RESEARCH PAPER

Effect of Kinetic Control Exercise on Shoulder Dysfunction Post Mastectomy

Alaa Tarek Mostafa ElNawawy[1]*, Karim Ibrahim Saafan[2], Ahmed Salem Salem El fiqi[3], Haidy Nady Ashem[4]

1Department of Physical Therapy for Surgery, Faculty Physical Therapy, Cairo university & Assistant lecturer, Department of Physical Therapy for Surgery October University for Modern Science and Arts, Egypt.
2Assistant Professor of Physical Therapy for Surgery, Faculty of Physical Therapy, Cairo University and Horus University, Egypt.
3Consultant Plastic Surgeon, Faculty of Medicine, Ain Shams University, Egypt.
4Professor and Head of Department of Physical Therapy for Surgery, Faculty of Physical Therapy, Cairo University, Egypt.

ABSTRACT

Background: Post-mastectomy shoulder dysfunction (PMSD) is a common complication that negatively affects functional ability and quality of life. Impairments in scapular stability and motor control contribute significantly to restricted shoulder movement and pain. Kinetic control exercises may improve shoulder function by enhancing muscle coordination and movement efficiency.

Objective: To investigate the effect of kinetic control exercises on shoulder function in patients with shoulder dysfunction following mastectomy.

Methods: Sixty female patients within age ranged from 40 to 50 were selected from learning hospitals Al Kaser Al Ayni hospital and National Cancer Institution who had undergone unilateral modified radical mastectomy one month after the surgery. They were randomly assigned into two groups. Group A (n = 30) received kinetic control exercises inform of activation local and general Stabilizer, mobilizer, while Group B (n = 30) received traditional therapy inform of stretching and strengthening exercise as shoulder roll, arm circle, wall climb, back climb and hand behind neck. Both groups received three sessions per week for eight weeks. Shoulder range of motion (flexion, extension, abduction, internal rotation, and external rotation) was assessed using a goniometer. Scapular stability and kinetic control were evaluated using a pressure biofeedback unit. Pre- and post-treatment measurements were statistically analyzed.

Results: Both groups showed significant improvements in all shoulder range-of-motion measures ($p < 0.001$). However, Group A demonstrated significantly greater improvements compared to Group B in shoulder flexion, extension, abduction, and rotational movements ($p < 0.01$). Pressure biofeedback assessment revealed improved scapular stability and reduced compensatory patterns in the kinetic control group. The geniometer results in this study highlight the clear superiority of kinetic intervention protocols in improving shoulder mobility across all ranges of motion. While control groups achieved only modest gains44% in flexion, 3% in extension, 17% in abduction, 22% in adduction, and 8% in internal rotation—the kinetic groups consistently demonstrated far greater improvements, reaching 109% in flexion, 43% in extension, 85% in abduction, 63% in adduction, and 32% in internal rotation. Similarly, biofeedback readings confirmed significant progress in both groups, though kinetic protocols again produced markedly higher gains: flexion improved by over 200% compared to 36% in the control, abduction by 64% versus 28%, depression by 56% versus 33%, and retraction by 18% versus 16%. Collectively, these findings underscore the therapeutic superiority of kinetic interventions in restoring and enhancing shoulder mobility.

Conclusion: Kinetic control exercises are more effective than traditional rehabilitation alone in improving shoulder mobility and scapular stability after mastectomy. Incorporating kinetic control into post-mastectomy rehabilitation programs is recommended to enhance functional recovery.

Keywords: Kinetic control, Post-mastectomy shoulder dysfunction, Scapular stability, Biofeedback, Shoulder rehabilitation

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INTRODUCTION

Breast cancer is the second largest cause of cancer mortality among women. Breast cancer develops in a multi-step process involving various cell types, and prevention remains a global challenge (1). One of the most effective ways to avoid breast cancer is to diagnose it early. Breast cancer patients from some advanced countries have a 5-year relative survival rate of more than 80% because of early detection and treatment (2).

**Author for Correspondence:*

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There are two categories for tumors: benign and malignant. While benign tumors are made up of non-invasive cells that stay localized and resemble normal tissue, malignant tumors are made up of abnormal cells that have the ability to invade neighboring tissues and spread. Additionally, pre-cancerous cells were significantly present **(3).**

Even when there is no definite malignancy, some women who were at high risk for breast cancer decided to have a prophylactic mastectomy as a preventative precaution. However, shoulder function may be impacted by postoperative problems following surgical procedures like mastectomy. These included abnormalities in normal biomechanics, axillary web syndrome, and scar tissue accumulation, all of which lead to shoulder discomfort and decreased mobility **(4).**

Mastectomy rates differ significantly across the globe, as shown in a study of surgical methods involving 4,700 women with early breast cancer across 37 countries. Central and Eastern Europe had the highest mastectomy rate at 77%, followed by the USA at 56%. Western and Northern Europe averaged 46%, Southern Europe 42%, and Australia and New Zealand 34% **(5).**

Post-mastectomy shoulder dysfunction (PMSD) could significantly impact quality of life, hindering daily activities and psychological well-being. One major concern was shoulder dysfunction. After mastectomy, patients frequently faced various musculoskeletal problems, largely as a result of surgical trauma, changes in biomechanics, and shifts in muscle function. The common practice of removing lymph nodes during the procedure to hinder cancer spread could worsen these issues, resulting in shoulder pain, restricted range of motion, and muscle weakness. Studies show that nearly 50% of patients experience shoulder dysfunction after mastectomy, with symptoms such as decreased flexibility, strength loss, and pain during everyday activities **(6).**

In addition to post-surgical pain and the noticeable alteration in breast shape, potential complications from a mastectomy could include wound infections, hematomas (blood accumulation in the wound), and seromas (clear fluid accumulation) **(7).**

Over the last decade, significant progress has been achieved in the knowledge of breast cancer as well as the development of prevention measures. Rehabilitation programs focusing on physical therapy are critical in addressing these issues, as they aim not only to restore shoulder function but also to enhance overall quality of life for survivors. Studies had shown that targeted exercises can significantly improve shoulder range of motion and reduce pain levels **(8).**

Kinetic control is a therapeutic approach focusing on movement efficiency and motor control **(8).** It addressed impairments in muscle activation and coordination, potentially benefiting PMSD by improving movement patterns and reducing compensatory strategies.

This study explored the impact of a kinetic control-based intervention on shoulder dysfunction following mastectomy.

PATIENTS AND METHODS

Ethical Approval

Each patient completed an informed consent sheet after being fully informed of their rights before taking part in the trial. The Institutional Review Board of Cairo University's Faculty of Physical Therapy granted ethical permission (No. P.T. REC/012/005394) prior to the study execution. The Declaration of Helsinki Guidelines for Human Research was followed in the conduct of the current investigation.

1. Subject:

1.1. Sample size determination

Sample size calculation was done using shoulder flexion ROM with 90% power at $\alpha = 0.05$ level, number of measurements 2, for 2 groups and effect size = 0.9 using F-test MANOVA repeated measures within and between interaction. Total sample size is 60 subjects, 30 subjects in each group. The sample size was calculated using G*Power software (version 3.0.10) was calculated using the G*Power software (version 3.0.10).

1.2. Subject selection:

This prospective study was carried out on 60 female patients aged from 40-50 years old, undergone (simple) modified radical mastectomy one month after the surgery, were physically able to participate in Kinetic Control exercises, had clearance from an oncologist/surgeon to participate in physical therapy.

Exclusion criteria included patients with presence of metastatic cancer or other serious health complications, contraindications to exercise (such as recent surgeries outside of the mastectomy, cardiovascular issues), ongoing radiation or chemotherapy treatments, previous lymphedema without proper medical clearance and severe mental health issues that prevent them from understanding. Informed written consent was obtained from the patients.

1.3. Recruitment and randomization:

Patients were randomly assigned to one of two groups, each consisting of 30 individuals, using a blinding approach to eliminate selection bias. The randomization process was conducted using OpenEpi Random Group Generator and Calculator Soup Random Number Generator, both of which are reliable online tools designed for statistical accuracy. These methods ensured an unbiased distribution of participants, reinforcing the validity and reliability of the study findings.

2. Interventions

2.1. Treatment

Group A (kinetic control exercise group):

Participants underwent a kinetic control exercise consisting of 45-minute sessions, three times per week for eight weeks (total of 24 sessions). The program included flexibility exercises targeting the pectoralis minor and latissimus dorsi muscles, as well as stabilization exercises for the subscapularis, supraspinatus, serratus anterior, and middle and lower trapezius muscles.

Group B (control group):

Participants underwent traditional therapy inform of stretching and strengthening exercise as shoulder roll, arm circle, wall climb, back climb and hand behind neck. Patients received 3 sessions per week for 8 weeks, the time of session is 45 - 60 min according to patient ability.

2.2. Assessment

Biofeedback Assessment and Kinetic Control Testing

Kinetic control of the shoulder and scapula was assessed using a pressure biofeedback unit. Testing included controlled shoulder flexion or abduction, scapular retraction or depression, and isometric holds in various arm positions. Participants were instructed to perform movements while maintaining a steady pressure reading on the gauge. Performance was evaluated based on pressure accuracy, presence of compensatory patterns (e.g., excessive pressure changes indicating muscle substitution or scapular instability), and consistency across multiple repetitions to assess fatigue or loss of control.

Stabilization Tests

A scapular stabilization test was performed with the participant in a prone position, placing the inflatable cuff beneath the scapula. Participants were instructed to gently retract and depress the scapula while maintaining pressure within ±5 mmHg of the baseline. The position was held for 3–5 minutes. A shoulder flexion stability test was also conducted by placing the cuff under the shoulder joint while the participant performed small-range shoulder flexion movements. Pressure changes were monitored as indicators of muscle activation patterns and shoulder stability **(9)**.

Method of Evaluation

Primary outcome measures included pressure variability (mmHg) during tasks and the participant's ability to maintain pressure within the predefined stability range (±5 mmHg).

Rehabilitation Framework and Biofeedback Training

The intervention followed a structured framework consisting of an initial assessment to identify faulty movement patterns and compensatory strategies, followed by targeted rehabilitation focusing on muscle activation, strengthening of underactive stabilizers, and flexibility exercises for overactive muscles. Biofeedback training was used to monitor scapular retraction and stability through an inflatable cuff set at baseline pressures of 20–40 mmHg depending on position.
Patient positioning included prone positioning for scapular retraction assessment and quadruped positioning for dynamic scapular stability. Pressure consistency, compensatory muscle recruitment, and endurance were recorded. Following the intervention period, the same assessments were repeated to evaluate improvements in scapular stability and kinetic control **(9)**.

RESULTS

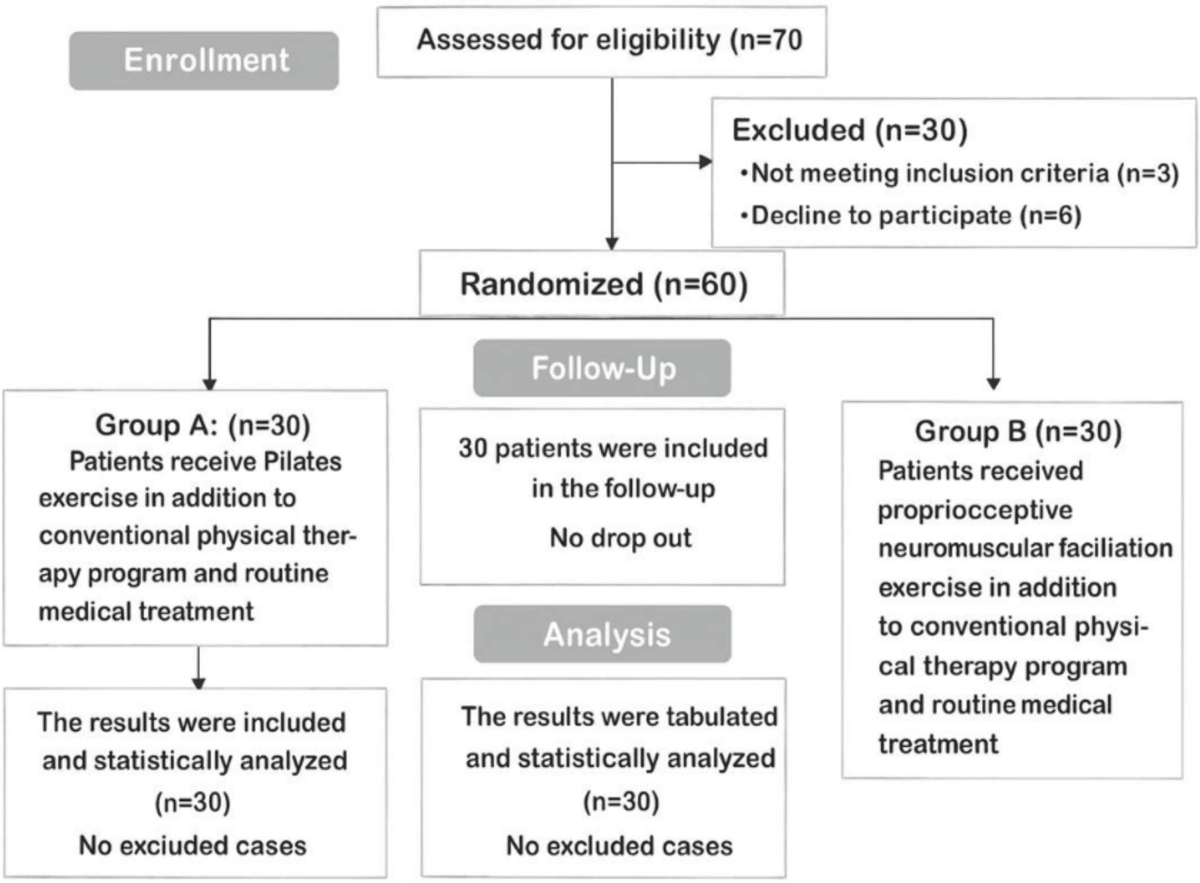

Figure 1: CONSORT flowchart of the enrolled patients

Table 1: Demographic Data of the Studied Group

	Group A (n=30)	Group B (n=30)	P value

Age (years)	**Mean ± SD**	61.8 ± 8.17	57.6 ± 9.98	0.318
	Range	40 – 50	45 - 50	
Weight (kg)	**Mean ± SD**	74.9 ± 9.14	73.2 ± 14.57	0.240
	Range	61 – 92	54 - 100	
Height (m)	**Mean ± SD**	1.66 ± 0.08	1.64 ± 0.07	0.632
	Range	1.54 - 1.78	1.56 - 1.75	
BMI (kg/m^2)	**Mean ± SD**	27.1 ± 2.88	27.3 ± 5.81	0.369
	Range	21.6 - 31.2	19.3 - 38.2	

There was no significant difference between Group A and Group B regarding age, weight, height, and BMI.

Table 1: Flexion Measurement by Goniometer

	Group A (n=30)	Group B (n=30)	Post hoc	T Value
Geniometer	**Flexion Kinetic group**	**Flexion Control group**		
pretreatment	66.90 ± 27.080	125.26 ± 22.81°	**>0.005**	**-5.48**
Post treatment	100.558 ± 34.085	140.10 ± 28.05°	**0.003**	**-20.625**
P value	**<0.001***	**<0.001***		

Based on the finding, Group B exhibited a mean flexion of 125.26° ± 22.81, markedly higher than Group A's 66.90° ± 27.08, with a post hoc analysis indicating a statistically significant difference ($p > 0.005$, $T = -5.48$). After four weeks of treatment, both groups showed notable gains; however, Group B maintained a greater increase, reaching 140.10° ± 28.05, while Group A improved to 100.56° ± 34.09. The post-intervention comparison yielded a highly significant difference ($p = 0.003$, $T = -20.625$). Additionally, within-group analysis verified significant improvements over time ($p < 0.001$ for both groups), highlighting the kinetic intervention's superiority over the control protocol in increasing flexion range.

Table 2: Extension Measurement by Geniometer

	Group A (n=30)	**Group B (n=30)**	**Post hoc**	**T Value**
Geniometer	**Extension Kinetic group**	**Extension Control group**		
Pre treatment	44.359± 15.260	41.774± 6.878°	>0.005	-16.949
Post mastectomy	59.595±19.038	45.741± 6.980°	0.003	-19.193
P value	<0.001*	<0.001*		

Extension range revealed significant improvements in both groups following the intervention, with Group A (Extension Kinetic) demonstrating a more pronounced enhancement. Prior to treatment, Group B (Extension Control) recorded a mean extension of 41.77° ± 6.88, while Group A showed a slightly higher baseline of 44.36° ± 15.26. Although the initial difference was not statistically significant (post hoc $p > 0.005$, $T = -16.949$), the disparity became more evident after eight weeks. Post-treatment, Group B improved modestly to 45.74° ± 6.98, whereas Group A exhibited a substantial increase to 59.60° ± 19.04. This difference was statistically significant (post hoc $p = 0.003$, $T = -19.193$), and within-group analysis confirmed highly significant improvements over time in both groups ($p < 0.001$*). These findings suggest that the kinetic extension protocol was more effective in enhancing joint extension compared to the control approach.

Table 3: Abduction Measurement by Goniometer

	Group A (n=30)	**Group B (n=30)**	**Post hoc**	**T Value**
Geniometer	**Abduction Kinetic Group**	**Abduction Control Group**		
pretreatment	61.997 ± 24.485	35.064 ± 7.3772	**>0.005**	-14.828
Post treatment	114.581 ± 47.402	40.903 ± 6.6175	**0.006**	-10.994
P value	**<0.001***	**<0.001***		

The study has shown that shoulder abduction range revealed significant improvements in both groups following the intervention, with Group A (Abduction Kinetic) demonstrating markedly superior outcomes. At baseline, Group B (Abduction Control) recorded a mean abduction of 35.06° ± 7.38, while Group A showed a substantially higher initial value of 61.99° ± 24.49. Although the pre-treatment difference was not statistically significant (post hoc $p > 0.005$, $T = -14.828$), the post-treatment results highlighted a pronounced divergence. After eight weeks, Group A improved modestly to 40.90° ± 6.62, whereas Group A exhibited a dramatic increase to 114.58° ± 47.40. This difference was statistically significant (post hoc $p = 0.006$, $T = -10.994$), and within-group analysis confirmed highly significant improvements over time in both groups ($p < 0.001$*). These findings underscore the effectiveness of the kinetic abduction protocol in enhancing shoulder mobility far beyond the gains observed in the control group.

Table 5: Adduction Measurement by Geniometer

	Group A (n=30)	**Group B (n=30)**	**Post hoc**	**T Value**
Geniometer	**Adduction Kinetic Group**	**Adduction Control Group**		
pretreatment	50.000 ± 12.121	32.516 ± 6.617	**>0.005**	**-9.824**
Post treatment	81.484 ± 10.145	39.677 ± 6.695	**0.003**	**-20.973**
P value	<0.001*	<0.001*		

The study demonstrated that Group B (Adduction Control) exhibited a mean adduction of 32.52° ± 6.62, while Group A recorded a higher baseline value of 50.00° ± 12.12. Although the pre-treatment difference was not statistically significant (post hoc p > 0.005, T= -9.824), the post-treatment outcomes revealed a substantial divergence. After four weeks, Group B improved to 39.68° ± 6.70, whereas Group A reached 81.48° ± 10.15. This post-intervention difference was statistically significant (post hoc p = 0.003, T = -20.973), and within-group analysis confirmed highly significant improvements over time in both groups (p < 0.001*). These findings suggest that the kinetic adduction protocol was considerably more effective in enhancing shoulder mobility than the control approach.

Table 6: Internal Rotation Measurement by Geniometer

	Group A (n=30)	Group B (n=30)	Post hoc	**T Value**
Geniometer	**Internal Rotation Kinetic Group**	**Internal Rotation Control Group**		
Pre treatment	62.888 ± 16.671	62.888 ± 9.537	**>0.005**	-11.118
Post treatment	83.065 ± 10.079	83.065 ± 9.672	**0.003**	-20.973
P value	**<0.001***	**<0.001***		

The study revealed that internal rotation measurements revealed significant improvements in both groups following the intervention, with Group A (Internal Rotation Kinetic) showing a more pronounced enhancement. At baseline, both Group B (Control) and Group A (Kinetic) recorded identical mean values of 62.89°, though Group B exhibited greater variability (±16.67 vs. ±9.54). The pre-treatment difference was not statistically significant (post hoc p > 0.005, T = -11.118). After four weeks, both groups demonstrated marked improvement, reaching a mean of 83.07°, with Group A maintaining a slightly higher standard deviation (±10.08 vs. ±9.67). The post-intervention comparison yielded a statistically significant difference (post hoc p = 0.003, T = -20.973), and within-group analysis confirmed highly significant changes over time (p < 0.001* for both groups). These findings suggest that while both protocols were effective, the kinetic approach may offer enhanced consistency and therapeutic benefit in improving internal rotation.

Table 7: Flexion Measurement By Biofeed Back

	Group A (n=30)z	Group B (n=30)	Post hoc	**T Value**
Biofeed Back	**Flexion Kinetic Group**	**Flexion Control Group**		
Pretreatment	21.290 ± 16.671	19.581± 8.261	**>0.005**	-10.657
Post treatment	64.613 ± 10.079	26.613 ± 6.998	**0.003**	-15.253
P value	**<0.001***	**<0.001***		

The research has shown that flexion measurements demonstrated a substantial improvement in both groups following the intervention, with Group A (Flexion Kinetic) showing a markedly greater enhancement. At baseline, Group B (Control) recorded a mean of 19.58° (±8.26), while Group A started slightly higher at 21.29° (±16.67), though the difference was not statistically significant (post hoc p > 0.005, T = -10.657). After four weeks, Group B improved modestly to 26.61° (±6.99), whereas Group A exhibited a dramatic increase to 64.61° (±10.08). The post-intervention comparison revealed a statistically significant difference between the groups (post hoc p = 0.003, T = -15.253), and within-group analysis confirmed highly significant improvements over time (p < 0.001* for both). (Table 6)

Table 8: External Rotation Measurement by Biofeedback

	Group A (n=30)	Group B (n=30)	Post hoc	
Geniometer	**External Rotation Kinetic Group**	**External Rotation Control Group**		

Pre treatment	62.888 ± 16.671	62.888 ± 9.537	**>0.005**	-11.118
Post treatment	83.065 ± 10.079	83.065 ± 9.672	**0.007**	-20.973
P value	**<0.001***	**<0.001***		

Both the control and kinetic groups demonstrated significant improvements in external shoulder rotation following the intervention. At baseline, Group B (Control) and Group A (Kinetic) shared identical mean values of 62.89°, though Group A showed greater variability (±16.67 vs. ±9.54). The pre-treatment difference was not statistically significant (post hoc p > 0.005, T = -11.118). After four weeks, both groups improved to a mean of 83.07°, with Group A again showing slightly higher variability (±10.08 vs. ±9.67). The post-intervention comparison revealed a statistically significant difference between groups (post hoc p = 0.007, T = -20.973), and within-group analysis confirmed highly significant changes over time (p < 0.001* for both).

Table 9: Abduction Control group Measurement by Biofeed Back for both group

	Group A (n=30)	**Group B (n=30)**	**Post hoc**	**T Value**
Biofeed Back	**Abduction Kinetic Group**	**Abduction Control Group**		
Pre treatment	23.097± 13.736	16.774 ± 7.588	**>0.005**	-24.358
Post treatment	37.903 ± 10.922	21.387 ± 7.753	**0.002**	-17.280
P value	**<0.001***	**<0.001***		

The measurements revealed significant improvements in abduction of both groups following the intervention, with Group A (Abduction Kinetic) demonstrating a notably greater gain. At baseline, Group B (Control) recorded a mean of 16.77° (±7.59), while Group A started higher at 23.10° (±13.74), though the difference was not statistically significant (post hoc p > 0.005, T = -24.358). After four weeks, Group A showed a modest increase to 21.39° (±7.75), whereas Group A improved substantially to 37.90° (±10.92). The post-treatment comparison yielded a statistically significant difference (post hoc p = 0.002, T = -17.280), and within-group analysis confirmed highly significant improvements over time (p < 0.001* for both groups).

Table 10: Depression Measurement By Biofeed Back for both groups

	Group B (n=30)	**Group A (n=30)**	**Post hoc**	**T Value**
Biofeed Back	**Depression Kinetic Group**	**Depression Control Group**		
Pre treatment	26.097 ±11.579	18.258 ± 6.894	**>0.005**	-7.564
Post treatment	40.677 ±19.248	24.323 ± 6.5645	**0.002**	-8.969
P value	**<0.001***	**<0.001***		

The study revealed that measurements of shoulder depression showed significant improvement in both groups following the intervention, with Group B (Depression Kinetic) demonstrating a markedly greater enhancement. At baseline, Group A (Control) recorded a mean of 18.26° (±6.89), while Group B started higher at 26.10° (±11.58), though the difference was not statistically significant (post hoc p > 0.005, T = -7.564). After four weeks, Group A improved to 24.32° (±6.56), whereas Group B showed a substantial increase to 40.68° (±19.25). The post-treatment comparison revealed a statistically significant difference between the groups (post hoc p = 0.002, T = -8.969), and within-group analysis confirmed highly significant improvements over time (p < 0.001* for both).

Table 11: Retraction Measurement By Biofeed Back for both groups

	Group A (n=30)	**Group B (n=30)**	**Post hoc**	**T Value**
Biofeed Back	**Retraction Kinetic Group**	**Retraction Control Group**		
Pre treatment	26.065 ± 14.680	18.097 ± 7.652	**>0.005**	-7.209
Post treatment	30.871 ±14.240	20.935 ± 7.945	**0.006**	-18.792
P value	**<0.001***	**<0.001***		

Both groups experienced significant improvements in shoulder retraction following the intervention, with the kinetic group showing a more substantial increase. Initially, Group B (Control) had a mean retraction of 18.10° (±7.65), while Group A (Kinetic) began at a higher average of 26.07° (±14.68); however, this difference was not statistically significant (post hoc p > 0.005, T = -7.209). After four weeks, Group B's mean rose to 20.94° (±7.95), whereas Group A reached 30.87° (±14.24), reflecting a statistically significant difference between the two groups (post hoc p = 0.006, T = - 18.792). Within-group analysis also showed highly significant progress over time (p < 0.001* for both).

DISCUSSION

The demographic data in this study, including age, weight, height, and BMI, indicated no significant differences between the three groups, confirming effective randomization. This similarity in baseline characteristics across groups is crucial in clinical trials, as it mitigates confounding variables that might otherwise influence the outcomes. By ensuring demographic equivalence, the study design supports a more accurate attribution of observed differences in shoulder function and pain to the interventions themselves, rather than to pre-existing demographic factors. This alignment strengthens the study's internal validity, making the results more reliable and clinically applicable. The study found significant improvements in mobilizer and stabilizer muscles in flexion range across the kinetic control group, which outperformed the control group in enhancing shoulder flexion. The flexion is one of the most improved ranges. A crucial component of postoperative rehabilitation after mastectomy is recovering the ability of shoulder flexion, which had a direct impact on patients' functional independence and quality of life. Restricted range of motion, especially in flexion, is frequently the result of surgically disrupting soft tissues, protective postures, and psychological discomfort **(10).** The findings of this study emphasize the critical role of kinetic control as a structured intervention in enhancing shoulder flexion following mastectomy. Improved flexion promoted active joint engagement, reduced protective stiffness, and alleviated postoperative pain factors that were essential for restoring functional mobility and preventing long-term musculoskeletal complications (**10).** Furthermore, the observed correlation between increased flexion and favorable patient-reported outcomes reinforced its value as a central objective within post-mastectomy rehabilitation protocols, highlighting its impact on both physical recovery and patient comfort (11). In shoulder rehabilitation, particularly following conditions like mastectomy, the distinction between traditional therapy and kinetic control becomes crucial. Traditional therapy often emphasizes general strengthening and range-of-motion exercises, targeting mobilizer muscles such as the latissimus dorsi and pectoralis minor. These muscles contribute to gross movement but may dominate when stabilizers are weak, leading to compensatory patterns and reduced joint precision (12). The present study revealed marked improvements in shoulder extension within the kinetic control group, significantly surpassing gains observed in the kinetic group. These findings reinforced the established efficacy of kinetic control techniques in enhancing joint mobility and muscular adaptability (13). Shoulder extension limitations were a common consequence of mastectomy, often resulting from surgical disruption, protective muscular guarding, and fibrotic tissue changes. Rehabilitation strategies that activated key mobilizer muscles such as latissimus dorsi and teres major had demonstrated effectiveness in restoring extension capacity. These muscles were integral to posterior glenohumeral articulation and scapular support, both of which were critical for functional arm movement (10). Individuals recovering from reconstructive breast surgery, restoring functional shoulder mobility and maintaining postural alignment are closely related to effective scapular retraction. The integration of biofeedback into rehabilitation protocols serves both as an assessment tool and a training modality, enhancing proprioceptive input and facilitating the activation of key stabilizing muscles such as the middle trapezius. In this study kinetic control interventions, which emphasized coordinated segmental movement and targeted muscle engagement, offer a more structured and corrective approach than traditional therapy methods. This strategy had been shown to reduce incorrect movement patterns and improve scapular kinematics, thereby supporting more efficient functional recovery (14). The study showed that in post-mastectomy rehabilitation, internal rotation often suffered due to capsular restriction and disrupted scapulohumeral mechanics. Traditional therapy typically addressed this through passive mobilization and generalized strengthening, which improved range but often various aspects of muscle coordination and produced passive gains without addressing underlying motor dysfunctions. Kinetic control, on the other hand, promoted proprioceptive awareness and segmental control. It empowered patients to actively participate in their recovery and reduced reliance on compensatory strategies. This method enhanced movement precision and reduced compensatory patterns, particularly in muscles like the subscapularis that govern internal rotation. Clinical findings by Hashem et al. (10) also supported this approach, showing that patients receiving kinetic control exercises achieved more substantial improvements in shoulder mobility and scapular coordination than those treated with traditional methods. The study found improvements after mastectomy, but external rotation was often limited, mostly because of posterior capsular stiffness and preventive muscle guarding. Traditional rehabilitation methods frequently used isotonic strengthening and passive stretching, which may have resulted in modest improvements but were inaccurate in regaining coordinated motor function. By strategically involving external rotators like the teres minor and infraspinatus, kinetic control, on the other hand, offered more targeted intervention while simultaneously enhancing proprioceptive input and scapular stability. When goniometer measurements were used to objectively quantify improvements in external rotation, the kinetic control group showed greater gains than the standard therapy group (15). Limitations of the study included that the sample size was relatively small. The study was in a short-term intervention period that may have limited the ability to observe long-term effects of Kinetic control and on shoulder function and pain management. It focused solely on post-mastectomy patients, which may restrict the applicability of findings to individuals with shoulder dysfunction due to other causes. Measures did not assess adherence to exercise protocols outside the supervised sessions, potentially influencing the consistency of intervention effects.

CONCLUSION

It was concluded that kinetic control exercises were found to significantly enhance shoulder function and alleviate pain in post-mastectomy patients. These exercises effectively activated stabilizing muscles without eliciting pain, demonstrated precise timing, and avoided compensatory movement patterns, producing enhanced outcomes compared to traditional rehabilitation approaches. Notable enhancements were recorded in flexion, extension, and abduction among the kinetic control exercises participants, underscoring their effectiveness in increasing range of motion. While conventional therapy yielded similar results but less improvement. These results indicate that kinetic control exercises into post-mastectomy rehabilitation could offer distinct benefits, leading to significant improvements in patient recovery. With further studies and an increase in the number of patie2nts, a significant difference may emerge. The research has been conducted to find out and improve this very aspect of our health care system.

Conflict of Interest: The authors declare no conflict of interest.
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RECOMMENDATIONS

The results of this study indicated the need to suggest the following recommendations:

1. There Need to be more papers and knowledge in Kinetic Control exercise
2. Discover other methods to support the advancement of kinetic control, such as electromyography
3. Long-term follow-up and interdisciplinary collaboration are also essential to enhance clinical relevance and establish evidence-based guidelines for post- mastectomy rehabilitation.
4. Future research should critically compare kinetic control with other targeted rehabilitation approaches—such as Pilates, motor control training, and proprioceptive neuromuscular facilitation (PNF)—to identify its unique therapeutic advantages.

DISCLOSURE STATEMENT

The author, Dr. Alaa Tarek Mostafa ElNawawy, declares that there are no conflicts of interest related to this manuscript. No financial support, sponsorship, or commercial relationships influenced the study design, data collection, analysis, or interpretation of results. All ethical standards were adhered to, and any funding sources or institutional affiliations relevant to this research have been transparently acknowledged.

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