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Original Article

# Effects of Intervention Program for Frozen Shoulder Patients in Erbil City: A Comparison Study

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## ABSTRACT

**Background and Objectives:** Frozen shoulder is a painful inflammatory disorder characterized by progressive loss of shoulder mobility, most common in women aged 40–60 years. It may occur primarily, often associated with diabetes or thyroid disease, or secondarily following trauma or immobilization and typically progresses through painful, frozen, and thawing stages over a period of up to two years. This study evaluated the effect of a multi-technique intervention on shoulder Range of Motion in female patients treated at public hospitals.

**Methods:** A quasi-experimental study was conducted with 134 female patients aged over 30 years in the frozen phase of the condition. Participants were assigned based on matching criteria and availability to four groups. The three experimental groups received a multi -technique physiotherapy intervention, defined as the combination of shortwave diathermy, a specific glenohumeral joint mobilization technique, and prescribed home-based therapeutic exercises. Group A (n=30) received posterior mobilization; Group B (n=30) received anterior mobilization; and Group C (n=30) received inferior mobilization. Group D, the control group (n=34), received shortwave diathermy with home exercises only. Treatments were administered three times per week for three weeks. ROM—including flexion, extension, abduction, internal rotation, and external rotation—was measured before and after the intervention using a universal goniometer.

**Results:** All experimental groups showed significant ROM improvement (P-value <0.001). Posterior glide achieved the largest gain in external rotation (20.53° to 73.97°), anterior glide maximized flexion improvement (78.03° to 122.83°), and inferior glide enhanced both flexion and abduction. The control group improved modestly in flexion and abduction only (P-value <0.05).

**Conclusion:** The multi-technique program significantly improved shoulder ROM, with each mobilization showing specific benefits; posterior glide achieved the greatest gains.

**Keywords:** Frozen shoulder; Multi-technique intervention program; Shortwave diathermy; Glenohumeral mobilization; Exercises.

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## INTRODUCTION

Frozen shoulder (FS), or adhesive capsulitis, is an inflammatory condition causing pain and progressive loss of active and passive shoulder range of motion (ROM) in all directions [1]. It affects 2–5% of the general population, mainly women aged 40–60 years, usually with unilateral involvement [2, 3]. FS is classified as primary, often linked to diabetes, thyroid disorders, hyperlipidemia, or cervical spondylosis [4-7]. Or secondarily following trauma, rotator cuff tears, fractures, surgery, or immobilization [8]. The disease progresses through three phases: painful (2–9 months), frozen (4–12 months), and thawing (12–24 months), with significant morbidity from restricted joint mobility, especially in external rotation, abduction, and flexion [9]. Frozen shoulder results in significant morbidity due to chronic pain and restricted glenohumeral joint mobility, particularly in external rotation, followed by abduction and flexion [10-12]. This limitation adversely affects activities of daily living, such as dressing, lifting, and reaching, thereby reducing overall quality of life. Furthermore, FS imposes considerable healthcare and socioeconomic burdens [13]. Conservative management remains the primary approach for FS treatment. Physical therapy is a cornerstone of management, often combined with oral medications or intra-articular steroid injections to enhance therapeutic outcomes [14]. Typical physiotherapy includes stretching, joint mobilization, and electrotherapy such as shortwave diathermy, aimed at reducing pain and restoring ROM [15]. Joint mobilization involves slow, controlled movements designed to restore normal joint mechanics and relieve pain [16]. When combined with heat therapy, such as shortwave diathermy, it may increase collagen extensibility and enhance patient comfort, thereby reducing pain and stiffness [17]. Stretching exercises improve flexibility and circulation, facilitating mobility restoration and discomfort reduction [18]. While various joint mobilization techniques are used to treat frozen shoulder, few studies have directly compared the specific effects of posterior, anterior, and inferior mobilization combined with shortwave diathermy and home-based exercises. Consequently, the optimal direction-specific approach to maximize range of motion remains unclear. The aim of this study is to evaluate the effect of a multi-technique intervention program on improving range of motion in frozen shoulder patients in public hospitals. The study hypothesis is that posterior, anterior, and inferior mobilization combined with shortwave diathermy and home-based exercises produce different effects on shoulder range of motion, with one direction being more effective than the others.

## METHODS

This quasi-experimental study was conducted in the physiotherapy departments of public hospitals (Rizgary and Hawler Teaching Hospitals) to investigate the effectiveness of glenohumeral joint mobilization techniques in patients with adhesive capsulitis. A total of 134 female participants aged over 30 years were recruited. Inclusion criteria required a clinical diagnosis of frozen shoulder in the frozen phase, presenting with limited range of motion, and no concurrent physiotherapy. Participants were excluded if they had a history of shoulder surgery, fractures, dislocations, the inflammatory stage of a frozen shoulder, inflammatory arthritis, or dermatological conditions affecting the involved shoulder. Due to clinical and logistical constraints, participants were assigned based on availability and matched according to sociodemographic factors and disease stage.

Baseline demographic and clinical variables were assessed to confirm group equivalence. Participants were allocated into four groups: Group A (n=30) received shortwave diathermy (SWD), posterior glenohumeral (GH) joint mobilization, and home-based exercises; Group B (n=30) received SWD, anterior GH mobilization, and the same exercise program; Group C (n=30) received SWD, inferior GH mobilization, along with identical exercises; and Group D (n=34), the control group, received SWD and home exercises only. Home exercises included pendulum exercises, towel stretches, cross-body stretches, and overhead stretches. Treatments were administered three times per week for three weeks. Ethical approval was obtained from the Medical Ethics Committee of Erbil Polytechnic University (Approval No.: 25/0075 HRE, Date: 2024/07/22). The SWD was administered using the Curapuls 970 Enraf-Nonius device with airspace electrodes at a frequency of 27.12 MHz and an output of 400 watts for 15 minutes. Joint mobilizations began with distraction to tissue resistance, followed by end-range stretching maintained for one minute, repeated 10 times with a 30-second rest between repetitions. The prescribed home exercise program performed twice daily included pendulum exercises, towel stretches, cross-body stretches, and overhead stretches. Range of motion measurements were obtained at baseline and after the intervention period for both active and passive shoulder movements. Five directions were assessed: abduction, flexion, and extension from the neutral position, as well as internal rotation and external rotation at 45° of shoulder abduction. All measurements were conducted using a standard universal goniometer, in accordance with a pre-defined protocol to ensure consistency and accuracy [19]. The data was connected through a direct interview method (face-to-face) with the patients. Informal written consent was obtained from each participant. All participants were informed about the study procedures, and written Informed consent was obtained prior to participation. Confidentiality and the right to withdraw at any time were guaranteed. The data was analyzed through statistical software (Statistical Package for Science Service-SPSS V.27) which includes descriptive statistical analysis such as frequency, percentage, mean, and standard deviation, and inferential statistical analysis including both paired and two independent sample t-tests. The P-value is considered significant if it is less than or equal to 0.05.

## RESULTS

The 49–59 age group was the most common across all groups, especially in the Inferior Glide (63.3%) and Anterior Glide (56.7%) groups. This age range also included 46.7% of participants in the Posterior Glide group and 44.1% in the Control group. The majority of participants were unable to read and write, particularly in the Inferior Glide (66.7%) and Anterior Glide (53.3%) groups, followed by Posterior Glide (50%) and Control (47.1%) group. Higher levels of education were generally low across all groups. Most participants were married, with the highest proportion in the Posterior Glide group (80%), and similar rates in Anterior Glide and Inferior Glide (73.3% each), while the Control group had 61.8%. Housewives formed the largest occupational group in each category, with the highest proportions in Inferior Glide (80%) and Posterior Glide (70%), followed by Control (67.6%) and Anterior Glide (63.3%). In terms of residence, the majority lived in urban areas, particularly in the Posterior Glide and Inferior Glide groups (90%), followed by Anterior Glide (80%) and Control (76.5%).

There was no significant difference between the groups in terms of age, education, marital status, occupation, or residency, as Table 1 presented.

**Table 1:** Socio demographic Characteristics of Patients with Frozen Shoulders

| Socio demographic Characteristics of Patients with Frozen Shoulders | | Groups | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Posterior Glide | | Anterior Glide | | Inferior Glide | | Control | | P-value |
| | | F. | (%) | F. | (%) | F. | (%) | F. | (%) | |
| Age Group (years) | 38-48 | 7 | (23.3) | 6 | (20) | 6 | (20) | 12 | (35.3) | **0.575** |
| | 49-59 | 14 | (46.7) | 17 | (56.7) | 19 | (63.3) | 15 | (44.1) | **NS** |
| | 60-70 | 9 | (30) | 7 | (23.3) | 5 | (16.7) | 7 | (20.6) | |
| Education Level | Unable to read and write | 15 | (50) | 16 | (53.3) | 20 | (66.7) | 16 | (47.1) | **0.696 NS** |
| | Able to read and write | 3 | (10) | 2 | (6.7) | 1 | (3.3) | 8 | (23.5) | |
| | Primary school graduate | 5 | (16.7) | 7 | (23.3) | 6 | (20) | 6 | (17.6) | |
| | Secondary school graduate | 3 | (10) | 2 | (6.7) | 2 | (6.7) | 1 | (2.9) | |
| | Institute and College graduates | 3 | (10) | 2 | (6.7) | 1 | (3.3) | 2 | (5.9) | |
| | Postgraduate | 1 | (3.3) | 1 | (3.3) | 0 | (0) | 1 | (2.9) | |
| Marital Status | Married | 24 | (80) | 22 | (73.3) | 22 | (73.3) | 21 | (61.8) | **0.242** |
| | Not married | 1 | (3.3) | 2 | (6.7) | 2 | (6.7) | 6 | (17.6) | **NS** |
| | Widowed | 5 | (16.7) | 4 | (13.3) | 5 | (16.7) | 7 | (20.6) | |
| | Divorced | 0 | (0) | 0 | (0) | 1 | (3.3) | 0 | (0) | |
| | Separate | 0 | (0) | 2 | (6.7) | 0 | (0) | 0 | (0) | |
| Occupation | Employed (public and private) | 5 | (16.7) | 6 | (20) | 3 | (10) | 4 | (11.8) | **0.778 NS** |
| | Self-employed | 4 | (13.3) | 5 | (16.7) | 3 | (10) | 7 | (20.6) | |
| | Retired | 0 | (0) | 0 | (0) | 0 | (0) | 0 | (0) | |
| | Housewives | 21 | (70) | 19 | (63.3) | 24 | (80) | 23 | (67.6) | |
| Residence | Urban | 27 | (90) | 24 | (80) | 27 | (90) | 26 | (76.5) | **0.337** |
| | Rural | 3 | (10) | 6 | (20) | 3 | (10) | 8 | (23.5) | **NS** |

Table 2 shows that the right shoulder was more commonly affected across all groups, especially in the Control (64.7%) and Posterior Glide (63.3%) groups, followed by Inferior Glide (53.3%) and Anterior Glide (50%). The dominant arm was more frequently affected in all groups, with the highest rates in the Inferior Glide group (100%) and Posterior Glide group (96.7%). It was also common in the Control (82.4%) and Anterior Glide (76.7%) groups. Obesity was the most common BMI category across all groups, particularly in the Inferior Glide (56.7%) and Control (52.9%) groups, followed by Posterior Glide (53.3%) and Anterior Glide (33.3%). Overweight status was most frequent in the Anterior Glide group (50%). Normal weight was the least common in all groups. Patients with frozen shoulder symptoms lasting less than three months were excluded from the study. Most participants had symptoms for less than six months, especially in the Control (67.6%), Inferior Glide (66.7%), Posterior Glide (63.3%), and Anterior Glide (60%) groups. Most participants did not engage in any physical activity or exercise outside of treatment across all groups. Only a small number in the Inferior Glide (6.7%) and Control (2.9%) groups reported doing so. Only walking was reported as a physical activity, ranging from 2.9% to 6.7% across groups. No participants reported swimming, yoga, or weightlifting. Diabetes was present in around half of participants in all groups, ranging from 44.1% to 53.3%. Hypertension and heart disease were also similarly distributed, with no notable variation between groups. A small proportion of participants had arthritis, reported at 3.3%, 10%, 17.6%, and 23.3%, respectively. Hypothyroidism was present at 3.3%, 5.9%, 10%, and 13.3%. Other diseases were reported at 3.3%, 8.8%, 13.3%, and 13.3%. About half of the participants in the Posterior Glide (50%) group and a little less than half in the Inferior Glide (43.3%) group reported taking medication. In contrast, less than one-quarter of the Anterior Glide group (23.3%) and about one-third of the Control group (32.4%) were using medication at the time of the study. Nonsteroidal anti-inflammatory drugs (NSAIDs) were more frequently used in the Posterior Glide (46.7%) and Inferior Glide (36.7%) groups, with usage ranging from 20% to 46.7% across all groups. No participants reported using steroid medications, ensuring a consistent absence of steroid influence across groups. Other drug use varied significantly, ranging from 2.9% to 26.7%, with the highest frequency in the Posterior Glide group. Injection rates also differed significantly, ranging from 3.3% to 23.3%, with the highest rates observed in the Posterior Glide and Control groups. No participants had breast or shoulder surgery; only one participant in the Inferior Glide group had cervical surgery. The majority of variables showed no significant differences between groups, suggesting overall baseline comparability.

Data in Table 3 indicated that the posterior glide group showed significant improvements ($p < 0.001$) in all shoulder ROM measures. Passive flexion increased by nearly 50°, and external rotation showed the greatest gain, with passive ROM improving over 53°, confirming the effectiveness of posterior glide in restoring key movements. Moderate gains in abduction, extension, and internal rotation further support improved shoulder mechanics. These findings highlight posterior glide with shortwave diathermy and stretching as a highly effective intervention, especially for external rotation and flexion in frozen shoulders.

**Table2:** Medical History and Anthropometric Measurements of Patients with Frozen Shoulders

| Medical History and Anthropometric Measurements of Patients with Frozen Shoulders | | Posterior Glide F. | Posterior Glide (%) | Anterior Glide F. | Anterior Glide (%) | Inferior Glide F. | Inferior Glide (%) | Control F. | Control (%) | P-value |
|---|---|---|---|---|---|---|---|---|---|---|
| Affected Shoulder | Right | 19 | (63.3) | 15 | (50) | 16 | (53.3) | 22 | (64.7) | 0.229 NS |
| | Left | 11 | (36.7) | 15 | (50) | 12 | (40) | 12 | (35.3) | |
| | Both | 0 | (0) | 0 | (0) | 2 | (6.7) | 0 | (0) | |
| Dominant Arm | Dominant Arm | 29 | (96.7) | 23 | (76.7) | 30 | (100) | 28 | (82.4) | 0.010 S |
| | Non-Dominant Arm | 1 | (3.3) | 7 | (23.3) | 0 | (0) | 6 | (17.6) | |
| Body Mass Index (kg/m²) | Normal Weight | 4 | (13.3) | 5 | (16.7) | 4 | (13.3) | 3 | (8.8) | 0.587 NS |
| | Over-weight | 10 | (33.3) | 15 | (50) | 9 | (30) | 13 | (38.2) | |
| | Obese | 16 | (53.3) | 10 | (33.3) | 17 | (56.7) | 18 | (52.9) | |
| Duration of Frozen Shoulder Symptoms/months | 1-6 | 19 | (63.3) | 18 | (60) | 20 | (66.7) | 23 | (67.6) | 0.013 S |
| | 7-12 | 11 | (36.7) | 11 | (36.7) | 10 | (33.3) | 5 | (14.7) | |
| | 13-18 | 0 | (0) | 1 | (3.3) | 0 | (0) | 6 | (17.6) | |
| Do you participate in other physical activities or exercises outside of Treatment? | Yes | 0 | (0) | 0 | (0) | 2 | (6.7) | 1 | (2.9) | 0.282 NS |
| | No | 30 | (100) | 30 | (100) | 28 | (93.3) | 33 | (97.1) | |
| Walking | N/A | 0 | (0) | 1 | (3.3) | 0 | (0) | 0 | (0) | 0.505 NS |
| | Yes | 0 | (0) | 1 | (3.3) | 2 | (6.7) | 1 | (2.9) | |
| | No | 30 | (100) | 28 | (93.3) | 28 | (93.3) | 33 | (97.1) | |
| Does your job involve lifting and repetitive shoulder movements | N/A | 0 | (0) | 0 | (0) | 0 | (0) | 0 | (0) | < 0.001 VHS |
| | Yes | 6 | (20) | 0 | (0) | 2 | (6.7) | 15 | (44.1) | |
| | No | 24 | (80) | 30 | (100) | 28 | (93.3) | 19 | (55.9) | |
| Diabetes Mellitus | Yes | 15 | (50) | 16 | (53.3) | 15 | (50) | 15 | (44.1) | 0.269 |
| | No | 15 | (50) | 14 | (46.7) | 15 | (50) | 19 | (55.9) | NS |
| Hypertension | Yes | 14 | (46.7) | 13 | (43.3) | 15 | (50) | 16 | (47.1) | 0.966 |
| | No | 16 | (53.3) | 17 | (56.7) | 15 | (50) | 18 | (52.9) | NS |
| Heart Disease | Yes | 5 | (16.7) | 4 | (13.3) | 4 | (13.3) | 4 | (11.8) | 0.953 |
| | No | 25 | (83.3) | 26 | (86.7) | 26 | (86.7) | 30 | (88.2) | NS |
| Arthritis | Yes | 1 | (3.3) | 3 | (10) | 7 | (23.3) | 6 | (17.6) | 0.118 |
| | No | 29 | (96.7) | 27 | (90) | 23 | (76.7) | 28 | (82.4) | NS |

**Table2:** Medical History and Anthropometric Measurements of Patients with Frozen Shoulders

| Medical History and Anthropometric Measurements of Patients with Frozen Shoulders | | Groups | | | | | | | | P-value |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Posterior Glide | | Anterior Glide | | Inferior Glide | | Control | | |
| | | F. | (%) | F. | (%) | F. | (%) | F. | (%) | |
| Hypothyroidism | Yes | 4 | (13.3) | 3 | (10) | 1 | (3.3) | 2 | (5.9) | 0.949 |
| | No | 26 | (86.7) | 27 | (90) | 29 | (96.7) | 32 | (94.1) | NS |
| Other disease | Yes | 4 | (13.3) | 1 | (3.3) | 4 | (13.3) | 3 | (8.8) | 0.507 |
| | No | 26 | (86.7) | 29 | (96.7) | 26 | (86.7) | 31 | (91.2) | NS |
| Are you currently taking any medications | Yes | 15 | (50) | 7 | (23.3) | 13 | (43.3) | 11 | (32.4) | 0.145 |
| | No | 15 | (50) | 23 | (76.7) | 17 | (56.7) | 23 | (67.6) | NS |
| Non-steroidal anti-inflammatory drug | N/A | 16 | (53.3) | 24 | (80) | 19 | (63.3) | 23 | (67.6) | |
| | Yes | 14 | (46.7) | 6 | (20) | 11 | (36.7) | 9 | (26.5) | 0.094 NS |
| | No | 0 | (0) | 0 | (0) | 0 | (0) | 2 | (5.9) | |
| Other drug use | N/A | 18 | (60) | 25 | (83.3) | 25 | (83.3) | 29 | (85.3) | |
| | Yes | 8 | (26.7) | 5 | (16.7) | 5 | (16.7) | 1 | (2.9) | 0.018 S |
| | No | 4 | (13.3) | 0 | (0) | 0 | (0) | 4 | (11.8) | |
| Injection | N/A | 23 | (76.7) | 25 | (83.3) | 29 | (96.7) | 23 | (67.6) | |
| | Yes | 7 | (23.3) | 5 | (16.7) | 1 | (3.3) | 7 | (20.6) | 0.010 S |
| | No | 0 | (0) | 0 | (0) | 0 | (0) | 4 | (11.8) | |
| Duration of last injection | N/A | 23 | (76.7) | 25 | (83.3) | 29 | (96.7) | 27 | (79.4) | |
| | 1-6 | 4 | (13.3) | 4 | (13.3) | 1 | (3.3) | 7 | (20.6) | 0.092 NS |
| | 7-12 | 3 | (10) | 1 | (3.3) | 0 | (0) | 0 | (0) | |
| Spinal or Neck Surgeries | Yes | 0 | (0) | 0 | (0) | 1 | (3.3) | 0 | (0) | 0.368 |
| | No | 30 | (100) | 30 | (100) | 29 | (96.7) | 34 | (100) | NS |

**Table 3.** Shoulder Range of Motion (ROM) for Posterior glide group

| Shoulder Range of Motion (ROM) | Baseline (Pre-test) M ± SD | 1st Post-test M ± SD | 2nd Post-test M ± SD | 3rd Post-test M ± SD | Pre-test and 3rd Post-test Mean Difference | t-value | P-value of Paired t-test |
|---|---|---|---|---|---|---|---|
| Passive Flexion ROM | 82.0±16.06 | 103.5± 17.9 | 118.9±19.99 | 131.37±14.69 | -49.37 | -14.36 | < 0.001 |
| Active Flexion ROM | 84.0±17.06 | 93.1±23.99 | 107.47±18.91 | 119.7±14.28 | -35.7 | -12.38 | < 0.001 |
| Passive Extension ROM | 29.1±18.44 | 47.7±15.2 | 52.27±11.56 | 55.0±8.17 | -25.87 | -9.03 | < 0.001 |
| Active Extension ROM | 23.6±16.57 | 41.6±16.41 | 48.07±12.97 | 51.8± 10.76 | -28.233 | -12.760 | < 0.001 |
| Passive Abduction ROM | 72.1±19.1 | 88.7±13.98 | 96.97±14.21 | 107.37±14.31 | -35.27 | -13.45 | < 0.001 |
| Active Abduction ROM | 63.8±19.1 | 81.77±14.36 | 89.53±12.47 | 99.87±13.45 | -36.033 | -13.070 | < 0.001 |
| Passive Internal Rotation ROM | 61.6±21.4 | 69.1±15.64 | 75.90±10.76 | 78.23±8.07 | -16.6 | -4.65 | < 0.001 |
| Active Internal Rotation ROM | 58.7±23.97 | 65.0±18.4 | 73.17±12.35 | 74.83±9.7 | -16.13 | -4.39 | < 0.001 |
| Passive External rotation ROM | 20.53±14.63 | 47.0±14.34 | 63.0±13.12 | 73.97±8.74 | -53.43 | -18.34 | < 0.001 |
| Active External rotation ROM | 15.47±12.98 | 39.03±15.71 | 56.67±12.25 | 69.03±9.5 | -53.57 | -20.51 | < 0.001 |

Table 4 shows the Anterior Glide Group showed significant improvements across all shoulder ROM parameters from baseline to the third post-test. Passive flexion increased markedly from 78.03° to 122.83° and active flexion from 88.1° to 114.1° ($p < 0.001$). Extension and abduction also improved substantially, with passive abduction rising from 72.8° to 104.8° and active from 63.77° to 96.2° ($p < 0.001$). Internal rotation gains were moderate, while external rotation improved less but remained significant. Overall, anterior glide mobilization effectively enhanced shoulder mobility, especially flexion, abduction, and internal rotation. Table 5 illustrated that the inferior glide group showed significant improvements in shoulder ROM across all movements ($p < 0.001$). Passive flexion increased by nearly 60°, and active flexion improved by 33°, indicating better forward elevation. Abduction also improved substantially, with passive and active gains of 44° and 47°, respectively. External and internal rotation showed smaller but significant improvements, reflecting enhanced rotational mobility. Extension increased moderately for both passive and active ROM. Overall, these results demonstrate that inferior glide mobilization effectively enhances shoulder joint mobility, particularly in flexion and abduction, contributing to improved functional movement in frozen shoulder patients.

**Table 4:** Shoulder Range of Motion (ROM) for Anterior Glide Group

| Shoulder Range of Motion (ROM) | Baseline (Pre-test) M ± SD | 1st Post-test M ± SD | 2nd Post-test M ± SD | 3rd Post-test M ± SD | Pre-test and 3rd Post-test Mean Difference | t-value | P-value of Paired t-test |
|---|---|---|---|---|---|---|---|
| Passive Flexion ROM | 78.03±17.5 | 104.7± 17.31 | 113.17±16.72 | 122.83±17.34 | -44.8 | -11.52 | < 0.001 |
| Active Flexion ROM | 88.1±17.8 | 94.73±15.39 | 105.03±14.32 | 114.1±17.01 | -26.0 | -7.68 | < 0.001 |
| Passive Extension ROM | 41.33±13.40 | 49.9±10.78 | 54.73±9.28 | 57.83±14.48 | -16.5 | -7.28 | < 0.001 |
| Active Extension ROM | 36.37±14.88 | 44.9±11.1 | 51.87±9.57 | 55.17± 7.08 | -18.8 | -8.74 | < 0.001 |
| Passive Abduction ROM | 72.8±14.16 | 88.03±13.76 | 98.83±14.48 | 104.8±14.83 | -32.0 | -11.34 | < 0.001 |
| Active Abduction ROM | 63.77±13.85 | 78.9±15.93 | 88.37±16.73 | 96.2±15.34 | -32.43 | -11.26 | < 0.001 |
| Passive Internal Rotation ROM | 60.2±21.4 | 68.23±15.64 | 73.13±13.23 | 77.93±8.49 | -17.7 | -5.53 | < 0.001 |
| Active Internal Rotation ROM | 56.07±23.97 | 64.7±18.4 | 69.4±15.18 | 74.17±10.3 | -18.1 | -5.48 | < 0.001 |
| Passive External rotation ROM | 22.6±15.31 | 34.77±14.34 | 41.13±21.69 | 46.3±21.33 | -23.7 | -7.67 | < 0.001 |
| Active External rotation ROM | 17.5±12.98 | 28.6±15.71 | 35.73±22.72 | 38.97±22.26 | -21.47 | -6.7 | < 0.001 |

Shoulder Range of Motion (ROM) Baseline (Pre-test) 1st Post-test 2nd Post-test 3rd Post-test Pre-test and 3rd Post-test

**Table 5:** Shoulder Range of Motion (ROM) for Inferior Glide Group

| Shoulder Range of Motion (ROM) | Baseline (Pre-test) M ± SD | 1st Post-test M ± SD | 2nd Post-test M ± SD | 3rd Post-test M ± SD | Pre-test and 3rd Post-test Mean Difference | t-value | P-value of Paired t-test |
|---|---|---|---|---|---|---|---|
| Passive Flexion ROM | 69.87 ± 16.18 | 104.1 ± 11.44 | 117.43 ± 9.42 | 129.2 ± 11.73 | -59.33 | -17.5 | < 0.001 |
| Active Flexion ROM | 81.63 ± 14.43 | 92.6 ± 15.65 | 104.10 ± 13.99 | 115.1 ± 20.02 | -33.47 | -7.36 | < 0.001 |
| Passive Extension ROM | 33.7 ± 18.19 | 41.67 ±15.12 | 48.3 ± 18.43 | 50.57 ± 11.47 | -16.87 | -6.6 | < 0.001 |
| Active Extension ROM | 27.63 ± 17.76 | 36.03 ± 16.39 | 41.0 ± 14.89 | 44.77 ± 13.51 | -17.13 | -7.49 | < 0.001 |
| Passive Abduction ROM | 71.13 ± 17.03 | 91.77 ± 11.81 | 101.43 ± 14.29 | 114.67 ± 11.7 | -43.53 | -14.99 | < 0.001 |
| Active Abduction ROM | 60.83 ± 16.02 | 81.1 ± 15.08 | 95.7 ± 13.4 | 107.9 ± 9.29 | -47.07 | -18.7 | < 0.001 |
| Passive Internal Rotation ROM | 59.8 ± 22.25 | 62.8 ± 19.39 | 66.93 ± 19.23 | 67.37 ± 16.06 | -7.57 | -3.62 | 0.001 |
| Active Internal Rotation ROM | 52.6 ± 26.8 | 55.5 ± 24.95 | 59.17 ± 22.92 | 60.70 ± 21.9 | -7.87 | -3.7 | 0.001 |
| Passive External rotation ROM | 26.07 ± 16.95 | 30.13 ± 17.77 | 35.5 ± 21.66 | 35.37 ± 19.47 | -9.3 | -4.94 | < 0.001 |
| Active External rotation ROM | 21.6 ± 15.24 | 25.07 ± 16.12 | 28.03 ± 16.7 | 30.1 ± 16.61 | -8.5 | -6.1 | < 0.001 |

The control group at Table 6 showed that passive flexion improved from 89.09° to 107.62° (P-value = 0.000), and passive abduction increased from 76.47° to 86.5° (P-value = 0.000), showing significant gains. Passive extension rose from 43.12° to 47.44° (P-value = 0.011) and passive external rotation from 30.35° to 33.4° (P-value = 0.031), both with modest improvement. In contrast, active flexion, internal rotation, and external rotation showed minimal or no significant change (P-value >0.05), indicating a limited effect on active mobility without joint mobilization.

**Table 6:** Shoulder Range of Motion (ROM) for Control Group

| Shoulder Range of Motion (ROM) | Posterior Glide M ± SD | Anterior Glide M ± SD | Two Independent Sample t-test Mean Difference | t-value | P-value of Independent t-test |
|---|---|---|---|---|---|
| Post Passive Flexion ROM | 131.4 ± 14.7 | 122.8 ±17.4 | 8.5 | 2.1 | 0.044 |
| Post Active Flexion ROM | 119.7 ± 14.3 | 114.1 ± 17.0 | 5.6 | 1.4 | 0.173 |
| Post Passive Extension ROM | 55.0 ± 8.2 | 57.8 ± 6.4 | -2.8 | -1.5 | 0.140 |
| Post Active Extension ROM | 51.8 ± 10.8 | 55.2 ± 7.0 | -3.4 | -1.4 | 0.158 |
| Post Passive Abduction ROM | 107.4 ± 14.3 | 104.8 ± 14.8 | 2.6 | 0.7 | 0.498 |
| Post Active Abduction ROM | 99.9 ± 13.4 | 96.2 ± 15.3 | 3.7 | 1.0 | 0.329 |
| Post Passive Internal Rotation ROM | 78.2 ± 8.1 | 77.9 ± 8.5 | 0.3 | 0.1 | 0.889 |
| Post Active Internal Rotation ROM | 74.8 ± 9.7 | 74.2 ±10.3 | 0.6 | 0.3 | 0.797 |
| Post Passive External Rotation ROM | 74.0 ± 8.7 | 46.3 ± 21.3 | 27.7 | 6.6 | < 0.001 |
| Post Active External Rotation ROM | 69.0 ± 9.5 | 39.0 ± 22.3 | 30.1 | 6.8 | < 0.001 |

As detailed in Table 7, the comparison of shoulder range of motion (ROM) between the Posterior Glide and Anterior Glide groups revealed significant differences in selected movements. The Posterior Glide group showed greater improvements in passive flexion (mean difference = 8.5°, p = 0.044), passive external rotation (27.7°, p < 0.001), and active external rotation (30.1°, p < 0.001) than the Anterior Glide group. No significant differences were observed in active flexion, extension, abduction, or internal rotation (p > 0.05). These results suggest that posterior glide mobilization is more effective in enhancing shoulder flexion and external rotation in frozen shoulder patients. Table 8 indicated a comparison of shoulder range of motion (ROM) between the Posterior Glide and Inferior Glide groups revealed several statistically significant differences. The Posterior Glide group showed significantly greater improvements in active extension (p = 0.030), internal rotation (both passive and active, p = 0.002), and especially in external rotation, where both passive (mean difference = 38.6°, p < 0.001) and active (mean difference = 38.93°, p < 0.001) ROM values were markedly higher. In contrast, the Inferior Glide group demonstrated significantly better results in passive (p= 0.035) and active abduction (p = 0.009). Differences in flexion and passive extension were not statistically significant (p > 0.05). These findings suggest that Posterior Glide mobilization is more effective than Inferior Glide in enhancing shoulder rotation and extension, while Inferior Glide may better support abduction gains.

**Table 7:** Shoulder Range of Motion (ROM) Comparison Between Posterior Glide with Anterior Glide

| Shoulder Range of Motion (ROM) | Baseline (Pre-test) | 3rd Post-test | Pre-test and 3rd Post-test | | |
|---|---|---|---|---|---|
| | M ± SD | M ± SD | Mean Difference | t-value | P-value of Paired t-test |
| Passive Flexion ROM | 89.09±24.44 | 107.62±25.94 | -18.53 | -6.19 | < 0.001 |
| Active Flexion ROM | 96.09±24.98 | 97.91±27.2 | -1.82 | -0.58 | 0.567 |
| Passive Extension ROM | 43.12±15.1 | 47.44±13.77 | -4.32 | -2.70 | 0.011 |
| Active Extension ROM | 46.35±32.77 | 45.03±15.03 | 1.32 | 0.22 | 0.828 |
| Passive Abduction ROM | 76.47±20.49 | 86.5±14.99 | -10.03 | -4.49 | < 0.001 |
| Active Abduction ROM | 72.47±20.12 | 81.59±15.98 | -9.12 | -4.68 | < 0.001 |
| Passive Internal Rotation ROM | 62.97±20.32 | 64.50±18.09 | -1.53 | -1.44 | 0.158 |
| Active Internal Rotation ROM | 61.56±20.57 | 62.38±19.15 | -0.82 | -0.85 | 0.404 |
| Passive External rotation ROM | 30.35±15.78 | 33.4±15.62 | -3.09 | -2.25 | 0.031 |
| Active External rotation ROM | 27.651±4.58 | 28.56±15.53 | -0.91 | -0.67 | 0.510 |

**Table 8:** Shoulder Range of Motion (ROM) Comparison Between Posterior Glide with Inferior Glide

| Shoulder Range of Motion (ROM) | Posterior Glide | Inferior Glide | Two Independent Sample t-test | | |
|---|---|---|---|---|---|
| | M ± SD | M ± SD | Mean Difference | t-value | P-value of Independent t-test |
| Post Passive Flexion ROM | 131.4 ± 14.7 | 129.2 ± 11.7 | 2.17 | 0.63 | 0.530 |
| Post Active Flexion ROM | 119.7 ± 14.3 | 115.1 ± 20.0 | 4.60 | 1.02 | 0.310 |
| Post Passive Extension ROM | 55.0 ± 8.2 | 50.6 ± 11.5 | 4.43 | 1.72 | 0.090 |
| Post Active Extension ROM | 51.8 ± 10.8 | 44.8 ± 13.5 | 7.03 | 2.23 | 0.030 |
| Post Passive Abduction ROM | 107.4 ± 14.3 | 114.7 ± 11.7 | -7.30 | -2.16 | 0.035 |
| Post Active Abduction ROM | 99.9 ± 13.4 | 107.4 ± 14.3 | -8.03 | -2.69 | 0.009 |
| Post Passive Internal Rotation ROM | 78.2 ± 8.1 | 67.4 ± 16.1 | 10.87 | 3.31 | 0.002 |
| Post Active Internal Rotation ROM | 74.8 ± 9.7 | 60.7 ± 21.9 | 14.13 | 3.23 | 0.002 |
| Post Passive External Rotation ROM | 74.0 ± 8.7 | 35.4 ± 19.4 | 38.60 | 9.92 | < 0.001 |
| Post Active External Rotation ROM | 69.0 ± 9.5 | 30.1 ± 16.6 | 38.93 | 11.15 | < 0.001 |

Table 9 presented the posterior glide group showed significantly greater improvements in all shoulder ROM measures compared to the Control group ($p < 0.05$). The largest gains were observed in external rotation (passive: 74.0° vs. 33.4°; active: 69.0° vs. 28.6°) and notable improvements were also seen in flexion, abduction, and internal rotation. These results indicate that posterior glide mobilization is highly effective in restoring shoulder mobility compared to standard care.

**Table 9:** Shoulder Range of Motion (ROM) Comparison Between Posterior Glide with Control

| Shoulder Range of Motion (ROM) | Posterior Glide M ± SD | Control M ± SD | Two Independent Sample t-test: Mean Difference | t-value | P-value of Independent t-test |
|---|---|---|---|---|---|
| Post Passive Flexion ROM | 131.4 ± 14.7 | 107.6 ±25.9 | 23.75 | 4.42 | < 0.001 |
| Post Active Flexion ROM | 119.7 ± 14.3 | 97.9 ±14.3 | 21.79 | 3.93 | < 0.001 |
| Post Passive Extension ROM | 55.0 ± 8.2 | 47.4 ± 13.8 | 7.56 | 2.63 | 0.011 |
| Post Active Extension ROM | 51.8 ± 10.8 | 45.0 ± 15.0 | 6.77 | 2.05 | 0.045 |
| Post Passive Abduction ROM | 107.4 ± 14.3 | 86.5 ± 15.0 | 20.87 | 5.68 | < 0.001 |
| Post Active Abduction ROM | 99.9 ± 13.4 | 81.6 ± 16.0 | 18.28 | 4.92 | < 0.001 |
| Post Passive Internal Rotation ROM | 78.2 ± 8.1 | 64.5 ± 18.0 | 13.73 | 3.83 | < 0.001 |
| Post Active Internal Rotation ROM | 74.8 ± 9.7 | 62.4 ± 19.2 | 12.45 | 3.22 | 0.002 |
| Post Passive External Rotation ROM | 74.0 ± 8.7 | 33.4 ± 15.6 | 40.56 | 12.58 | < 0.001 |
| Post Active External Rotation ROM | 69.0 ± 9.5 | 28.6 ± 15.5 | 40.48 | 12.37 | < 0.001 |

Table 10 shows the comparison of the Anterior Glide and Inferior Glide groups; the Inferior Glide group showed significantly greater improvements in extension, abduction, and internal rotation ($p < 0.01$). Passive and active external rotation also favored Inferior Glide, though active external rotation was not statistically significant ($p = 0.086$). No significant differences were observed in flexion measures ($p > 0.05$). These results suggest that inferior glide mobilization may be more effective than anterior glide mobilization for improving specific shoulder movements in individuals with frozen shoulder. According to Table 11, the anterior glide group showed significantly greater improvements than the Control group across all shoulder ROM measures ($p < 0.05$). The largest gains were observed in abduction, flexion, and internal while passive and active external rotation also improved significantly. These results indicate that anterior glide mobilization is more effective than standard control interventions in enhancing shoulder mobility in frozen shoulder patients.Table12, showing the comparison between the Inferior Glide and Control groups, showed significant improvements in several shoulder ROM parameters in favor of the Inferior Glide group. Specifically, significant gains were found in passive flexion (mean difference = 21.58°, P-value <0.001), active flexion (17.19°, P-value = 0.006), passive abduction (28.17°, P-value <0.001), and active abduction (26.31°, P-value <0.001). However, no significant differences were observed in extension (both passive and active), internal rotation, or external rotation (all P-value >0.05). These findings suggest.

that Inferior Glide mobilization is particularly effective in improving shoulder flexion and abduction but does not significantly impact rotation or extension compared to the control group

**Table 10:** Shoulder Range of Motion (ROM) Comparison Between Anterior Glide with Inferior Glide

| Shoulder Range of Motion (ROM) | Anterior Glide | Inferior Glide | Two Independent Sample t-test | | |
|---|---|---|---|---|---|
| | M ± SD | M ± SD | Mean Difference | t-value | P-value of Independent t-test |
| Post Passive Flexion ROM | 122.8 ±17.4 | 129.2 ± 11.7 | -6.37 | -1.66 | 0.102 |
| Post Active Flexion ROM | 114.1 ± 17.0 | 115.1 ± 20.0 | -1.00 | -0.21 | 0.836 |
| Post Passive Extension ROM | 57.8 ± 6.4 | 50.6 ± 11.5 | 7.27 | 3.03 | 0.004 |
| Post Active Extension ROM | 55.2 ± 7.0 | 44.8 ± 13.5 | 10.40 | 3.73 | 0.000 |
| Post Passive Abduction ROM | 104.8 ± 14.8 | 114.7 ± 11.7 | -9.87 | -2.86 | 0.006 |
| Post Active Abduction ROM | 96.2 ± 15.3 | 107.4 ± 14.3 | -11.70 | -3.57 | 0.001 |
| Post Passive Internal Rotation ROM | 77.9 ± 8.5 | 67.4 ± 16.1 | 10.57 | 3.19 | 0.002 |
| Post Active Internal Rotation ROM | 74.2 ±10.3 | 60.7 ± 21.9 | 13.47 | 3.05 | 0.003 |
| Post Passive External Rotation ROM | 46.3 ± 21.3 | 35.4 ± 19.4 | 10.93 | 2.28 | 0.042 |
| Post Active External Rotation ROM | 39.0 ± 22.3 | 30.1 ± 16.6 | 8.87 | 1.75 | 0.086 |

**Table 11:** Shoulder Range of Motion (ROM) Comparison Between Anterior Glide with Control

| Shoulder Range of Motion (ROM) | Anterior | Control | Two Independent Sample t-test | | |
|---|---|---|---|---|---|
| | M ± SD | M ± SD | Mean Difference | t-value | P-value of Independent t-test |
| Post Passive Flexion ROM | 122.8 ±17.4 | 107.6 ±25.9 | 15.22 | 2.72 | 0.008 |
| Post Active Flexion ROM | 114.1 ± 17.0 | 97.9 ±14.3 | 16.19 | 2.81 | 0.007 |
| Post Passive Extension ROM | 57.8 ± 6.4 | 47.4 ± 13.8 | 10.39 | 3.79 | < 0.001 |
| Post Active Extension ROM | 55.2 ± 7.0 | 45.0 ± 15.0 | 10.14 | 3.38 | 0.001 |
| Post Passive Abduction ROM | 104.8 ± 14.8 | 86.5 ± 15.0 | 18.30 | 4.90 | < 0.001 |
| Post Active Abduction ROM | 96.2 ± 15.3 | 81.6 ± 16.0 | 14.61 | 3.72 | < 0.001 |
| Post Passive Internal Rotation ROM | 77.9 ± 8.5 | 64.5 ± 18.0 | 13.43 | 3.72 | < 0.001 |
| Post Active Internal Rotation ROM | 74.2 ±10.3 | 62.4 ± 19.2 | 11.78 | 3.01 | 0.004 |
| Post Passive External Rotation ROM | 46.3 ± 21.3 | 33.4 ± 15.6 | 12.89 | 2.78 | 0.007 |
| Post Active External Rotation ROM | 39.0 ± 22.3 | 28.6 ± 15.5 | 10.41 | 2.19 | 0.032 |

**Table 12:** Shoulder Range of Motion (ROM) Comparison Between Inferior Glide with Control

| Shoulder Range of Motion (ROM) | Inferior M ± SD | Control M ± SD | Two Independent Sample t-test Mean Difference | t-value | P-value of Independent t-test |
|---|---|---|---|---|---|
| Post Passive Flexion ROM | 129.2 ± 11.7 | 107.6 ±25.9 | 21.58 | 4.19 | < 0.001 |
| Post Active Flexion ROM | 115.1 ± 20.0 | 97.9 ±14.3 | 17.19 | 2.85 | 0.006 |
| Post Passive Extension ROM | 50.6 ± 11.5 | 47.4 ± 13.8 | 3.12 | 0.98 | 0.331 |
| Post Active Extension ROM | 44.8 ± 13.5 | 45.0 ± 15.0 | -0.26 | -0.07 | 0.942 |
| Post Passive Abduction ROM | 114.7 ± 11.7 | 86.5 ± 15.0 | 28.17 | 8.30 | < 0.001 |
| Post Active Abduction ROM | 107.4 ± 14.3 | 81.6 ± 16.0 | 26.31 | 7.91 | < 0.001 |
| Post Passive Internal Rotation ROM | 67.4 ± 16.1 | 64.5 ± 18.0 | 2.87 | 0.67 | 0.508 |
| Post Active Internal Rotation ROM | 60.7 ± 21.9 | 62.4 ± 19.2 | -1.68 | -0.33 | 0.744 |
| Post Passive External Rotation ROM | 35.4 ± 19.4 | 33.4 ± 15.6 | 1.96 | 0.45 | 0.657 |
| Post Active External Rotation ROM | 30.1 ± 16.6 | 28.6 ± 15.5 | 1.54 | 0.38 | 0.703 |

## DISCUSSION

The present study examined the effectiveness of different glenohumeral mobilization techniques-posterior, anterior, and inferior glides-in improving shoulder range of motion (ROM) among patients with frozen shoulder. Consistent with the epidemiology of the condition, the majority of participants were between 49 and 59 years old, predominantly female housewives, with low educational attainment and minimal physical activity [20-23]. This reflects known risk factors for frozen shoulder, particularly in populations with limited occupational mobility. Notably, most cases involved the dominant right arm, which differs from many studies reporting more frequent involvement of the non-dominant side [24], most participants in this study had right and dominant arm involvement. This discrepancy may relate to regional lifestyle factors in the Kurdish population, where repetitive household activities, such as bread making and carpet washing, may overload the dominant shoulder and contribute to pathology. The majority were overweight or obese based on their body mass index [25]. which may be a relevant factor in the development or persistence of shoulder stiffness. Chronic conditions such as diabetes mellitus and hypertension were commonly reported [26, 27]. Assessment of shoulder range of motion revealed significant improvements across all mobilization techniques applied. Among the three intervention programs, the combination of posterior glide mobilization, shortwave diathermy (SWD), and home stretching exercises produced the greatest improvement in overall ROM [28-30], particularly in external rotation and flexion, which are often limited in frozen shoulder [31]. This effect is biomechanically plausible, as posterior capsule tightness restricts anterior translation during external rotation, and posterior gliding effectively stretches this capsule to restore motion [32, 33]. Additionally, SWD enhanced soft tissue extensibility and reduced pain by increasing local circulation and preparing the joint for more efficient manual therapy

[34].The inclusion of direction-specific home stretching further supported sustained improvements in ROM [35]. In contrast, the anterior glide program was most effective in improving internal rotation, due to its direct influence on anterior capsular mobility [36]. Inferior glide mobilization showed the greatest benefit in abduction and extension, aligning with its biomechanical role in supporting humeral head depression during elevation [37]. While both anterior and inferior glide programs improved specific motion directions, posterior glide mobilization delivered the most comprehensive ROM gains, making it the most effective overall intervention in this study. Compared to the control group, all three mobilization programs led to significantly greater improvements in shoulder range of motion (ROM), highlighting the added value of manual therapy alongside passive modalities and exercise [3, 38]. Among the techniques, posterior glide demonstrated the most substantial overall gains, particularly in external rotation and flexion [29]. Anterior glide showed advantages in internal rotation [39], while inferior glide was more effective in improving extension and abduction [37]. These findings reflect the direction-specific biomechanical effects of each mobilization technique. Given the differing response patterns, a combination or tailored selection based on individual deficits may optimize outcomes. Additionally, the high prevalence of comorbidities such as diabetes mellitus and hypertension [26, 27], along with factors like low physical activity and elevated BMI[10, 23], further supports the need for individualized treatment strategies that consider systemic health risks.

This study had several limitations. The treatment period was limited to three weeks, preventing assessment of long-term effects. Only female patients were included due to separate male and female physiotherapy units, ensuring consistent follow-up but limiting generalizability. The public hospital setting, with high patient flow, sometimes led to missed sessions or incomplete data. The quasi-experimental design restricts causal inference, and adherence to the program was not formally tracked. Future studies should use randomized designs, longer follow-ups, and systematic adherence monitoring. The findings suggest that a structured, combined physiotherapy program can meaningfully improve shoulder range of motion in patients with frozen shoulders, even within a short treatment period. Physiotherapists and rehabilitation professionals can integrate similar protocols into routine care to address mobility restrictions, particularly in public hospital settings where resources and treatment time may be limited. Early initiation of targeted stretching, mobilization, and active exercises, delivered consistently over consecutive weeks, may accelerate ROM recovery, enabling patients to regain functional arm use and perform daily activities with greater ease.

## CONCLUSION

A multi-technique intervention program significantly improved the shoulder range of motion, within different movement-specific patterns. Posterior glide was most effective in improving external rotation and flexion, anterior glide in internal rotation, and inferior glide in extension and abduction. These findings can guide clinicians in selecting mobilization techniques based on patient-specific deficits. Further studies should investigate long-term outcomes, patient adherence, and the integration of manual therapy with adjunct modalities to optimize rehabilitation for frozen shoulder.

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