 2)

Outcome measures: The primary outcome measure was the Numeric Pain Rating Scale (NPRS) used to record the level of pain described by patients. This scale has numerical values from 0 to 10, where 0 shows no pain, 5 is moderate pain and 10 is very severe pain. The reliability of this scale is 84% [7]. The secondary outcome measures were *Quick*DASH and shoulder ROM. *Quick*DASH questionnaire assessed the level of shoulder disability. Its total score varies from 0 to 100, smaller value means lesser disability of arms, shoulders, and hands while a greater value means moderate to severe disability. The reliability and validity of *Quick*Dash are 90% and 70%, respectively [8]. A goniometer was used to measure shoulder ROM and it is a reliable tool with about 91-98% reliability recorded in a study [9].

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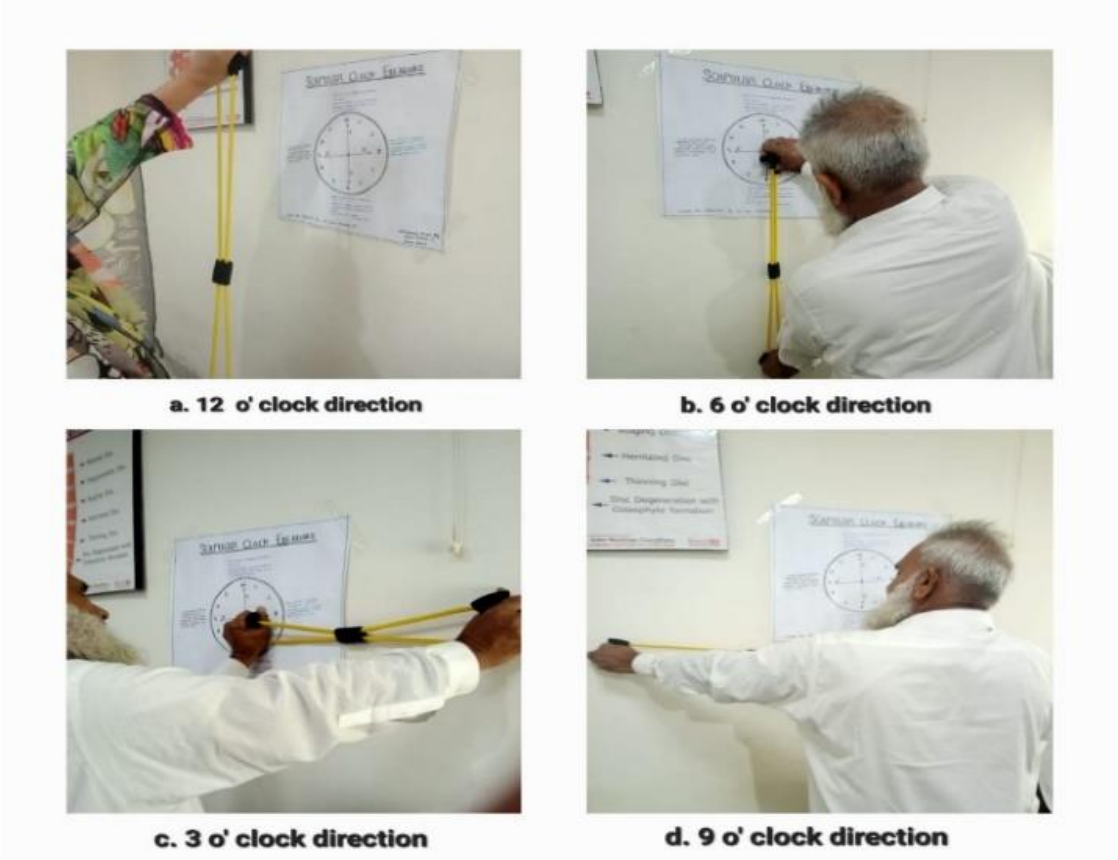

Figure 2: Patient is performing scapular clock exercise holding TheraBand in all directions

Data was analyzed by SPSS version 27 and a ($p<0.05$) was taken as significant. The assumptions of the parametric test were assumed. So, repeated measure ANOVA with pairwise comparison was used for within-group changes. For comparison between the groups, an Independent t-test was applied along with Cohen's d for effect size.

RESULTS

There were n=28 subjects analyzed with a mean age of 55.21±7.28 years. There was n=17(60%) male subjects and n=11(40%) female subjects. the majority of involved side of the patients in n=21(75%) were the left side, whereas only n=7(25%) were affected on the right side.

The RMANOVA with pairwise comparisons demonstrated that Group A (Scapular Clock Exercise) and Group B, showed significant improvements ($p<0.05$) in pain, disability, and shoulder ROM over four weeks at each assessment within both groups. (Table 1)

Table 1: Within-group comparison for pain, shoulder disability and ROMs

		Group A (Scapular Clock Exercise +CPT)			Group B (CPT)		
		Mean±SD	MD/F (2,26)	p-value	Mean±SD	MD/F (2,26)	p-value
NPRS	Baseline	7.36±.63	1.35a	0.001**	7.29±.46	.71a	0.011*
	After 2nd week	6.00±.392	1.78b	0.003**	6.57±.51	.42b	0.015*
	After 4rth week	4.21±.579	95.12c	0.00***	6.14±.36	45.67c	0.004**
QuickDASH	Baseline	38.57±5.94	14.85a	0.00***	40.07±8.22	7.42a	0.002**
	After 2nd week	23.71±5.49	13.78b	0.00***	32.64±9.03	6.42b	0.012*
	After 4rth week	9.93±2.52	132.67c	0.00***	26.21±9.42	88.49c	0.00***
Shoulder Flexion ROM	Baseline	84.50± 8.53	-15.42a	0.002**	85.71±17.98	-5.14a	0.041*
	After 2nd week	99.93±12.06	-18.00b	0.005**	90.86±17.93	-4.78b	0.026*
	After 4rth week	117.93±13.19	107.85c	0.00***	95.64±17.76	12.22c	0.019*
Abduction ROM	Baseline	79.57±10.72	-12.35a	0.003**	76.14±9.63	-4.57a	0.037*
	After 2nd week	91.93±8.53	-16.57b	0.002**	80.71±9.42	-4.64b	0.034*
	After 4rth week	108.50±9.49	12.22c	0.00***	85.36±7.99	15.33c	0.015*
External Rotation	Baseline	36.71±9.63	-7.35a	0.004**	37.57±4.66	-3.21a	0.046*
	After 2nd week	44.07±8.81	-8.85b	0.006**	40.79±4.28	-3.28b	0.031*
	After 4rth week	52.93±7.77	81.94c	0.00***	44.07±3.85	18.79c	0.021*

Significance level: p<0.05, p<0.01** & p<0.001****

S.D- Standard deviation; NPRS- Numeric-Pain Rating Scale; QuickDASH- Disability of arms, shoulder and hands questionnaire Quick form/short version; ROM- Range of Motion, MD- Mean Difference

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Table 2: Between-group comparison of outcome measures

		Group A (SCE+CPT)	Group B (CPT)			
Outcome measure		Mean±SD	Mean±SD	p-value	MD	Cohen's d
NPRS	Baseline	7.36±.63	7.29±.46	.737	0.07	0.13
	After 2 weeks	6.00±.392	6.57±.51	.003**	-0.57	-1.25
	After 4 weeks	4.21±.579	6.14±.36	.001**	-1.93	-4.00
Quick DASH	Baseline	38.57±5.94	40.07±8.22	.585	-1.5	-0.21
	After 2 weeks	23.71±5.49	32.64±9.03	.004**	-8.93	-1.20
	After 4 weeks	9.93±2.52	26.21±9.42	.001**	-16.28	-2.36
Shoulder Flexion ROM	Baseline	84.50± 8.53	85.71±17.98	.821	-1.21	-0.09
	After 2 weeks	99.93±12.06	90.86±17.93	.128	9.07	0.59
	After 4 weeks	117.93±13.19	95.64±17.76	.001**	22.29	1.42
Abduction ROM	Baseline	79.57±10.72	76.14±9.63	.382	3.43	0.34
	After 2 weeks	91.93±8.53	80.71±9.42	.003**	11.22	1.25
	After 4 weeks	108.50±9.49	85.36±7.99	.001**	23.14	2.64
External Rotation	Baseline	36.71±9.63	37.57±4.66	.767	-0.86	-0.11
	After 2 weeks	44.07±8.81	40.79±4.28	.221	3.28	0.47
	After 4 weeks	52.93±7.77	44.07±3.85	.001**	8.86	1.44

Significance level: p<0.05, p<0.01** & p<0.001****
SD- Standard deviation; NPRS- Numeric-Pain Rating Scale; QuickDASH- Disability of arms, shoulder and hands questionnaire Quick form/short version; ROM- Range of Motion; n- number of subjects in that group, MD- Mean Difference

As the group was comparable at the baseline, Group A achieved statistically (p<0.05) and clinically superior outcomes in pain relief, functional improvement, and all aspects of shoulder range of motion compared to Group B at every assessment, except for flexion ROM and external ROM which were only significant after 4th week, suggesting the greater effectiveness of Scapular Clock Exercises over conventional baseline exercises. (Table 2)

DISCUSSION

The current RCT evaluated the effectiveness of scapular clock exercises combined with conventional physical therapy (CPT) versus CPT alone in reducing pain, improving functional disability, and enhancing shoulder range of motion (ROM) in postoperative cardiac patients with scapular dyskinesia. The results revealed that both groups demonstrated significant improvements across all outcome measures over the 4-week intervention period. However, Group A, which received the scapular clock exercises, showed markedly greater improvements in the Numeric Pain Rating Scale (NPRS), Quick DASH, and all shoulder ROM directions compared to Group B. The between-group differences were especially evident in the 4th week of intervention, with a large effect size for pain relief, functional disability, and ROM.

Our findings are in line with prior research demonstrating the effectiveness of scapular-specific exercises in shoulder rehabilitation[10]. Scapular dyskinesia has been identified as a major contributor to pain and restricted ROM following thoracic surgery due to muscle weakness and poor scapular control [11]. Previous interventions using closed-chain scapular exercises and targeted strengthening of periscapular muscles have shown superior outcomes in restoring scapular kinematics, reducing pain, and improving shoulder function, which supports the greater improvements observed in our experimental group[12, 13]. Moreover, recent research has highlighted that progressive resistance exercises using TheraBands can improve muscle endurance and neuromuscular control, ultimately resulting in greater functional recovery[14,15,16]. Despite this, most existing rehabilitation protocols for post-cardiac surgery focus on general upper-limb mobility and strength without specifically targeting scapular kinematics. Our findings extend this evidence base by demonstrating that structured clock exercises can further enhance scapular stability and facilitate active movement in all three planes of motion.

The observed clinical benefits can be attributed to several mechanisms. Scapular clock exercises promote rhythmic and controlled protraction, retraction, elevation, and depression across multiple directions, which restores normal scapulohumeral rhythm and neuromuscular control[17]. Specifically, the exercises stretch shortened pectoral muscles and activate key stabilizers like the lower trapezius and serratus anterior, improving postural alignment and reducing abnormal scapular winging that often accompanies post-cardiac surgery rehabilitation[18, 19].

The progressive use of theraband in the latter two weeks increased the load, which led to the adaptive strengthening of scapulothoracic musculature, contributing to enhanced active ROM and greater functional gains measured on the QuickDASH[20]. Reduction in pain can be explained by the decrease in soft-tissue stiffness, restoration of joint mechanics, and modulation of pain-processing pathways through active movement and sensory input[15]. The resultant improvements in motor control and stability not only relieved pain but also enabled participants to perform daily arm and shoulder tasks more efficiently.

Despite these encouraging results, the relatively small sample size limits the generalizability of the findings, and future multicenter trials with larger samples are needed to confirm these results. Further, the study was short-term (4 weeks), so the sustainability of the improvements beyond this period is unknown.

CONCLUSION

The study supports the use of scapular clock exercises in conjunction with baseline exercises as a safe, practical, and effective rehabilitation strategy for reducing shoulder pain, disability, and ROM restrictions in post-operative cardiac patients with scapular dyskinesia. By demonstrating these exercises for this underserved group, this research holds significant implications for both clinical practice and future guideline development in cardiac rehabilitation. Future research with longer follow-ups and larger, more diverse cohorts will help establish the sustained efficacy of this intervention and its feasibility as a routine component of post-cardiac rehabilitation programs.

DECLARATIONS & STATEMENTS

Author's Contribution

IA, SZ and AS: substantial contributions to the conception and design of the study.
IA, SZ and AS: acquisition of data for the study.
SZ and AS: interpretation of data for the study.
IA, RAB and AM: analysis of the data for the study.
IA, SZ, AS, RAB and AM: drafted the work.
IA, SZ, AS, RAB and AM: revised it critically for important intellectual content.
IA, SZ, AS and RAB: final approval of the version to be published and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors contributed to the article and approved the submitted version.

Ethical Statement

This RCT was carried out in the Faisalabad Institute of Cardiology (FIC), Faisalabad, Pakistan, after the approval (Tuf/IRB/314/24) from institute's review board of The University of Faisalabad (TUF).

AI Use Statement

No AI was used for content generation, data analysis, or interpretation.

Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

Due to privacy or ethical considerations, the data presented in this study are available upon request from the corresponding author, as they are not publicly accessible.

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Conflicts of Interest

The authors declare no conflict of interest.

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None to declare.

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