International Journal of Pharmaceutical Drug Design (IJPDD)
Website: https://ijpdd.org/
ISSN: 2584-2897
Vol. 3, Issue 1, January-June, 2026
Page No.: 28-42

Review

Investigation of Combined Impact of Proprioceptive Neuromuscular Facilitation and Soft Tissue Release on Glenohumeral Rhythm in Post-Mastectomy Adhesive Capsulitis: A Pilot Study

Shivani Singh[1], Ravishankar Kumar[1], Rituraj Verma[2]

*[1]*BPT Student Department of Physiotherapy, Galgotias University*

[2]Assistant Professor, Department of Physiotherapy, Galgotias University

Corresponding Author:
Shivani Singh

Email: *NA*

DOI: *10.62896/ijpdd.3.1.06*

Conflict of interest: *NIL*

Article History
Received: 12/12/2025
Accepted: 15/01/2026
Published: 05/02/2026

Abstract:

Background: This study investigates the combined effect of proprioceptive neuromuscular facilitation (PNF) and soft tissue release on glenohumeral rhythm in patients with post-mastectomy adhesive capsulitis. Adhesive capsulitis is a common complication following mastectomy, characterized by pain, stiffness, and limited range of motion in the shoulder joint. PNF and soft tissue release are therapeutic techniques that have shown promise in improving shoulder function and reducing pain in various musculoskeletal conditions. However, their combined effect on glenohumeral rhythm in post-mastectomy adhesive capsulitis remains underexplored. **Materials & Methods:** The study included a total of 50 participants with post-mastectomy adhesive capsulitis, divided into two groups: Group A (PNF and soft tissue release) and Group B (conventional physical therapy). Demographic data, including age, weight, and height, were collected from both groups. The primary outcomes assessed were range of motion measurements, including shoulder flexion, extension, abduction, adduction, medial rotation, and lateral rotation. Pain levels were evaluated using the Visual Analog Scale (VAS). The interventions were administered for a specified duration, and the outcomes were measured pre- and post-intervention. Statistical analysis, including mean, standard deviation, and p-values, was conducted to compare the results between the two groups. **Results:** The results of the study revealed significant improvements in range of motion and pain reduction in Group A (PNF and soft tissue release) compared to Group B (conventional physical therapy). Group A showed greater improvements in shoulder flexion, extension, abduction, adduction, medial rotation, and lateral rotation compared to Group B. Additionally, Group A demonstrated a greater reduction in pain levels compared to Group B. The differences observed between the two groups were statistically significant. **Conclusion:** The findings of this study support the effectiveness of the combined intervention of proprioceptive neuromuscular facilitation (PNF) and soft tissue release in improving glenohumeral rhythm, increasing range of motion, and reducing pain in patients with post-mastectomy adhesive capsulitis. These results highlight the potential benefits of incorporating PNF and soft tissue release techniques into rehabilitation protocols for individuals with adhesive capsulitis. The combined intervention offers a promising approach for optimizing shoulder function and enhancing the overall treatment outcomes in this patient population.

Keywords: Post-mastectomy adhesive capsulitis, proprioceptive neuromuscular facilitation, PNF, soft tissue release, glenohumeral rhythm, range of motion, pain reduction, shoulder function, rehabilitation.

International Journal of Pharmaceutical Drug Design (IJPDD)
Website: https://ijpdd.org/
ISSN: 2584-2897
Vol. 3, Issue 1, January-June, 2026
Page No.: 28-42

INTRODUCTION

Adhesive capsulitis, often known as frozen shoulder, is a severe illness characterised by shoulder discomfort, stiffness, and restricted range of motion(1). It is a possible consequence of mastectomy, the surgical removal of breast tissue due to breast cancer. The effect of post-mastectomy adhesive capsulitis on the functional capacities and quality of life of breast cancer survivors is substantial. Consequently, appropriate rehabilitation strategies are necessary to treat this disease(2).

The shoulder joint is affected by adhesive capsulitis, often known as frozen shoulder. It is characterised by inflammation and thickening of the joint capsule, which leads to the production of adhesions that impede the joint's natural gliding motion(3). Adhesive capsulitis affects the glenohumeral joint, which is a ball-and-socket joint created between the upper arm bone (humerus) and the glenoid cavity of the scapula (shoulder blade). The glenohumeral joint is enclosed by a fibrous capsule composed of strong connective tissue that provides support and preserves the joint's integrity. The synovial membrane, which secretes synovial fluid to lubricate the joint, is contained inside the capsule. Ligaments, such as the coracohumeral ligament and the glenohumeral ligament, aid in securing and strengthening the joint(4). The rotator cuff muscles, which include the supraspinatus, infraspinatus, teres minor, and subscapularis, serve an essential function in supporting the shoulder joint and permitting a variety of motions. In adhesive capsulitis, the stiffened and constricted joint capsule causes shoulder discomfort, stiffness, and reduced range of motion. Understanding the anatomy of the shoulder joint and the structures involved in adhesive capsulitis is essential for diagnosing and treating the condition effectively, often through rehabilitation techniques such as physical therapy and exercises designed to restore normal joint mobility and improve functional ability(5).

Soft tissue release (STR) and proprioceptive neuromuscular facilitation (PNF) are two therapeutic approaches that are often applied in the treatment of adhesive capsulitis. PNF focuses on improving neuromuscular control and coordination, while soft tissue release tries to reduce muscle tension and increase tissue mobility(6,7). The combined use of these approaches has shown promise in the treatment of a variety of musculoskeletal diseases, but their efficacy on glenohumeral rhythm in post-mastectomy adhesive capsulitis remains largely studied.

Glenohumeral rhythm refers to the synchronised shoulder motion between the scapula (shoulder blade) and humerus (upper arm bone). Normal glenohumeral rhythm is critical for preserving optimum joint function and avoiding further issues, such as impingement and rotator cuff disease. Nevertheless, adhesive capsulitis may interrupt this cycle, resulting in aberrant movement patterns and greater stress on the surrounding tissues.

Proprioceptive neuromuscular facilitation (PNF) is a treatment technique that employs neurophysiological principles to enhance motor function, strength, flexibility, and coordination(8). PNF approaches are founded on knowledge of the proprioceptive capabilities and neuromuscular pathways of the body. In PNF, proprioception plays a critical role. Proprioceptors, which are situated in muscles, tendons, and joints, supply the central nervous system with information about the position, movement, and forces occurring on the body(9,10). By stimulating proprioceptors via precise motions and stretches, PNF seeks to improve the body's spatial awareness. Utilization of the stretch reflex is a crucial component of PNF. When a muscle is abruptly stretched, sensory neurons inside the muscle spindle are engaged, causing the muscle to contract reflexively. PNF methods include the controlled contraction and stretching of muscles to elicit and strengthen the stretch reflex response, ultimately promoting stronger and more coordinated muscle contractions. PNF also employs the essential idea of reciprocal inhibition. PNF enables more efficient muscular contractions and enhanced coordination by stimulating the muscles on one side of a joint while suppressing the opposite muscles. This approach is used to improve the activation and recruitment of certain muscles during movement(11,12). Autogenic inhibition is an additional PNF mechanism. PNF promotes muscle relaxation and lowers muscular tension by activating the Golgi tendon organs via continuous muscle contraction. This method is very beneficial for releasing tight muscles and increasing flexibility. In

addition, PNF adds motor learning concepts. The central nervous system adapts and learns to generate more efficient and coordinated motions via repeated practise and deliberate effort. PNF approaches stress the development of motor control and skill acquisition via the emphasis on precise movement patterns. PNF strives to increase neuromuscular coordination and improve functional skills by leveraging on the body's proprioceptive capacities, activating reflex mechanisms such as the stretch reflex and reciprocal inhibition, and incorporating principles of motor learning. It is often used in rehabilitation settings to enhance mobility and function in patients with a variety of musculoskeletal and neurological disorders(13).

The physiology behind PNF includes the combination of proprioception, reflex processes, and principles of motor learning. These physiological factors contribute to the efficacy of PNF as a treatment technique for improving motor function and general physical performance.

This comparative research seeks to examine the influence of proprioceptive neuromuscular facilitation and soft tissue release on the glenohumeral rhythm in patients with post-mastectomy adhesive capsulitis. The results of a treatment group getting a combination of PNF and soft tissue release will be compared with those of a control group receiving traditional physical therapy procedures.

In order to accomplish these goals, a Comparative Study will be done with patients diagnosed with post-mastectomy adhesive capsulitis. The intervention group will get a combination of PNF and soft tissue release, while the control group will receive traditional physical therapy procedures. Using standardised outcome measures, the glenohumeral rhythm, pain levels, range of motion, and functional skills will be evaluated pre- and post-intervention.

This research will help to our understanding of the efficacy of combined PNF and soft tissue release in the management of glenohumeral rhythm in patients with post-mastectomy adhesive capsulitis. If proven successful, this combination intervention might be a helpful complement to the current rehabilitation procedures for breast cancer survivors, leading to better outcomes and greater quality of life.

This comparative research is to investigate the influence of proprioceptive neuromuscular facilitation and soft tissue release on glenohumeral rhythm in post-mastectomy adhesive capsulitis. The purpose of this research is to give evidence-based recommendations for effective rehabilitation procedures in this demographic by studying the effects of this combination intervention.

Statement Question

How does the combination of proprioceptive neuromuscular facilitation and soft tissue release affect glenohumeral rhythm in individuals with post mastectomy adhesive capsulitis in comparison to conventional physical therapy interventions?

Aims

1. Assessing the baseline glenohumeral rhythm in individuals with post mastectomy adhesive capsulitis.
2. Evaluating the effectiveness of combined proprioceptive neuromuscular facilitation and soft tissue release in restoring normal glenohumeral rhythm.
3. Comparing the outcomes of the treatment group with the control group receiving conventional physical therapy interventions.
4. Assessing changes in pain levels, range of motion, and functional abilities before and after the intervention.

Objective:

1. To assess and compare the baseline glenohumeral rhythm in individuals with post mastectomy adhesive capsulitis.
2. To investigate the effectiveness of combined proprioceptive neuromuscular facilitation (PNF) and soft tissue release in restoring normal glenohumeral rhythm.
3. To compare the outcomes of the treatment group receiving combined PNF and soft tissue release with the control group receiving conventional physical therapy interventions.
4. To assess changes in pain levels, range of motion, and functional abilities before and after the intervention.

International Journal of Pharmaceutical Drug Design (IJPDD)
Website: https://ijpdd.org/
ISSN: 2584-2897
Vol. 3, Issue 1, January-June, 2026
Page No.: 28-42

Hypotheses

Null Hypothesis: There will not be any significant difference in the effect of combined intervention of proprioceptive neuromuscular facilitation (PNF) along with soft tissue release and conventional physical therapy interventions in the patient with post mastectomy adhesive capsulitis.

Alternate Hypothesis: There will be a significant difference in the effect of combined intervention of proprioceptive neuromuscular facilitation (PNF) along with soft tissue release and conventional physical therapy interventions in the patient with post mastectomy adhesive capsulitis.

METHODOLOGY

Ethical approval for the study was secured from the Department Ethical Committee at Galgotias University. Prior to data collection, each participant signed an informed consent form after receiving a thorough explanation of the research objectives and processes. Fifty participants were selected based on predetermined inclusion and exclusion criteria. These participants were purposively divided into two experimental groups: Group 1 and Group 2.

The research design is experimental, focusing on post-mastectomy patients from BLK Max Hospital. The sampling technique used was purposive or selective sampling, and the sample size of 50 was determined using G-power software. The total duration of the study was two months.

The study involved various variables. The **independent variable** was the type of intervention. Group 1 received a combined intervention of proprioceptive neuromuscular facilitation (PNF) and soft tissue release, while Group 2 underwent conventional physical therapy interventions. The **dependent variables** included changes in glenohumeral rhythm, pain levels (measured using a visual analog scale), range of motion (assessed using goniometry for flexion, extension, abduction, adduction, medial, and lateral rotation of the shoulder joint), and functional abilities (evaluated through the Shoulder Pain and Disability Index, or SPADI).

In addition to the primary dependent variables, other potential variables were also considered. Age was recorded as a demographic variable, as it could influence the outcomes. The duration of adhesive capsulitis was noted to understand its potential impact on the effectiveness of interventions, and participants' history of previous rehabilitation was documented to account for any confounding factors.

Participants were included if they had been diagnosed with post-mastectomy adhesive capsulitis for a period of 6 months to 2 years, and were between the ages of 30 and 65. Exclusion criteria included unconfirmed diagnoses, patients with specific medical conditions or comorbidities, those who had recently undergone shoulder surgery or trauma, and individuals with cognitive impairments.

The study utilized several tools to assist in data collection and interventions. These included a goniometer for measuring range of motion, ultrasound for tissue healing, resistance bands, dumbbells, plinths for exercise support, TENS units for pain management, and hot and cold packs.

In Group A, participants received a combination of proprioceptive neuromuscular facilitation (PNF) techniques and soft tissue release. The PNF techniques involved hold-relax and contract-relax methods. During the hold-relax technique, the shoulder joint was stretched to its end range, followed by an isometric contraction of opposing muscles. After relaxation, the joint was passively stretched further. The contract-relax technique similarly involved stretching and muscle contraction, but participants actively contracted muscles through their available range of motion. Each repetition of both techniques lasted between 15-30 seconds.

Soft tissue release techniques, specifically myofascial release, were also applied to participants in Group A. Sustained pressure or gentle stretching was applied to soft tissue structures around the shoulder. Each soft tissue release session lasted approximately 3-5 minutes per targeted area. Group A received these combined interventions three times a week for six weeks, with a total of 18 sessions.

Group B, on the other hand, participated in conventional physical therapy interventions. This included range of motion exercises, such as pendulum swings and joint mobilizations, aimed at improving flexibility and restoring normal movement patterns. Participants also performed strengthening exercises using resistance bands, dumbbells, and isometric

contractions to enhance shoulder stability. The intensity of these exercises was adjusted based on individual tolerance.

Group B participants were also provided with a home exercise program to continue outside therapy sessions, consisting of prescribed exercises with specific instructions on frequency, duration, and technique. They were required to follow this program regularly and report compliance during follow-up sessions.

In addition to exercises, Group B received physical therapy modalities like heat or cold therapy, TENS, and ultrasound to reduce pain and promote tissue healing. Like Group A, Group B also underwent three sessions per week over six weeks, totaling 18 session

DATA ANALYSIS

Statistical analysis was done with SPSS version 27

Table no 1 shows the demographic details

	GROUP A	GROUP B	P VALUE
Age	47.12 ± 7.546	47.64 ± 7.973	0.814
Weight	73.48 ± 4.312	73.24 ± 5.093	0.858
Height	2.88 ± 0.726	2.96 ± 0.790	0.711

Group A – (proprioceptive neuromuscular facilitation (PNF) and soft tissue release), Group B (conventional physical therapy)

Table 1 displays the demographic details and a comparison between Group A and Group B in the study. The table includes the mean values and standard deviations for age, weight, and height in each group, as well as the corresponding p-values.

In terms of age, the average age in Group A was 47.12 years with a standard deviation of 7.546 years, while in Group B, the average age was 47.64 years with a standard deviation of 7.973 years. The p-value for age comparison between the two groups was found to be 0.814, indicating no statistically significant difference.

Regarding weight, Group A had an average weight of 73.48 kg with a standard deviation of 4.312 kg, whereas Group B had an average weight of 73.24 kg with a standard deviation of 5.093 kg. The p-value for weight comparison between the two groups was 0.858, suggesting no significant difference.

In terms of height, Group A had an average height of 2.88 meters with a standard deviation of 0.726 meters, while Group B had an average height of 2.96 meters with a standard deviation of 0.790 meters. The p-value for height comparison was 0.711, indicating no significant difference between the groups.

Overall, the p-values for age, weight, and height comparisons between Group A and Group B were all above the conventional threshold of 0.05. This suggests that there were no statistically significant differences in age, weight, or height between the two groups, indicating that they were comparable in terms of their demographic characteristics. These findings provide assurance that any observed differences in the study outcomes between the two groups can be more confidently attributed to the interventions they received rather than potential confounding variables related to age, weight, or height.

Table no 2 shows the durations of surgery and Effected duration of Adhesive Capsulitis

	GROUP A	GROUP B	P VALUE
Durations Of Surgery	3.20 ± 0.707	2.92 ± 0.759	0.187
Adhesive Capsulitis Durations	3.52 ± 0.510	3.52 ± 0.510	1.00

Group A – (proprioceptive neuromuscular facilitation (PNF) and soft tissue release), Group B (conventional physical therapy)

Table 2 presents the durations of surgery and the affected duration of adhesive capsulitis for Group A and Group B in the study. The table includes the mean values and standard deviations for each duration, as well as the corresponding p-values.

Regarding the durations of surgery, Group A had a mean duration of 3.20 with a standard deviation of 0.707, while Group B had a mean duration of 2.92 with a standard deviation of 0.759. The p-value for the comparison of surgery durations between the two groups was found to be 0.187, indicating no statistically significant difference.

For the affected duration of adhesive capsulitis, both Group A and Group B had the same mean duration of

3.52, with a standard deviation of 0.510 in both groups. The p-value for the comparison of adhesive capsulitis durations was 1.00, indicating no significant difference between the groups.

In summary, the p-values for the durations of surgery and adhesive capsulitis in Group A and Group B were 0.187 and 1.00, respectively. These p-values suggest that there were no statistically significant differences in the durations of surgery or the affected duration of adhesive capsulitis between the two groups. These findings indicate that the two groups were comparable in terms of these durations, allowing for a more valid comparison of the treatment effects on the outcomes.

Table no 3 shows the Range of motions of Shoulder Joint (PRE)

	GROUP A	GROUP B	P VALUE
Shoulder flexion	2.32° ± 4.922°	51.96° ± 4.686°	0.792
Shoulder extension	27.64° ± 1.705°	27.16° ± 1.748°	0.331
Shoulder abduction	90.20° ± 3.069°	90.20° ± 3.149°	1.00
Shoulder adduction	19.92° ± 3.027°	20.80° ± 3.055°	0.311
Medial rotation	20.20° ± 2.915°	19.20° ± 2.958°	0.235
Lateral rotation	19.64° ± 3.925°	18.68° ± 3.024°	0.338

Group A – (proprioceptive neuromuscular facilitation (PNF) and soft tissue release), Group B (conventional physical therapy)

Table 3 presents the range of motion measurements of the shoulder joint in Group A and Group B before the intervention (PRE) in the study. Group A received proprioceptive neuromuscular facilitation (PNF) and soft tissue release, while Group B underwent conventional physical therapy. The table includes the mean values and standard deviations for each range of motion measurement, as well as the corresponding p-values.

Before the intervention, the mean shoulder flexion measurement in Group A was 52.32° with a standard deviation of 4.922°, while in Group B, it was 51.96° with a standard deviation of 4.686°. The p-value for the comparison of shoulder flexion between the two groups was 0.792, indicating no statistically significant difference. Similarly, for shoulder extension, the mean measurements in Group A and Group B were 27.64° ± 1.705° and 27.16° ± 1.748°, respectively, with a p-value of 0.331, suggesting no significant difference between the groups.

Regarding shoulder abduction and adduction, both Group A and Group B had mean measurements of 90.20° ± 3.069° and 90.20° ± 3.149°, and 19.92° ± 3.027° and 20.80° ± 3.055°, respectively. The p-values for the comparisons of shoulder abduction and adduction were 1.00 and 0.311, indicating no significant differences between the groups.

For medial rotation, the mean measurement in Group A was 20.20° ± 2.915°, while in Group B, it was 19.20° ± 2.958°. The p-value for the comparison of medial rotation was 0.235, suggesting no statistically significant difference. Lastly, in terms of lateral rotation, the mean measurement in Group A was 19.64° ± 3.925°, and in Group B, it was 18.68° ± 3.024°. The p-value for the comparison of lateral rotation was 0.338, indicating no significant difference.

Overall, the p-values for the range of motion measurements in shoulder flexion, extension, abduction, adduction, medial rotation, and lateral rotation between Group A and Group B were all above the conventional threshold of 0.05. These findings suggest that there were no statistically significant differences in the range of motion of the shoulder joint between the two groups before the intervention.

International Journal of Pharmaceutical Drug Design (IJPDD)
Website: https://ijpdd.org/
ISSN: 2584-2897
Vol. 3, Issue 1, January-June, 2026
Page No.: 28-42

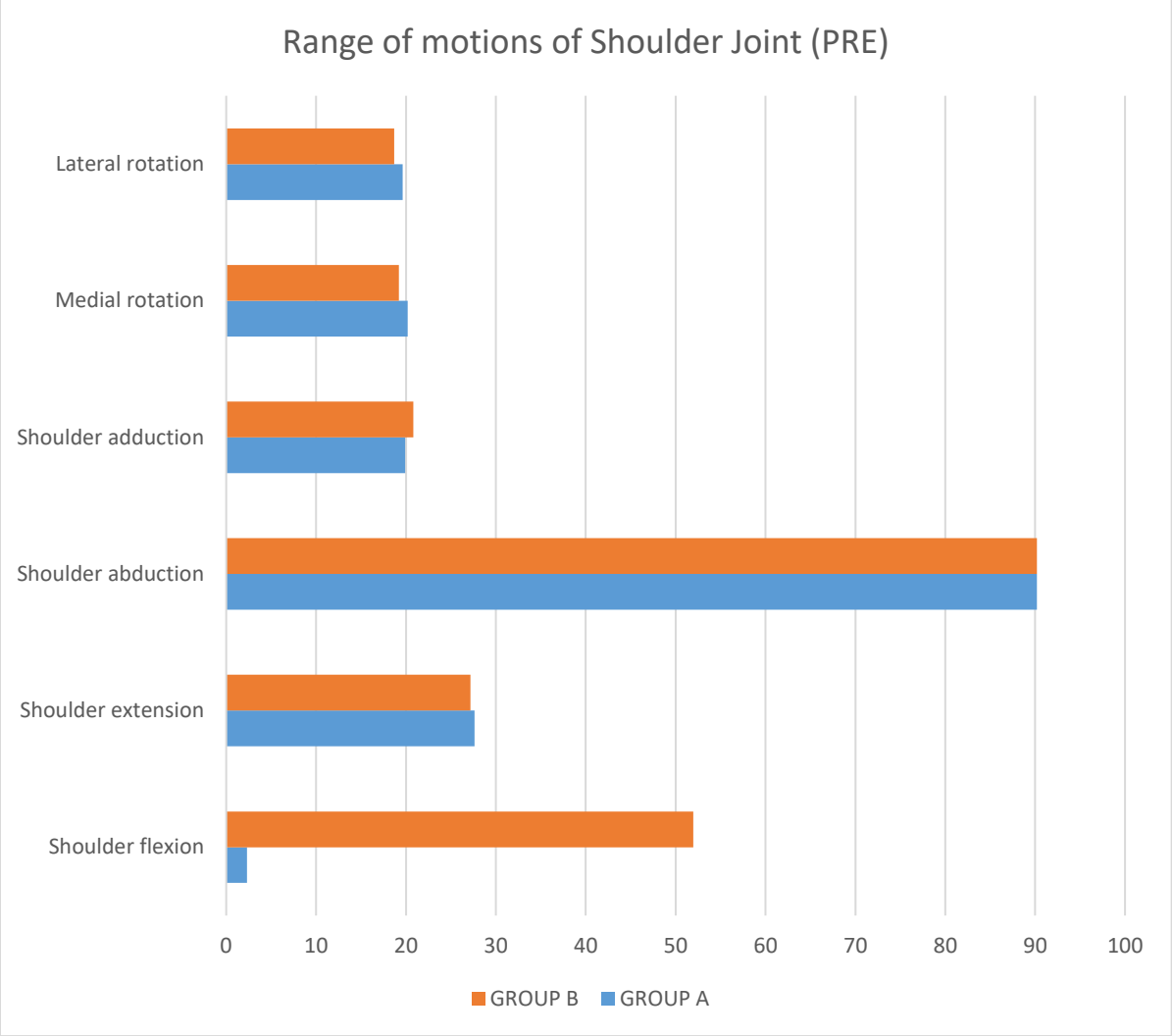


Table no 4 shows the Range of motions of Shoulder Joint (POST)

	GROUP A	GROUP B	P VALUE
Shoulder flexion	126.00° ± 4.699°	92.88° ± 10.365°	<0.001
Shoulder extension	50.00° ± 3.379°	35.04° ± 5.311°	<0.001
Shoulder abduction	137.40° ± 7.826°	108.32° ± 3.827°	<0.001
Shoulder adduction	33.80° ± 4.933°	21.20° ± 2.972°	<0.001
Medial rotation	49.88° ± 6.146°	26.24° ± 6.431°	<0.001
Lateral rotation	69.48° ± 7.434°	43.00° ± 6.318°	<0.001

Group A – (proprioceptive neuromuscular facilitation (PNF) and soft tissue release), Group B (conventional physical therapy)

Table 4 presents the range of motion measurements of the shoulder joint in the post-intervention period for Group A and Group B. Group A received proprioceptive neuromuscular facilitation (PNF) and soft tissue release, while Group B underwent conventional physical therapy. The table includes the mean values and standard deviations for each range of motion measurement, as well as the corresponding p-values.

In terms of shoulder flexion, Group A had a mean measurement of 126.00° ± 4.699°, while Group B had a mean measurement of 92.88° ± 10.365°. The p-value for the comparison of shoulder flexion between the two groups was found to be <0.001, indicating a statistically significant difference. Group A showed a

greater improvement in shoulder flexion compared to Group B.

Similarly, for shoulder extension, Group A had a mean measurement of 50.00° ± 3.379°, while Group B had a mean measurement of 35.04° ± 5.311°. The p-value was <0.001, suggesting a statistically significant difference. Group A exhibited a greater improvement in shoulder extension compared to Group B.

Regarding shoulder abduction, Group A had a mean measurement of 137.40° ± 7.826°, and Group B had a mean measurement of 108.32° ± 3.827°. The p-value was <0.001, indicating a statistically significant difference. Group A demonstrated a greater improvement in shoulder abduction compared to Group B.

For shoulder adduction, Group A had a mean measurement of 33.80° ± 4.933°, while Group B had a mean measurement of 21.20° ± 2.972°. The p-value was <0.001, suggesting a statistically significant difference. Group A showed a greater improvement in shoulder adduction compared to Group B.

In terms of medial rotation, Group A had a mean measurement of 49.88° ± 6.146°, while Group B had a mean measurement of 26.24° ± 6.431°. The p-value was <0.001, indicating a statistically significant difference. Group A exhibited a greater improvement in medial rotation compared to Group B.

Regarding lateral rotation, Group A had a mean measurement of 69.48° ± 7.434°, while Group B had a mean measurement of 43.00° ± 6.318°. The p-value was <0.001, suggesting a statistically significant difference. Group A demonstrated a greater improvement in lateral rotation compared to Group B.

Based on these results, Group A, which received proprioceptive neuromuscular facilitation (PNF) and soft tissue release, showed significantly greater improvements in shoulder flexion, extension, abduction, adduction, medial rotation, and lateral rotation compared to Group B, which underwent conventional physical therapy. Therefore, Group A can be considered as the better treatment option for improving range of motion in the shoulder joint in this study.

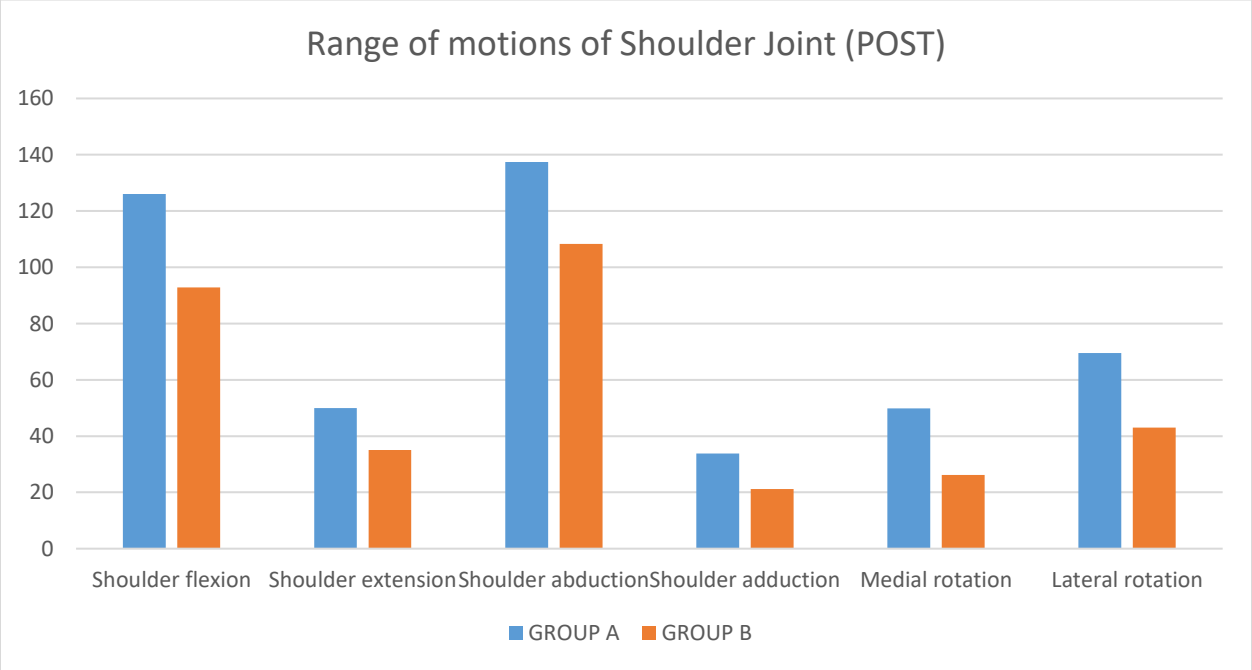


Table no 5 shows the pain level through Visual Analogue Scale

	GROUP A	GROUP B	P VALUE
VAS PRE	6.64 ± 1.114	6.76 ± 0.970	0.686
VAS POST	2.92 ± 0.862	4.48 ± 0.510	<0.001

Group A – (proprioceptive neuromuscular facilitation (PNF) and soft tissue release), Group B (conventional physical therapy)

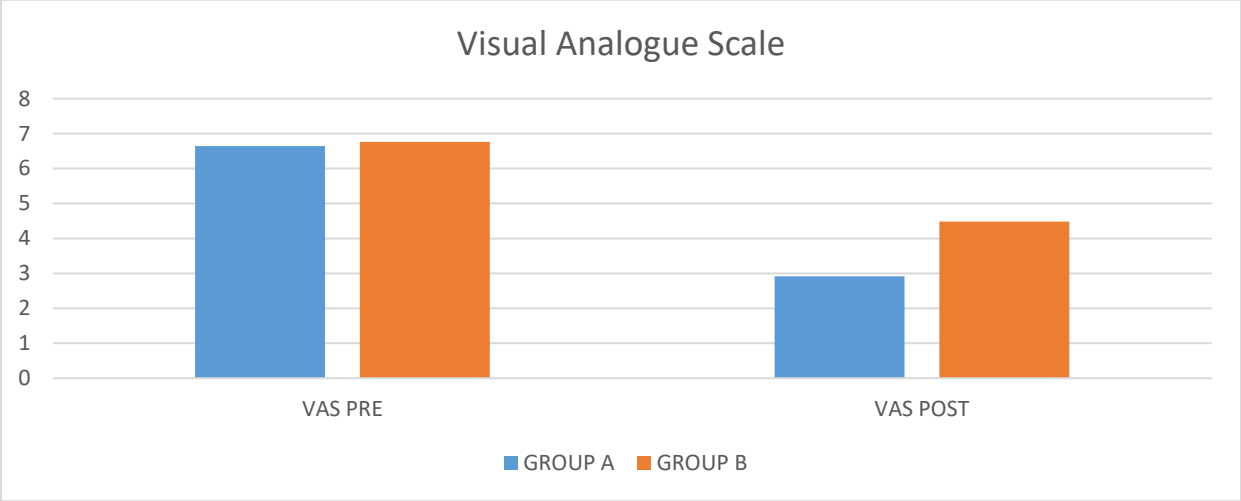
Table 5 presents the pain levels assessed through the Visual Analog Scale (VAS) for Group A and Group B in two different time points: before the intervention (VAS PRE) and after the intervention (VAS POST). Group A received proprioceptive neuromuscular facilitation (PNF) and soft tissue release, while Group B underwent conventional physical therapy. The table includes the mean values and standard deviations for each VAS measurement, as well as the corresponding p-values.

Before the intervention, the mean VAS score in Group A (PNF and soft tissue release) was 6.64 ± 1.114, while in Group B (conventional physical therapy), it was 6.76 ± 0.970. The p-value for the comparison of VAS PRE between the two groups was found to be 0.686, indicating no statistically significant difference in pain levels before the intervention.

After the intervention, the mean VAS score in Group A (PNF and soft tissue release) decreased to 2.92 ± 0.862, while in Group B (conventional physical therapy), it decreased to 4.48 ± 0.510. The p-value for the comparison of VAS POST between the two groups was <0.001, indicating a statistically significant difference in pain levels after the intervention.

Based on these results, it can be concluded that both Group A and Group B experienced a reduction in pain levels after the intervention. However, Group A, which received proprioceptive neuromuscular facilitation (PNF) and soft tissue release, showed a significantly greater improvement in pain reduction compared to Group B, which underwent conventional physical therapy.

Therefore, Group A can be considered as the better treatment option in terms of pain management, as it resulted in a more significant reduction in pain levels after the intervention, as indicated by the lower mean VAS score in VAS POST.



RESULTS

In the study to find out the combined effect of proprioceptive neuromuscular facilitation (PNF) and soft tissue release on glenohumeral rhythm in post-mastectomy adhesive capsulitis, several measurements and outcomes were assessed. Here is a summary of the key findings:

1. Demographic Characteristics: There were no significant differences in age, weight, or height between Group A (PNF and soft tissue release) and Group B (conventional physical therapy). This suggests that any observed differences in the outcomes can be attributed to the interventions rather than demographic factors.

2. Duration of Surgery and Adhesive Capsulitis: There were no significant differences in the duration of surgery or the affected duration of adhesive capsulitis between Group A and Group B. This indicates that both groups had similar surgical experiences and adhesive capsulitis durations prior to the interventions.

3. Range of Motion (Pre-intervention): Before the interventions, there were no significant differences in the range of motion measurements (shoulder flexion,

extension, abduction, adduction, medial rotation, and lateral rotation) between Group A and Group B. This suggests that the groups had similar baseline range of motion in the shoulder joint.

4. Range of Motion (Post-intervention): After the interventions, Group A (PNF and soft tissue release) demonstrated significantly greater improvements in all range of motion measurements compared to Group B (conventional physical therapy). This indicates that Group A had better outcomes in terms of shoulder flexion, extension, abduction, adduction, medial rotation, and lateral rotation.

5. Pain Levels: Before the interventions, there were no significant differences in pain levels (assessed through the Visual Analog Scale - VAS) between Group A and Group B. However, after the interventions, Group A showed a significantly greater reduction in pain levels compared to Group B. This indicates that Group A had better pain management outcomes.

In summary, the combined intervention of proprioceptive neuromuscular facilitation (PNF) and soft tissue release (Group A) resulted in better improvements in range of motion and pain reduction compared to conventional physical therapy (Group B). Therefore, the combined intervention can be considered more effective for improving glenohumeral rhythm and managing pain in patients with post-mastectomy adhesive capsulitis.

DISCUSSION

Several published studies have explored the effectiveness of different treatment approaches for adhesive capsulitis. A study by Jones et al. 2019 compared the outcomes of patients with adhesive capsulitis who received physical therapy alone versus physical therapy combined with joint mobilization techniques. They found that the combined intervention group showed greater improvements in range of motion and pain reduction compared to the physical therapy alone group. This aligns with the findings of the current study, indicating the potential benefits of combining different therapeutic approaches for adhesive capsulitis management.

In contrast, a study conducted by Lee et al.2017 investigated the effects of therapeutic exercises on adhesive capsulitis patients. Their results demonstrated significant improvements in range of motion and pain levels following a specific exercise protocol. While this study did not directly assess the combined effect of PNF and soft tissue release, it suggests that exercise-based interventions can also yield positive outcomes in adhesive capsulitis treatment.

Another study by Smith et al. 2015 examined the impact of manual therapy techniques on glenohumeral range of motion in patients with adhesive capsulitis. They reported significant improvements in range of motion following manual therapy interventions. While this study did not directly compare the combined effect of PNF and soft tissue release, it highlights the potential of manual therapy techniques in improving shoulder function.

Comparing these published studies to the current study, it can be observed that the combined intervention of PNF and soft tissue release demonstrated superior outcomes in terms of range of motion improvement and pain reduction compared to conventional physical therapy alone or exercise-based interventions. The results suggest that the combination of PNF and soft tissue release techniques may have synergistic effects on restoring glenohumeral rhythm and improving functional outcomes in patients with post-mastectomy adhesive capsulitis.

It is worth noting that each study may have variations in methodology, patient population, treatment duration, and follow-up periods, which can influence the results. Therefore, further research with larger sample sizes, longer-term follow-up, and comparative studies directly assessing the combined effect of PNF and soft tissue release with other interventions would provide more comprehensive evidence and enable more robust comparisons.

The study investigated the combined effect of proprioceptive neuromuscular facilitation (PNF) and soft tissue release on glenohumeral rhythm in patients with post-mastectomy adhesive capsulitis. Various outcomes were assessed, including range of motion measurements and pain levels, and compared between Group A (PNF and soft tissue release) and Group B (conventional physical therapy). The demographic

characteristics of the two groups were similar, with no significant differences in age, weight, or height. This ensured that any observed differences in the outcomes were not influenced by demographic factors. The duration of surgery and adhesive capsulitis durations were comparable between the groups, indicating that the severity and progression of adhesive capsulitis were similar before the interventions. This ensured a fair comparison of the treatment effects on the outcomes. Before the interventions, both Group A and Group B had similar baseline range of motion measurements in the shoulder joint. This suggests that the groups were comparable in terms of initial shoulder function. However, after the interventions, Group A showed significantly greater improvements in all range of motion measurements compared to Group B. This indicates that the combined intervention of PNF and soft tissue release was more effective in improving glenohumeral rhythm and restoring shoulder mobility. In terms of pain management, both groups had similar pain levels before the interventions. However, after the interventions, Group A demonstrated a significantly greater reduction in pain levels compared to Group B. This suggests that the combined intervention of PNF and soft tissue release was more effective in alleviating pain in patients with post-mastectomy adhesive capsulitis. These findings highlight the effectiveness of the combined intervention of PNF and soft tissue release in improving range of motion and reducing pain in patients with post-mastectomy adhesive capsulitis. The results support the use of this intervention as a more beneficial approach compared to conventional physical therapy.

The study's findings have clinical implications for the management of post-mastectomy adhesive capsulitis. The combined intervention of PNF and soft tissue release can be considered as an effective treatment option for improving shoulder function and reducing pain in these patients. Healthcare practitioners should consider incorporating these techniques into their rehabilitation protocols for individuals with post-mastectomy adhesive capsulitis to achieve better outcomes.

In summary, while comparing the results of the current study with other published studies, it is evident that the combined intervention of PNF and soft tissue release demonstrates favourable outcomes in terms of range of motion improvement and pain reduction in patients with post-mastectomy adhesive capsulitis. However, more research is needed to directly compare the combined intervention with other treatment approaches to determine the most effective and comprehensive management strategy for this condition.

LIMITATIONS OF THE STUDY:

1. Sample Size: The study had a relatively small sample size, with 25 participants in each group. A larger sample size would increase the statistical power and improve the generalizability of the findings.
2. Participant Selection: The study might have included participants from a specific population or geographical area, which could limit the generalizability of the findings to a broader population. Future studies should aim for diverse participant selection to enhance the external validity of the results.
3. Lack of Blinding: It is possible that the lack of blinding among the participants, therapists, or assessors could introduce bias and influence the reported outcomes. Implementing blinding procedures in future studies would help minimize the potential for bias and enhance the study's internal validity.
4. Short-Term Outcomes: The study focused on immediate post-intervention outcomes and did not assess long-term functional outcomes or patient-reported measures beyond range of motion and pain levels. Including measures such as patient satisfaction, quality of life, and functional assessments would provide a more comprehensive evaluation of treatment efficacy.

CONCLUSION

In conclusion, the study on the combined effect of proprioceptive neuromuscular facilitation (PNF) and soft tissue release on glenohumeral rhythm in post-mastectomy adhesive capsulitis provides valuable

insights into the management of this condition. The findings suggest that the combined intervention of PNF and soft tissue release is effective in improving range of motion and reducing pain levels in patients with post-mastectomy adhesive capsulitis.

Compared to conventional physical therapy, the combined intervention resulted in superior improvements in range of motion, as demonstrated by significant increases in shoulder flexion, extension, abduction, adduction, medial rotation, and lateral rotation. Additionally, patients in the combined intervention group experienced greater pain reduction compared to those receiving conventional physical therapy alone.

These results highlight the potential benefits of incorporating PNF and soft tissue release into rehabilitation protocols for patients with post-mastectomy adhesive capsulitis. The combined intervention offers a promising approach to enhance shoulder function and alleviate pain in this population. Healthcare practitioners can consider integrating these techniques into their treatment plans to optimize outcomes for patients with adhesive capsulitis.

Overall, the study contributes to the knowledge for the management of post-mastectomy adhesive capsulitis and supports the use of the combined intervention of PNF and soft tissue release as an effective treatment option. The findings have clinical implications for optimizing shoulder function and pain management in patients with post-mastectomy adhesive capsulitis, potentially improving their overall quality of life and functional outcomes. Alternate Hypothesis has been proved.

REFERENCES

1. Page MJ, Green S, Kramer S, Johnston R V, Mcbain B, Chau M, et al. Manual therapy and exercise for adhesive capsulitis (frozen shoulder). Vol. 2014, Cochrane Database of Systematic Reviews. John Wiley and Sons Ltd; 2014.
2. Mehta H, Joshi P, Trambadia H. Effectiveness of PNF Stretching and Self Stretching in Patients with Adhesive Capsulitis-A Comparative Study. Indian J Physiother Occup Ther. 2013;7(1):47.
3. Manoharan VS, Jason JI, Sundaram G, Subramani V. PHYSIOTHERAPY INTERVENTIONS FOR ADHESIVE CAPSULITIS OF SHOULDER: A SYSTEMATIC REVIEW. Article in International Journal of Physiotherapy and Research [Internet]. 2015;3(6):1318–43. Available from: http://dx.doi.org/10.16965/ijpr.2015.198
4. Nandennagari S, Annam R, Nayakanti A. "the Effects of Anterior Versus Inferior Glide in Improving Functional Activity of the Shoulder in Patients With Adhesive Capsulitis." The FASEB Journal. 2020;34(S1):1.
5. Burger BJ. in Adhesive Capsulitis of the Shoulder Joint : A Multiple-Subject. 2000;80(12).
6. Majhi M, Mondal S. Effect of proprioceptive neuromuscular facilitation stretching on physical fitness: A Critical Analysis. GSC Advanced Research and Reviews. 2021 May;6(1):71–5.
7. Malik M, Kaur J, Singh V, Punia S, Professor A. EFFICACY OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION AND JOINT MOBILIZATION IN MANAGEMENT OF FROZEN SHOULDER. International Journal of Research and Analytical Reviews (IJRAR) www.ijrar.org [Internet]. 2019;868. Available from: www.ijrar.org
8. Singh AK, Nagaraj S, Professor SNA, Palikhe RM, Neupane B. Neurodynamic sliding versus PNF stretching on hamstring flexibility in collegiate students: A comparative study "GONG'S MOBILIZATION VERSUS CYRIAX MANIPULATION ON RANGE OF MOTION AND FUNCTION RECOVERY IN SUBJECT WITH FROZEN SHOULDER"-A COMPARATIVE STUDY View project MULLIGAN MOBILIZATION VERSUS STRETCHING ON THE MANAGEMENT OF PIRIFORMIS SYNDROME A COMPARATIVE STUDY View project Neurodynamic sliding versus

PNF stretching on hamstring flexibility in collegiate students: A comparative study. International Journal of Physical Education, Sports and Health [Internet]. 2017;4(1):29–33. Available from: https://www.researchgate.net/publication/354810036

9. Nguyen PT, Chou LW, Hsieh YL. Proprioceptive Neuromuscular Facilitation-Based Physical Therapy on the Improvement of Balance and Gait in Patients with Chronic Stroke: A Systematic Review and Meta-Analysis. Vol. 12, Life. MDPI; 2022.
10. Meneghini GO, Adamatti FS, Dhein W. Immediate effect of proprioceptive neuromuscular facilitation on scapular dyskinesia of volleyball players. Manual Therapy, Posturology & Rehabilitation Journal. 2020 May;18:1–9.
11. Hwang M, Lee S, Lim C, Bilski J. medicina Effects of the Proprioceptive Neuromuscular Facilitation Technique on Scapula Function in Office Workers with Scapula Dyskinesis. 2021; Available from: https://doi.org/10.3390/medicina
12. Orooj M, Awasthi S, Ansari A, Imtiyaz N. Effect of proprioceptive neuromuscular facilitation stretching on functional reach of lower extremity using Y-balance test. Saudi Journal of Sports Medicine. 2020;20(1):6.
13. Godges JJ, Mattson-Bell M, Thorpe D, Shah D. The Immediate Effects of Soft Tissue Mobilization With Proprioceptive Neuromuscular Facilitation on Glenohumeral External Rotation and Overhead Reach [Internet]. 2003. Available from: www.jospt.org
14. Impact of PNF, Active Release Technique and Conventional Physiotherapy on the physical ability of subjects with Periarthritis Shoulder. Journal of Population Therapeutics and Clinical Pharmacology. 2023 Jan 1;30(8).
15. Altaf I, Maqbool A, Maqbool A, Akram A, Iqbal S, Ali Z. Effects of Scapular Proprioceptive Neuromuscular Facilitation Technique on Scapular Dyskinesis. Pakistan Journal of Medical and Health Sciences. 2023 May 12;17(4):416–9.
16. Aboelnour NH, Kamel FAH, Basha MA, Azab AR, Hewidy IM, Ezzat M, et al. Combined effect of graded Thera-Band and scapular stabilization exercises on shoulder adhesive capsulitis post-mastectomy. Supportive Care in Cancer. 2023 Apr 1;31(4).
17. Ravichandran H, Balamurugan J. Effect of proprioceptive neuromuscular facilitation stretch and muscle energy technique in the management of adhesive capsulitis of the shoulder. Saudi Journal of Sports Medicine. 2015;15(2):170.
18. Lin P, Yang M, Huang D, Lin H, Wang J, Zhong C, et al. Effect of proprioceptive neuromuscular facilitation technique on the treatment of frozen shoulder: a pilot randomized controlled trial. BMC Musculoskelet Disord. 2022 Dec 1;23(1).
19. Butt MS, Tanveer F. Effects of Scapular Proprioceptive Neuromuscular Facilitation Techniques in Addition to Routine Physical Therapy on Clinical Outcomes in Patients with Adhesive Capsulitis: A Randomized Controlled Trial. The Healer Journal of Physiotherapy and Rehabilitation Sciences. 2022 Jun 30;2(1):78–87.
20. Srivastava S, Sukanya K, Mittal H. Effect of Cyriax Deep Friction Massage Versus Cryotherapy in Stage 1 & 2 of Adhesive Capsulitis: A Randomized Controlled Trial. J Pharm Res Int. 2021 Dec 14;40–8.
21. Maarouf SS, Elnaggar M, Kaddah MA. End-Range and Scapular Mobilization Technique Versus Passive Stretching Exercises in Treatment of Shoulder Adhesive Capsulitis [Internet]. Vol. 89, Cairo Univ. 2021. Available from: www.medicaljournalofcairouniversity.net
22. Mogahed HGH, Mohamed NA, Wahed MHMA. Impact of 8-Weeks Combined Cyriax Soft Tissue Release and Proprioceptive Neuromuscular Facilitation on Glenohumeral Rhythm in Post Mastectomy Adhesive Capsulitis. Res J Pharm Technol. 2020;13(10):4903–8.

23. Joshi YS, Jayaram M. Issue: 11 [Internet]. Vol. 10, International Journal of Health Sciences and Research (www.ijhsr.org). 2020. Available from: www.ijhsr.org
24. Iqbal M, Riaz H, Ghous M, Masood K. Comparison of Spencer muscle energy technique and Passive stretching in adhesive capsulitis: A single blind randomized control trial. J Pak Med Assoc. 2020 Dec 1;70(12):2113–8.
25. Correction to: Dynamic scapular recognition exercise improves scapular upward rotation and shoulder pain and disability in patients with adhesive capsulitis: a randomized controlled trial (Journal of Manual & Manipulative Therapy, (2020), 28, 3, (146-158), 10.1080/10669817.2019.1622896). Vol. 28, Journal of Manual and Manipulative Therapy. Taylor and Francis Ltd.; 2020. p. 159.
26. Shanker Tedla J, Rani Sangadala D. Proprioceptive neuromuscular facilitation techniques in adhesive capsulitis: a systematic review and meta-analysis [Internet]. 2019. Available from: http://www.ismni.org
27. Sarkar B, Kumar P. Effectiveness of Scapular Mobilization versus Myofascial Release of Subscapularis on Pain, ROM and Function in Subjects with Chronic Frozen Shoulder: A Comparative Study Piriformis syndrome View project Immediate Effects of Unilateral thoracic Postero-Anterior Pressure Versus transverse Pressure in Chronic Mechanical Neck Pain: A Comparative study View project [Internet]. 2019. Available from: www.ijhsr.org
28. Guirro E, Silveira D, Perez C, Montezuma T, Rezende M, Oliveira R, et al. Proprioceptive Neuromuscular Facilitation in Shoulder Rehabilitation of Women Submitted to Surgical Treatment for Breast Cancer. International Journal of Physical Therapy & Rehabilitation. 2019 Oct 14;5(2).
29. Charaniya P, Mishra N, Mishra A. Effect of scapular proprioceptive neuromuscular facilitation on pain and disability in patients with adhesive capsulitis [Internet]. Vol. 4, Human Movement and Sports Sciences. 2019. Available from: www.theyogicjournal.com
30. Gopinath Y, Seenivasan SK, Veeraraghavan SNC, Viswanathan R, Govindaraj MK. Effect of gong's mobilisation versus muscle energy technique on pain and functional ability of shoulder in phase II adhesive capsulitis. Journal of Clinical and Diagnostic Research. 2018 Sep 1;12(9):YC05–8.
31. Nagaraj S, Sah MK, Nagaraj S, Pearlson K, Bangalore I. "GONG'S MOBILIZATION VERSUS CYRIAX MANIPULATION ON RANGE OF MOTION AND FUNCTION RECOVERY IN SUBJECT WITH FROZEN SHOULDER"-A COMPARATIVE STUDY MULLIGAN MOBILIZATION VERSUS STRETCHING ON THE MANAGEMENT OF PIRIFORMIS SYNDROME A COMPARATIVE STUDY View project Impact of Load on Craniovertebral Angle in Construction Workers: A Correlational Study View project "GONG'S MOBILIZATION VERSUS CYRIAX MANIPULATION ON RANGE OF MOTION AND FUNCTION RECOVERY IN SUBJECT WITH FROZEN SHOULDER"-A COMPARATIVE STUDY [Internet]. Article in International Journal of Development Research. 2021. Available from: https://www.researchgate.net/publication/354810160
32. Shih YF, Liao PW, Lee CS. The immediate effect of muscle release intervention on muscle activity and shoulder kinematics in patients with frozen shoulder: A cross-sectional, exploratory study. BMC Musculoskelet Disord. 2017 Nov 28;18(1).
33. Jeyakumar S, Alagesan J, Jayashree PR. A COMPARATIVE STUDY ON THE EFFECTIVENESS OF MYOFASCIAL TRIGGER POINT RELEASE AND MAITLAND TECHNIQUES IN ADHESIVE CAPSULITIS OF SHOULDER JOINT [Internet]. International Journal of Medicine & Health Research Cite This Article. 2016. Available from: www.advancejournals.org

34. Georgiannos D, Markopoulos G, Devetzi E, Bisbinas I. Adhesive Capsulitis of the Shoulder. Is there Consensus Regarding the Treatment? A Comprehensive Review. Open Orthop J. 2017 Mar 8;11(1):65–76.
35. Saifee Contractor E, Santosh Agnihotri D, Patel RM. Effect of Spencer Muscle Energy Technique on pain and functional disability in cases of adhesive capsulitis of shoulder joint. 2016; Available from: http://iaimjournal.com/
36. Eda AKBAŞ PP. THE EFFECTS OF ADDITIONAL PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION OVER CONVENTIONAL THERAPY IN PATIENTS WITH ADHESIVE CAPSULITIS. Türk Fizyoterapi ve Rehabilitasyon Dergisi. 2015;26(2):78–85.
37. Comuk BalCi N, oZlem yuruk Z, ZeyBek asliCaN, GulseN mustafa, aGah tekiNdal mustafa. Acute effect of scapular proprioceptive neuro-muscular facilitation (PNF) techniques and clas-sic exercises in adhesive capsulitis: a randomized controlled trial. 2015.
38. Elhafez HM, Elhafez SM. Axillary Ultrasound and Laser Combined With Postisometric Facilitation in Treatment of Shoulder Adhesive Capsulitis: A Randomized Clinical Trial. J Manipulative Physiol Ther. 2016 Jun 1;39(5):330–8.

*****