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Effects of Maitland and Mulligan's Mobilization Techniques in Treatment of Post-CABG Adhesive Capsulitis

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KEYWORDS

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ABSTRACT

Background: Adhesive capsulitis is a condition characterized by pain and restriction of the shoulder range of motion. This may be predisposed by cardiac surgery, as patients need to immobilize their upper limbs after surgery. **Objective:** Effects of Maitland and Mulligan's mobilization techniques in the treatment of post-CABG adhesive capsulitis. **Methodology:** In this randomized clinical trial, participants were recruited using convenience sampling, with a total of 48 individuals enrolled. Random allocation into two groups was carried out through a simple lottery method, assigning patients with post-CABG adhesive capsulitis from Faisalabad Institute of Cardiology to two groups. Males and females between 40 and 60 years of age presented with shoulder pain, restricted range of motion, and limited movements in abduction and external rotation were included, and those with neurological conditions, traumatic injuries, osteoarthritis, or bony abnormalities, history of surgery, or musculoskeletal disorders were excluded. Screening procedures included baseline evaluation using the numeric pain rating scale and shoulder pain and disability index scores to assess pain and shoulder disability, respectively. The therapist applied the Mulligan technique to Group A with three sets of 10 repetitions, with 30 sec' rest between sets, and the Maitland technique to Group B at the rate of 2-3 glides per second for 30 seconds, and each glide was given for 5 sets to meet the requirement of this treatment. Within-group analysis was done using a paired sample t-test. Between-group analysis was done using the Mann-Whitney U and independent t-tests. **Results:** Both of the treatment groups showed significant improvement in frozen shoulder patients with a p-value of numeric pain rating scale and shoulder pain and disability index, p=0.00, which is less than 0.05 ($p<0.05$). The comparison between both groups showed that the Mulligan mobilization showed more improvements than the Maitland mobilization, with a p-value ($p<0.05$). **Conclusion:** This indicates a significant improvement in treatment outcomes with both Mulligan and Maitland mobilization techniques for managing pain and disability in post-CABG adhesive capsulitis. However, the Mulligan mobilization demonstrates comparatively greater effectiveness than the Maitland mobilization.

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INTRODUCTION

A condition that is characterized by pain and restricted external rotation is known as Adhesive capsulitis. Clinically, it is categorized into three stages: In stage I, the patient is unable to move their shoulder actively and passively due to pain, but they can achieve a full range of motion. In stage II, both active and passive movements are restricted. However, in stage III, due to insignificant shoulder pain, the patient could move their shoulder in a limited range of motion. Frozen shoulder can be divided into two primary and secondary forms. No history of trauma, associated disease, or surgery of the shoulder in primary form. In the Secondary form, there is a history of traumatic injury and surgery, and some other causes, which include shoulder immobilization.[1]

Adhesive capsulitis is classified into two categories: primary and secondary. Primary adhesive capsulitis develops without any identifiable cause and is not linked to systemic illness or prior trauma. Secondary adhesive capsulitis, on the other hand, arises in association with underlying medical conditions such as diabetes mellitus, thyroid disorders, cervical disc disease, fractures of the upper limb, or even prolonged immobilization.[2] The shoulder is a unique joint that provides extensive mobility, allowing interaction and functional use of the upper limb. Restriction of this movement can cause significant impairment and affect daily activities.

Adhesive capsulitis is a disabling musculoskeletal disorder that is still not fully understood. Several anatomical changes are observed in its progression, including thickening of the joint capsule, adhesions involving the subacromial or subdeltoid bursa, restriction around the biceps tendon, and loss of the axillary recess due to fibrotic adhesions. First described by Duplay over a century ago, adhesive capsulitis continues to be recognized as a complex shoulder condition marked by pain and a notable reduction in the range of motion of the glenohumeral joint.[3] According to previous studies, inflammation in the capsule and synovium of the shoulder joint can lead to contracture of the capsule. This results in the humeral head moving nearer to the glenoid fossa. The capsular pattern mobility of the shoulder is decreased, which involves both active and passive movements, while there is a greater reduction in external rotation, abduction, and internal rotation. This limited mobility of the shoulder is called frozen shoulder, in which the patient cannot perform their daily activities or home tasks.[4]

The shoulder provides a synergy pattern with the surrounding due to its exclusive fundamental arrangement and incredible range of motion. Any disease of the shoulder results in loss of its joint mobility.[5] Shoulder adhesive capsulitis is identified by persistent pain and a gradual restriction of both active and passive motion in the glenohumoral joint.[6] It is a frequent shoulder disorder in which progressive inflammation of the joint capsule eventually produces contracture, resulting in stiffness and reduced mobility. The age group most commonly affected ranges between 40 and 70 years. Secondary adhesive capsulitis often arises when a pre-existing condition, such as shoulder dislocation, humeral fracture, osteoarthritis, or neurological impairment, causes altered muscle function. In individuals with systemic illnesses like type 2 diabetes or thyroid dysfunction, the occurrence of secondary adhesive capsulitis has been reported between 4.3% and 38%.[7]

Clinical evaluation begins with a comprehensive history of shoulder problems. Patients frequently associate their shoulder pain with an apparently minor traumatic event. Such incidents may be insignificant or unrelated, yet are often recalled by patients as the possible trigger for their symptoms.[8] Management strategies commonly involve joint mobilization, a passive therapeutic technique applied to alleviate stiffness and discomfort. These maneuvers include small oscillatory motions of one articular surface relative to the other. The direction of oscillation corresponds to natural joint kinematics, involving rolling, gliding, spinning, and distraction forces that create separation between articular surfaces. For example, during abduction of the shoulder, accessory motion occurs as the humeral head shifts inferiorly while rotating on the glenoid fossa.[9]

Mulligan's mobilization with movement (MWM) displayed better results in improving pain and the maneuverability of joints. It was proposed by Mulligan that by correcting positional faults in injuries and strains, we can get better results. This technique is a concurrent operation of the corrective glide to the joint, along with movement. Movement with mobilization shows impressive effects in adhesive capsulitis. Movement with mobilization also helps to improve the motor strategies of scapulohumeral rhythm.[10] Maitland

described that Grade I and Grade II mobilization techniques are primarily applied when joint movement is restricted due to pain. The oscillatory movements in this method exert an inhibitory influence on pain perception by repeatedly activating mechanoreceptors, which interfere with the nociceptive signals at the spinal cord level. These repetitive oscillations also facilitate the nourishment of articular cartilage through the movement of synovial fluid.[11]

The Shoulder Pain and Disability Index (SPADI) is a self-administered assessment tool. It is divided into two domains: one measures pain and the other evaluates disability related to joint function and daily activities. The questionnaire requires about 5–10 minutes for patients to complete, and it is both reliable and valid in assessing shoulder-specific problems. In adhesive capsulitis, to regain the normal extensibility of the capsule and tightness of soft tissue, we need to perform passive stretching in the form of mobilization. According to Maitland, Kaltenborn, and Mulligan, mid-range mobilization and end-range mobilization can be used. Mulligan suggested that movement with mobilization has its effects by correcting its positional faults. According to them, mobilization is the effective treatment to improve and restore synovial joint mobility. The initial treatment should be an aggressive physiotherapy treatment program.[12]

Open heart surgery is one of the most invasive surgeries, with months of post-operative pain. Multiple physical functions, including movement, ambulation, and activities of everyday life, become impossible without a proper shoulder operation. Because of the inability to conduct exercises independently, improper alignment, muscle division during surgery, and rib spreading, cardiac surgery may result in shoulder dysfunction. During heart surgery, certain patients can have a stroke, which may result in shoulder immobility. The autoimmune reaction seems to be triggered when a joint is immobilized, resulting in adhesive capsulitis.[13] Other comorbid conditions include an increase or decrease in thyroid level, heart disease, lung disease, neurological issues, and other surgical issues that do not involve the shoulder, including heart surgery, brain surgery, and heart catheterization.[14]

METHODOLOGY

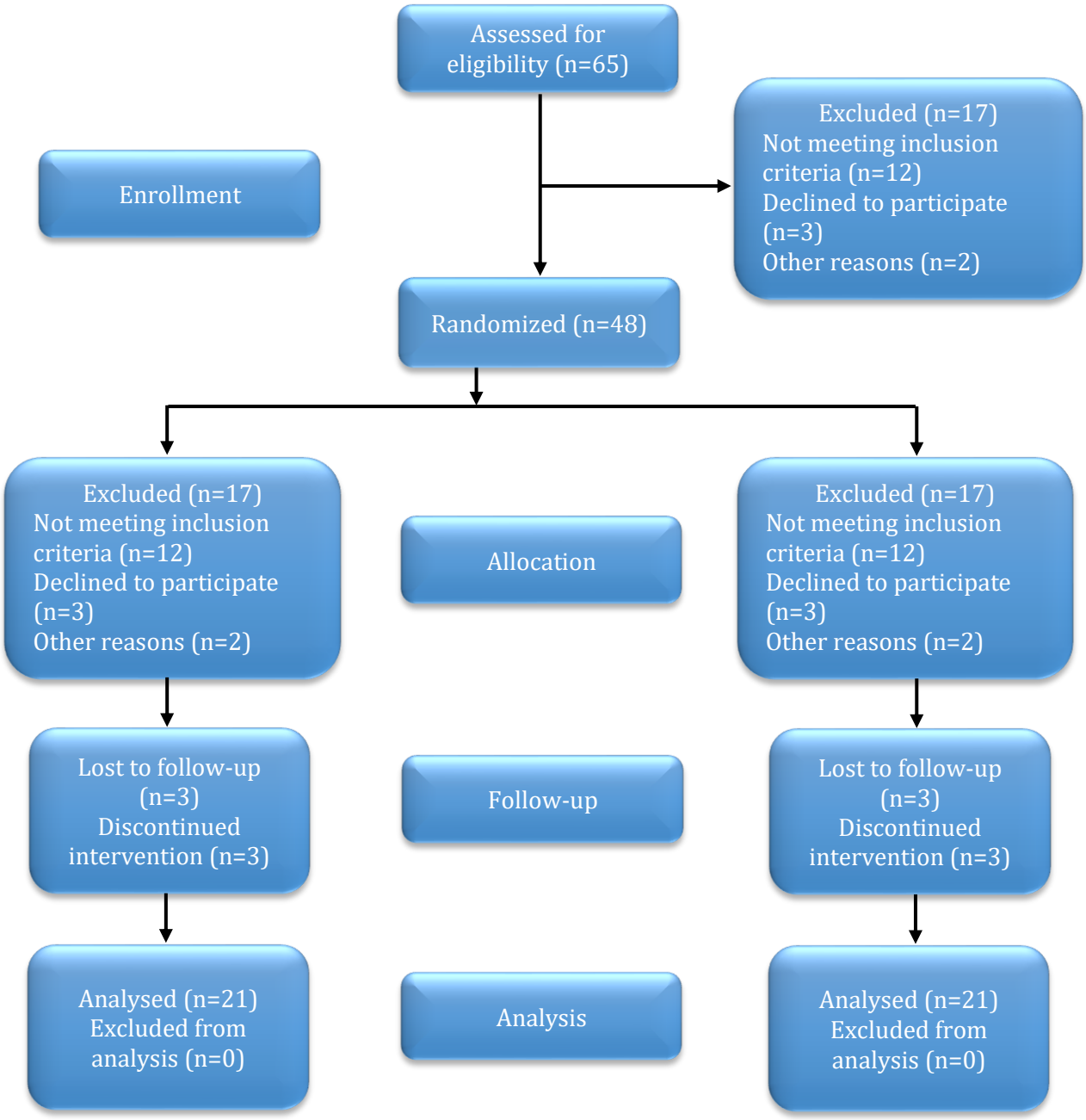
This study followed a randomized clinical trial design, and participants were recruited using a convenience sampling method, with a total of 48 individuals enrolled. Random allocation into two groups was carried out through a simple lottery method, assigning patients with post-CABG adhesive capsulitis from Faisalabad Institute of Cardiology to two groups. The required sample size was determined through Epitool, and the trial was conducted over a period of four months. All participants were asked to provide informed consent before enrollment.

Eligible individuals were males and females between 40 and 60 years of age who presented with shoulder pain, restricted range of motion after CABG, and limited movements in abduction and external rotation. Exclusion criteria involved those with neurological conditions, severe traumatic injuries leading to painful stiffness, radiographic evidence of osteoarthritis or bony abnormalities, history of surgery, manipulation under anesthesia, or previously diagnosed musculoskeletal disorders of the affected shoulder. Screening procedures included baseline evaluation using the numeric pain rating scale (NPRS) and SPADI scores. After selection, participants were divided into two groups, with Group A receiving the Mulligan technique and Group B receiving the Maitland technique. Immediately following the interventions, post-treatment NPRS and SPADI scores were recorded for comparison.

Both Group A and Group B received a single session of range of motion (ROM) exercises. The subject in the supine-lying and exercise session of ROM exercises from passive and active ROM had started, in which Circumduction for 5 minutes, along with pendulum exercise for 5 minutes, were included. The therapist applied the Mulligan technique (MWM) to Group A with three sets of 10 repetitions, with 30 sec rest between sets, and the Maitland (Grade III mobilization) technique to Group B after ROM exercises at the rate of 2-3 glides per second for 30 secs, and each glide was given for 5 sets to meet the requirement of this treatment.

Treatment was given for 4 weeks, and 3 sessions each week. There were 2 follow-ups in 4 weeks. The first follow-up was after 2 weeks, and the second was after 4 weeks. This follow-up plan is demonstrated in a tabulated form, as a CONSORT Flow Diagram (Figure 1) and it outlines the follow-up plan for all patients. To measure pain in the shoulder, the NPRS was used. It is a simple tool

Figure 1: Consort Diagram



used to measure pain intensity. It's an 11-point scale, ranging from 0 (no pain) to 10 (worst pain imaginable), according to the National Institutes of Health. Patients were asked to select a number that best represents their pain level, making it easy for them to describe their pain. Then the selected number was ticked on the NPRS scale and recorded.

To assess shoulder disability in patients with adhesive capsulitis, the SPADI questionnaire was applied. This is a self-reported measure divided into two sections: one related to pain and the other to functional tasks. The pain section contains five questions about the intensity of shoulder pain, while the functional section has eight questions that focus on difficulties in everyday activities requiring arm use. On average, patients need around 5–10 minutes to finish the questionnaire. It is considered one of the few region-specific tools that has shown good reliability and validity for shoulder assessment. After recording the NPRS scores, the SPADI was given to participants to collect information on both pain levels and functional limitations. Once the responses were gathered, the mean values of the two subscales were combined to form a total score, ranging from 0 (no symptoms) to 100 (severe disability).

Data analysis was carried out using SPSS version 23. Normality of the data was checked with the Shapiro–Wilk test. Ethical clearance for this work had already been obtained from the university's committee, and all participants signed an informed consent form before inclusion. Information

Figure 1: Posterior Mobilization with Mulligan Mobilization

Figure 2: Posterior Mobilization with Maitland Mobilization

collected from clinical settings was handled with Participants were also informed about the possible benefits as well as the drawbacks of the study. Subject selection was performed fairly and without discrimination of age, gender, or occupation, following standard ethical guidelines. Within-group analysis was done using a paired sample t-test. Between-group analysis was done using the Mann-Whitney U and independent t-tests.

RESULTS

In our study, 48 participants were enrolled. Out of which, 14 males and 10 females were included in Group A, while 15 males and 9 females were included in Group B. The mean±SD of age for group A and group B was 50.37±5.35 and 49.91±5.58, respectively. The mean±SD of weight for group A and group B was 80.70±12.58 and 81.125±11.53, respectively. The mean±SD of BMI for group A and group B was 27.92±2.29 and 27.92±2.29, respectively. The Normality of data showed that NPRS at the baseline is not significant, and the SPADI at the baseline was significant. So, non-parametric tests and Parametric tests were applied to measure the difference between the baseline and in the 2nd and 4th week of NPRS & SPADI, respectively.

The mean±SD of the NPRS scale for group A was 8.52±0.92 before the treatment, and after the 2nd week of treatment, the mean±SD of the NPRS was 6.47±0.67. After the 4th week of treatment, the mean±SD of NPRS was 3.95±0.66. The statistical analysis for the Friedman test conducted for NPRS group A participants showed that the NPRS was statistically significantly different from baseline to after the treatment by the treatment of Mulligan Technique on group A participants, p=0.00. The mean±SD of NPRS for group B was 8.52±1.07, and the mean±SD after the 2nd week of treatment was 7.38±1.02. After the 4th week, the mean±SD was 6.09±0.83. The statistical analysis for the Friedman test conducted for NPRS group B participants showed that the NPRS was statistically significantly different from baseline to after the treatment by the treatment of Maitland technique on group B participants, p=0.00.

The statistical analysis of the Mann-Whitney test showed that, at baseline, the mean±SD of both groups was 8.52±1.03. After the 2nd week of treatment, the mean±SD of both groups was 6.92±0.92. The mean±SD of groups after treatment at the 4th week was 5.02±1.31. The statistical analysis for the Mann-Whitney U test conducted for both groups showed that the NPRS was statistically significantly different from baseline to after the treatment, i.e, p=0.00, by the treatment of Mulligan and Maitland techniques on group A and B participants, respectively.

The paired sample statistics of the pain subscale show that for the participants of group A, the mean±SD before the treatment at baseline was 78.95±8.57 scores, and after the treatment, the mean±SD was 36.52±6.20 scores, which indicated a mean difference of 42.43 scores in the pain

subscale after getting treated with the Mulligan Technique. There was a mean±SD difference of 42.42±9.30 scores between the pre and post-test values of group A participants, with p=0.00, which means that results are significant and the Mulligan technique has statistically significant effects on the pain subscale of SPADI of the patients; p<0.00. The paired sample statistics of the pain subscale show that for the participants of group B, the mean±SD before the treatment at baseline was 76.23±10.80 scores, and after the treatment, the mean±SD was 54.38±8.93 scores, which indicated a mean difference of 21.85 scores in the pain subscale after getting treated with the Maitland technique. There was a mean±SD difference of 21.85±3.63 scores between the pre and post-test values of group B participants with p=0.00, which means that results are significant and the Maitland technique has statistically significant effects on the pain subscale of SPADI of the patients; p<0.00.

The paired sample statistics of the disability subscale show that for the participants of group A, the mean±SD before the treatment at baseline was 77.21±8.84 scores, and after the treatment, the mean±SD was 34.85±8.39 scores, which indicated a mean difference of 42.38 scores in the Disability subscale after getting treated with the Mulligan technique. There was a mean±SD difference of 42.38±9.75 scores between the pre and post-test values of group A participants, with the p=0.00, which means that results are significant and the Mulligan technique has statistically significant effects on disability subscale of SPADI of patients; p<0.00.

The paired sample statistics of the disability subscale show that for the participants of group B, the mean±SD before the treatment at baseline was 74.38±10.83 scores, and after the treatment, the mean±SD was 52.04±9.23 scores, which indicated a mean difference of 22.33 scores in the disability subscale after getting treated with the Maitland technique. There was a mean±SD difference of 22.33±3.27 scores between the pre and post-test values of group B participants, with p=0.00, which means that results are significant and the Maitland technique has statistically significant effects on disability subscale of SPADI of patients; p<0.00.

The statistical analysis of the independent sample t-test was conducted between the pre- and post-treatment values of SPADI. It is evident from the table that there was no significant difference in the scores of pre-tests SPADI (p=0.54). The description showed that p=0.00, indicating that both groups produced a significant difference in the scores of SPADI. However, the results for group A participants, who underwent the Mulligan technique, showed an improvement of 19.28 points compared to the Maitland technique group.

DISCUSSION

This study was designed to examine the impact of Maitland and Mulligan mobilization techniques on individuals with post-CABG adhesive capsulitis. It is estimated that frozen shoulder affects around 2–5% of the general population, while its prevalence in patients with diabetes rises to 10–20%. At the Faisalabad Institute of Cardiology (FIC), seventy patients were screened with the help of a structured form and were then divided into two groups. Group A patients were treated with the Mulligan approach, and Group B patients received Maitland therapy. Data were recorded on assessment sheets at the 2nd and 4th weeks using the NPRS scale, while SPADI scores were measured both before and after intervention. In NPRS readings, blue color indicated baseline values, black represented results at two weeks, and red reflected outcomes at four weeks.[15] Another study compared different mobilization techniques for

Table 1: Demographics of participants

Variables	Category	Mulligan Group	Maitland Group
		Percentage (%)	
Gender	Male	58.3	62.5
	Female	41.7	37.5
Age (years)	41-45	16.7	12.5
	46-50	45.8	37.5
	51-55	20.8	29.2
	56-60	16.7	20.8
Weight (kg)	61-70	33.3	29.2
	71-80	8.3	16.7
	81-90	37.5	33.3
	91-100	20.8	20.8
BMI	18.5-24.9	8.3	16.7
	25.0-29.9	66.7	66.7
	30.0-34.9	25	16.7

Table 2: Within-group analysis of NPRS for both groups

	Mean±SD (95% CI)						p-value
	Group A (Mulligan Group)			Group B (Maitland Group)			
NPRS	Baseline	2nd week	4th week	Baseline	2nd week	4th week	
	8.52±0.92	6.47±0.67	0.95±0.66	8.52±1.07	7.38±1.02	6.09±0.83	0.00

Table 3: Within-Group Analysis of SPADI for Group A & Group B

SPADI	Mean±SD (95% CI)				p-value
	Group A (Mulligan Group)		Group B (Maitland Group)		
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	
Pain Subscale	78.95±8.57	36.52±6.20	76.23±10.80	54.38±8.93	0.00
Disability Subscale	77.23±8.84	34.85±8.39	74.38±10.83	52.04±9.23	0.00

Table 4: Between-Group Analysis of NPRS & SPADI

	Baseline	2nd week	4th week	p-value	
NPRS	8.52±1.03	6.92±0.92	5.02±1.31	0.00	
SPADI	Pre-treatment	Post-treatment			
Group A	77.37±6.68	34.80±6.61		Pre-treatment	0.54
				Post-treatment	0.00
Group B	75.75±11.26	54.09±9.85		Pre-treatment	0.54
				Post-treatment	0.00

frozen shoulder in patients aged 40–70 years, often alongside electrotherapy. It was reported that 10–20% of diabetic patients develop frozen shoulder compared to 2–5% of the general population, with as much as 36% incidence in insulin-dependent diabetics. Findings showed that frozen shoulder is a common and painful but mostly self-limiting condition. Management in primary care usually involves analgesics, injections, and physiotherapy, with diagnosis based on clinical presentation. Educating patients remains vital, though in severe or unresponsive cases, referral to orthopedics may be required. Techniques such as manipulation under anesthesia and, in resistant cases, arthroscopic release have shown benefit, although many patients never achieve full recovery of shoulder motion.[16]

A randomized controlled trial compared Kaltenborn and Maitland mobilizations for adhesive capsulitis using a simple random sampling method with 40 participants. After obtaining informed consent, data were gathered through a structured questionnaire, along with SPADI and NPRS scores to evaluate pain and disability. Inclusion criteria involved patients with a limited range of motion, pain, and functional restrictions, while those with arthritis, rotator cuff injuries, malignancy, or periarthritis were excluded. Results suggested that adhesive capsulitis occurred more frequently in diabetic patients and women. Both mobilization techniques were effective, but Maitland showed greater benefit in reducing pain, improving range of motion, and decreasing disability, which enhanced patients' activities of daily living.[17]

Another group of researchers evaluated end-range mobilization (ERM) combined with a home exercise program versus MWM with the same program. The outcomes focused on shoulder abduction and external rotation, measured with a

goniometer before and after intervention. Both groups showed significant improvements in shoulder function, though differences in abduction were not notable between groups. However, ERM provided a marked advantage in external rotation gains. The study concluded that both ERM and MWM were effective in enhancing shoulder abduction, while ERM had an additional edge for external rotation. Limitations included the small sample size, reliance on patient-reported symptoms, financial constraints, and short study duration. Based on these findings, future work should aim for larger, more diverse populations and longer trial periods. It was further recommended that both Maitland and Mulligan mobilizations be tested across different orthopedic conditions to assess their broader therapeutic value.

CONCLUSION

In conclusion, this study showed that both Mulligan and Maitland mobilization techniques are effective in reducing pain and improving function in post-CABG adhesive capsulitis. However, Mulligan mobilization demonstrated superior outcomes in terms of pain relief and functional recovery when compared with Maitland. These results highlight Mulligan mobilization as a more effective treatment option for managing post-CABG frozen shoulder and support its wider use in clinical rehabilitation settings.

DECLARATIONS

Consent to participate: Written consent had been obtained from patients. All methods were performed following the relevant guidelines and regulations.

Availability of Data and Materials: Data will be made available upon request. The corresponding author will submit all dataset files.

Competing interests: None

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Authors' contributions: All authors had read and approved the final manuscript.

CONSORT Guidelines: All methods were performed following the relevant guidelines and regulations.

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