

Research Article

The Effect of Modified Range of Motion Aids on Shoulder-Arm Muscle Strength Mobilization in Post-Mastectomy Patients at Murni Teguh Hospital

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Abstract

This study aimed to determine the effect of a modified Range of Motion (ROM) assistive device on the mobilization and muscle strength of the shoulder and arm in post-mastectomy breast cancer patients at Murni Teguh Hospital, Medan. A quantitative experimental method with a one-group pretest-posttest design was used, involving 33 respondents selected through purposive sampling. Data collection was conducted from April to September 2025 using a goniometer to measure shoulder and arm mobility and the Medical Research Council (MRC) Scale to assess muscle strength. Statistical analysis included paired t-tests and N-gain tests to evaluate effectiveness. The results showed a significant improvement in shoulder movements (flexion, extension, abduction, and adduction) after using the modified ROM device, with all movements achieving a significance value of 0.000 ($p < 0.05$). In terms of effectiveness, the ROM aid was found to be most effective for abduction movements (85.18%), followed by adduction (75.11%) and flexion (74.25%), but less effective for extension (28.92%). The modified tool, made of elastic and soft fabric and rubber, provided comfort, ease of use, and adaptability to patients' movements. These findings demonstrate that the modified ROM assistive device effectively improves shoulder joint mobility and muscle strength in post-mastectomy patients. Further development and refinement of this device are recommended to enhance its design and therapeutic efficiency in clinical settings.

Keywords: Range of Motion (ROM), Post-Mastectomy, Muscle Strength Mobilization.



INTRODUCTION

Breast surgery is one of the most common treatment options chosen by breast cancer patients. Often, this procedure also involves the removal of nearby lymph nodes. Postoperative pain is common and frequently causes patients to avoid moving their arms and shoulders to protect the affected area. The shoulder joint, which plays a crucial role in daily activities, is highly susceptible to functional disorders—especially after mastectomy, where movement becomes limited due to inflammation, pain, and muscle spasms around the shoulder. Prolonged immobility can lead to stiffness, reduced circulation, and chronic pain.

According to Indonesia's Ministry of Health Regulation No. 65 of 2015, physiotherapy aims to develop, maintain, and restore body movement and function through manual therapy, exercise, and the use of physical or mechanical devices. One key physiotherapy intervention for post-mastectomy patients is Range of Motion (ROM) exercise, which helps improve blood circulation, prevent muscle stiffness, and restore joint mobility. ROM exercises can be active (AROM), performed by the patient, or passive (PROM), assisted manually or with a device. Early ROM exercises promote muscle strength, flexibility, endurance, and faster recovery.

In this study, the researcher aims to develop a modified ROM device designed specifically for breast cancer patients after mastectomy. The tool provides shoulder and arm support to enhance mobility and prevent stiffness. This research was conducted at Murni Teguh Hospital, Medan, a type-B referral hospital with oncology services and facilities for mastectomy procedures.

This study aims to determine the effect of a modified Range of Motion (ROM) device on the mobilization and muscle strength of the shoulder and arm in post-mastectomy breast cancer patients at Murni Teguh Hospital in 2025. Specifically, it seeks to assess the level of shoulder and arm mobility and strength before and after using the modified ROM device, as well as to evaluate the extent to which the device influences improvements in these physical functions.

METHOD

This study employs a quantitative experimental design using a one-group pretest-posttest method. In the pretest phase, shoulder and arm mobility and muscle

strength are measured during ROM exercises without assistive tools. Participants then undergo ROM exercises using a modified assistive device, followed by a posttest measuring the same variables. The population consists of all breast cancer patients 2–14 days post-mastectomy at Murni Teguh Hospital Medan, totaling 103 individuals in 2023. The sample size, determined using the Slovin formula, resulted in 29 participants, with an additional 10% added to anticipate dropouts, bringing the total to 33 respondents. Sampling was conducted using a purposive sampling technique based on specific inclusion criteria relevant to the study objectives. The study was conducted at Murni Teguh Hospital in Medan, from April to September 2025.

Data collection instruments in this study included tools to measure shoulder and arm mobility, as well as muscle strength. Shoulder and arm mobility were assessed using a goniometer, which measures the range of motion (ROM) of joints. The shoulder joint movements evaluated included flexion (0–170°), extension (0–60°), abduction (0–170°), horizontal abduction (0–130°), horizontal adduction (0–40°), internal rotation (0–60°), and external rotation (0–60°). For the arm, elbow joint movements measured included flexion (0–130° to 135°) and extension, while wrist and hand movements assessed included pronation and supination (0–80° to 90°), radial and ulnar deviation (0–20°), wrist flexion (0–80°), wrist extension (0–70°), and finger extension (0–15°). Muscle strength of the shoulder and arm was evaluated clinically using the Medical Research Council (MRC) Scale, ranging from 0 (no contraction) to 5 (normal strength), to determine the patient's ability to contract voluntary muscles against gravity and resistance.

The data collection procedure began by obtaining participants' consent through a signed informed consent form. This experimental study used a one-group pretest–posttest design. During the pretest, shoulder and arm mobility and muscle strength were measured while performing ROM exercises without assistive devices. Participants then underwent ROM exercises using the modified assistive tool, followed by a posttest to remeasure shoulder and arm mobility and muscle strength.

Data analysis in this study consisted of univariate and bivariate analyses. The univariate analysis described respondents' characteristics such as age, ethnicity, education, occupation, and the duration after mastectomy. The bivariate analysis was conducted to examine differences in shoulder and arm mobility and muscle strength before and after treatment using parametric statistical tests. Data homogeneity and

normality were first tested; if normally distributed, the paired t-test was used, while the Wilcoxon or Mann-Whitney test was applied for non-normal data. To evaluate the effectiveness of the modified ROM assistive device, the N-gain test was employed by comparing pretest and posttest scores, with effectiveness categorized as ineffective (<40%), less effective (40–75%), or effective (>76%) based on Suharsimi Arikunto (2019).

RESULT AND DISCUSSION

Respondent Characteristics

Based on the study results, most respondents were diagnosed with the Hormonal Luminal B subtype of breast cancer (60.6%), followed by Hormonal Luminal A (30.3%), Triple Positive (6.1%), and Triple Negative (3.0%). In terms of age distribution, the majority of respondents were between 48–57 years old (42.4%), followed by those aged 38–47 years (33.3%) and 28–37 years (24.3%), with a total of 33 participants included in the study.

Range of Motion (ROM) Mobilization Value Before Using Assistive Devices

Based on the table, for flexion movement, most respondents (60.6%) had a range of motion (ROM) of 0°–60°, and 39.4% had 61°–120°, with no respondents in the 121°–160° range. For extension, the majority (75.8%) had 21°–40°, 24.2% had 41°–60°, and none had 0°–20°. In abduction, most respondents (60.6%) were within 0°–60°, 39.4% within 61°–120°, and none beyond that. For adduction, most (84.8%) had 21°–40°, 15.2% had 41°–60°, and none had 0°–20°.

Table 1. ROM Values Before Using Assistive Devices

No.	ROM Value	Total	
		n	%
1.	Flexibility		
	0° - 60°	20	60,6
	61° - 120°	13	39,4
	121° -160°	0	0
	Total	33	100
2.	Extension		
	0° - 20°	0	0
	21° - 40°	25	75,8

	41° - 60°	8	24,2
	Total	33	100
3.	Abduction		
	0° - 60°	20	60,6
	61° - 120°	13	39,4
	121° - 160°	0	0
	Total	33	100
4.	Adduction		
	0° - 20°	0	0
	21° - 40°	28	84,8
	41° - 60°	5	15,2
	Total	33	100

Range of Motion (ROM) Mobilization Value After Using Assistive Devices

Based on the table, after treatment, all respondents (100%) showed a flexion ROM of 121°–160°. For extension, most (81.8%) had 41°–60°, and 18.2% had 21°–40°, with none in the 0°–20° range. In abduction, all respondents (100%) had 121°–160°, with no respondents in 0°–60° or 61°–120°. For adduction, all (100%) had 21°–40°, with no respondents in 0°–20°.

Table 2. ROM Values After Using Assistive Devices

No.	ROM Value	Total	
		n	%
1.	Flexibility		
	0° - 60°	0	0
	61° - 120°	0	0
	121° -160°	33	100
	Total	33	100
2.	Extension		
	0° - 20°	0	0
	21° - 40°	6	18,2
	41° - 60°	27	81,8
	Total	33	100
3.	Abduction		
	0° - 60°	0	0
	61° - 120°	0	0
	121° - 160°	33	100
	Total	33	100

4.	Adduction		
	0° - 20°	0	0
	21° - 40°	0	0
	41° - 60°	33	100
	Total	33	100

Average Increase in ROM Value During Assistive Device Use

1. Week 1

In Week 1, most respondents showed flexion ROM between 61°–120° (72.7%), and 27.3% between 0°–60°, with none above 120°. For extension, 63.6% had 41°–60°, 36.4% had 21°–40°, and none below 20°. In abduction, 90.9% had 61°–120°, 9.1% had 0°–60°, and none above 120°. For adduction, 57.6% had 41°–60°, 42.4% had 21°–40°, and none below 20°.

Table 3. ROM Values Week 1

No.	ROM Value	Total	
		n	%
1.	Flexibility		
	0° - 60°	9	27,3
	61° - 120°	24	72,7
	121° -160°	0	0
	Total	33	100
2.	Extension		
	0° - 20°	0	0
	21° - 40°	12	36,4
	41° - 60°	21	63,6
	Total	33	100
3.	Abduction		
	0° - 60°	3	9,1
	61° - 120°	30	90,9
	121° -160°	0	0
	Total	33	100
4.	Adduction		
	0° - 20°	0	0
	21° - 40°	14	42,4
	41° - 60°	19	57,6
	Total	33	100

2. Week 2

In Week 2, all respondents (100%) showed flexion ROM of 61°–120° and extension ROM of 41°–60°. For abduction, 97% had 61°–120°, and 3% had 0°–60°, with none above 120°. In adduction, 81.8% had 41°–60°, 18.2% had 21°–40°, and none below 20°.

Table 4. ROM Values Week 2

No.	ROM Value	Total	
		n	%
1.	Flexibility		
	0° - 60°	0	0
	61° - 120°	33	100
	121° -160°	0	0
	Total	33	100
2.	Extension		
	0° - 20°	0	0
	21° - 40°	0	0
	41° - 60°	33	100
	Total	33	100
3.	Abduction		
	0° - 60°	1	3
	61° - 120°	32	97
	121° -160°	0	0
	Total	33	100
4.	Adduction		
	0° - 20°	0	0
	21° - 40°	6	18,2
	41° - 60°	25	81,8
	Total	33	100

3. Week 3

In Week 3, most respondents (72.7%) had flexion ROM of 61°–120°, and 27.3% had 121°–160°, with none below 60°. All respondents (100%) showed extension ROM of 41°–60°. For abduction, 63.6% had 61°–120°, and 36.4% had 121°–160°, with none below 60°. In adduction, 90% had 41°–60°, 9.1% had 21°–40°, and none below 20°.

Table 5. ROM Values Week 3

No.	ROM Value	Total	
		n	%
1.	Flexibility		
	0° - 60°	0	0
	61° - 120°	24	72,7
	121° -160°	9	27,3
	Total	33	100
2.	Extension		
	0° - 20°	0	0
	21° - 40°	0	0
	41° - 60°	33	100
	Total	33	100
3.	Abduction		
	0° - 60°	0	0
	61° - 120°	21	63,6
	121° -160°	12	36,4
	Total	33	100
4.	Adduction		
	0° - 20°	0	0
	21° - 40°	3	9,1
	41° - 60°	30	90,9
	Total	33	100

4. Week 4

In Week 4, most respondents (81.8%) had flexion ROM of 121°–160°, and 18.2% had 61°–120°, with none below 60°. All respondents (100%) showed extension ROM of 41°–60°. For abduction, 75.8% had 121°–160°, 24.2% had 61°–120°, and none below 60°. In adduction, 90.9% had 41°–60°, 9.1% had 21°–40°, and none below 20°.

Table 6. ROM Values Week 4

No.	ROM Value	Total	
		n	%
1.	Flexibility		
	0° - 60°	0	0
	61° - 120°	6	18,2
	121° -160°	27	81,8

	Total	33	100
2.	Extension		
	0° - 20°	0	0
	21° - 40°	0	0
	41° - 60°	33	100
	Total	33	100
3.	Abduction		
	0° - 60°	0	0
	61° - 120°	8	24,2
	121° -160°	25	75,8
	Total	33	100
4.	Adduction		
	0° - 20°	0	0
	21° - 40°	3	9,1
	41° - 60°	30	90,9
	Total	33	100

In Week 5, all respondents (100%) had flexion ROM of 121°–160°. For extension, 60.6% had 21°–40° and 39.4% had 41°–60°, with none below 20°. In abduction, 63.6% had 61°–120°, 36.4% had 121°–160°, and none below 60°. All respondents (100%) showed adduction ROM of 41°–60°.

Table 7. ROM Values Week 5

No.	ROM Value	Total	
		n	%
1.	Flexibility		
	0° - 60°	0	0
	61° - 120°	0	0
	121° -160°	33	100
	Total	33	100
2.	Extension		
	0° - 20°	0	0
	21° - 40°	20	60,6
	41° - 60°	13	39,4
	Total	33	100
3.	Abduction		
	0° - 60°	0	0
	61° - 120°	1	3

	121° -160°	32	97
	Total	33	100
4.	Adduction		
	0° - 20°	0	0
	21° - 40°	0	0
	41° - 60°	33	100
	Total	33	100

Data Normality Test Results

Based on the Shapiro–Wilk normality test, all data were normally distributed ($p > 0.05$). Therefore, the parametric t-test was used.

Table 8. Results of Data Normality Test

Tests of Normality						
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
FLE_B	.092	33	.200 [*]	.974	33	.599
EKS_B	.095	33	.200 [*]	.969	33	.462
ABD_B	.093	33	.200 [*]	.969	33	.441
ADD_B	.100	33	.200 [*]	.971	33	.512
FLE_1	.127	33	.194	.945	33	.095
EKS_1	.123	33	.200 [*]	.946	33	.103
ABD_1	.102	33	.200 [*]	.988	33	.972
ADD_1	.144	33	.079	.958	33	.228
FLE_2	.157	33	.038	.950	33	.129
EKS_2	.109	33	.200 [*]	.948	33	.113
ABD_2	.097	33	.200 [*]	.951	33	.144
ADD_2	.113	33	.200 [*]	.960	33	.264
FLE_3	.112	33	.200 [*]	.970	33	.478
EKS_3	.127	33	.191	.942	33	.077
ABD_3	.109	33	.200 [*]	.973	33	.565
ADD_3	.108	33	.200 [*]	.947	33	.108
FLE_4	.181	33	.008	.978	33	.719
EKS_4	.159	33	.033	.944	33	.090
ABD_4	.157	33	.038	.945	33	.096
ADD_4	.126	33	.199	.936	33	.052
FLE_5	.111	33	.200 [*]	.942	33	.078

EKS_5	.120	33	.200 [*]	.948	33	.113
ABD_5	.110	33	.200 [*]	.962	33	.286
ADD_5	.110	33	.200 [*]	.940	33	.068
FLE_6	.088	33	.200 [*]	.980	33	.791
EKS_6	.131	33	.159	.978	33	.739
ABD_6	.136	33	.123	.938	33	.058
ADD_6	.122	33	.200 [*]	.937	33	.054

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Statistical Test Results

Based on the t-test results, the significance value was $p < 0.05$ for flexion, extension, abduction, and adduction, indicating a significant difference in ROM before and after using the assistive device.

Table 9. Statistical Test Results

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	FLE_B - FLE_6	-83.212	6.348	1.105	-85.463	-80.961	-75.302	32	.000
Pair 2	EKS_B - EKS_6	-7.061	6.586	1.146	-9.396	-4.725	-6.159	32	.000
Pair 3	ABD_B - ABD_6	-86.061	7.846	1.366	-88.843	-83.279	-63.011	32	.000
Pair 4	ADD_B - ADD_6	-16.970	4.319	.752	-18.501	-15.438	-22.570	32	.000

Table 10. Discussion Results

NO	ROM	Pretest (%)	Post test		
			Average	min	max
1	Flexibility	27,3 - 72,7	74,25	65,74	83,81
2	Extension	36,4 - 63,6	28,92	-57,14	86,96

3	Abduction	9,1 - 90,9	85,17	76,53	96,94
4	Adduction	42,4 - 57,6	75,11	29,41	100,00

In the study “The Effect of Modified Range of Motion Aids on Shoulder–Arm Muscle Strength Mobilization in Post-Mastectomy Patients at Murni Teguh Hospital,” the results showed an improvement in shoulder joint mobility.

For shoulder flexion, the pretest ROM ranged from 27.3 to 72.7, with a posttest average of 74.25, a minimum of 65.74, and a maximum of 83.81 — indicating improvement.

For shoulder extension, the pretest ROM ranged from 36.4 to 63.6, with a posttest average of 28.92, a minimum of -57.14, and a maximum of 86.96 — showing no improvement.

For shoulder abduction, the pretest ROM ranged from 9.1 to 90.9, with a posttest average of 85.17, a minimum of 76.53, and a maximum of 96.94 — indicating improvement.

For shoulder adduction, the pretest ROM ranged from 42.4 to 57.6, with a posttest average of 75.11, a minimum of 29.41, and a maximum of 100.00 — also showing improvement.

Results of ROM Effectiveness Test Before and After Using Assistive Devices

1. Flexibility

Based on the table below, the effectiveness value of using the ROM aid for flexion movement showed an N-gain score of 74.25%.

Table 11. Flexion ROM Effectiveness Test Results

Descriptives				
			Statistic	Std. Error
NGain_Skor	Mean		74.2511	.80398
	95% Confidence Interval for Mean	Lower Bound	72.6135	
		Upper Bound	75.8888	
	5% Trimmed Mean		74.2180	
	Median		73.5849	
	Variance		21.331	
	Std. Deviation		4.61852	

	Minimum	65.79	
	Maximum	83.81	
	Range	18.02	
	Interquartile Range	6.54	
	Skewness	.092	.409
	Kurtosis	-.801	.798

2. Extensions

Based on the table below, the effectiveness value of using the ROM aid for extension movement showed an N-gain score of 28.92%.

Table 12. Results of the Extension ROM Effectiveness Test

Descriptives				
			Statistic	Std. Error
PersenN_Gain	Mean		28.9234	5.18617
	95% Confidence Interval for Mean	Lower Bound	18.3595	
		Upper Bound	39.4872	
	5% Trimmed Mean		30.5470	
	Median		31.8182	
	Variance		887.580	
	Std. Deviation		29.79228	
	Minimum		-57.14	
	Maximum		86.96	
	Range		144.10	
	Interquartile Range		35.83	
	Skewness		-.870	.409
	Kurtosis		1.470	.798

3. Abductions

Based on the table below, the effectiveness value of using the ROM aid for abduction movement showed an N-gain score of 85.18%.

Table 13. Results of the Abduction Movement ROM Effectiveness Test

Descriptives		
	Statistic	Std. Error

PersenN_Gain	Mean		85.1760	1.02405
	95% Confidence Interval for Mean	Lower Bound	83.0901	
		Upper Bound	87.2619	
	5% Trimmed Mean		85.0438	
	Median		84.0426	
	Variance		34.607	
	Std. Deviation		5.88273	
	Minimum		76.53	
	Maximum		96.94	
	Range		20.41	
	Interquartile Range		9.68	
	Skewness		.296	.409
	Kurtosis		-.993	.798

4. Addition

Based on the table below, the effectiveness value of using the ROM aid for adduction movement showed an N-gain score of 75.11%.

Table 14. Results of the Adduction Movement ROM Effectiveness Test

Descriptives				
			Statistic	Std. Error
PersenN_Gain	Mean		75.1151	3.02153
	95% Confidence Interval for Mean	Lower Bound	68.9604	
		Upper Bound	81.2697	
	5% Trimmed Mean		75.9670	
	Median		80.0000	
	Variance		301.278	
	Std. Deviation		17.35736	
	Minimum		29.41	
	Maximum		100.00	
	Range		70.59	
	Interquartile Range		25.00	
	Skewness		-.742	.409
	Kurtosis		.102	.798

Discussion

Based on the research findings above, it was found that the use of assistive devices

had a significant effect on ROM movements, including flexion, extension, abduction, and adduction in post-mastectomy breast cancer patients, with a significance level of 0.000. This result proves that the modified ROM aid developed by the researcher can facilitate patients in performing ROM exercises. Unlike other aids, the device designed by the researcher—made of soft and elastic fabric and rubber—is assumed to adapt well to the patient's range of motion. Several patients reported feeling comfortable using the tool because it is easy to use, convenient to store, and follows the natural ROM movement.

In terms of effectiveness, the ROM aid created by the researcher was found to be most effective for abduction movements with an effectiveness rate of 85.18%, followed by adduction at 75.11%, and flexion at 74.25%. However, it was less effective for extension movements, with an effectiveness rate of 28.92%.

CONCLUSION

The results of this study indicate that the use of ROM assistive devices has a significant effect on shoulder movements, including flexion, extension, abduction, and adduction, as shown by the t-test analysis with a significance value of 0.000 for all movements. In terms of effectiveness, the modified ROM aid developed by the researcher was found to be most effective for abduction movements, with an effectiveness rate of 85.18%, followed by adduction at 75.11%, and flexion at 74.25%. However, it was less effective for extension movements, which showed an effectiveness rate of 28.92%.

Suggestion

The modified ROM assistive device developed by the researcher proved to have a significant effect on flexion, extension, abduction, and adduction movements, as well as demonstrated good effectiveness. Therefore, it can be considered an alternative option to improve ROM in post-mastectomy breast cancer patients. Further research and development are recommended to enhance and refine the design of this modified ROM aid.

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