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The Effect of Rehabilitation Exercises Using Cryotherapy on Pain Reduction and Improving Range of Motion in a Sample of Patients with Frozen Shoulder

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ABSTRACT: This research aims to develop rehabilitation exercises using cryotherapy for patients with frozen shoulder, Identify the effect of rehabilitation exercises combined with cryotherapy on pain relief and improved range of motion in the experimental group , and identify the effect of standard rehabilitation exercises on pain relief and improved range of motion in the control group, and identify the differences between the experimental and control groups in the post-tests for the variables of pain and range of motion. The researchers used an experimental design with two equivalent groups (experimental and control) using pre- and post-tests, as it was suitable for the nature of the research problem and its objectives, the research population consisted of (38) patients with frozen shoulder who were attending the rehabilitation center. The researcher selected a purposive sample of (30) patients, representing (62.5%) of the research population. One of the most important conclusions reached by the researcher is that : Rehabilitation exercises combined with cryotherapy have a significant positive effect on pain relief and range of motion improvement in patients with frozen shoulder, regular rehabilitation exercises have a significant positive effect on pain relief and range of motion improvement, but are less effective than the program combined with cryotherapy, and the experimental group outperformed the control group in all research variables in the post-tests, confirming the effectiveness of adding cryotherapy to the rehabilitation program. One of the most important recommendations made by the researcher is that: Adopt the proposed rehabilitation program combined with cryotherapy for treating frozen shoulder in rehabilitation and physical therapy centers, and educate patients about the importance of adhering to and continuing structured rehabilitation programs to achieve the best results.

INTRODUCTION:

The modern era has witnessed significant advancements in the fields of medical and sports sciences. Supporting sciences such as sports medicine, physiotherapy, and rehabilitation have benefited greatly from this development. Rehabilitation has become a cornerstone in restoring an injured person to their normal functional state in the shortest possible time and at the lowest possible cost, in addition to minimizing complications associated with injury.

The shoulder is one of the most complex joints in the body and has the widest range of motion, due to its freedom of movement in various directions. This wide range of motion makes it susceptible to injuries and pathological disorders, most notably frozen shoulder, also known medically as adhesive capsulitis. This condition is characterized by progressive pain and stiffness in the shoulder joint, leading to a clear limitation in both active and passive ranges of motion. This negatively affects the patient's ability to perform their daily, professional, and athletic activities.

Since traditional rehabilitation programs based solely on therapeutic exercises are time-consuming and can be painful, recent studies have focused on integrating physical therapy with rehabilitation exercises to enhance their effectiveness. One such method is cryotherapy, which involves lowering the temperature of tissues locally. This leads to vasoconstriction, reduced inflammation and edema, slowed nerve transmission, and relief of muscle spasms and pain, thus creating favorable conditions for performing rehabilitation exercises with a wider range of motion and less pain.

The importance of this research lies in its presentation of a structured, scientifically based rehabilitation program that combines progressive rehabilitation exercises with cryotherapy to treat frozen shoulder. This directly benefits patients by alleviating their pain and restoring their range of motion, while also providing a practical reference for professionals working in rehabilitation and physiotherapy centers.

RESEARCH PROBLEM

Through the researchers' field experience in sports rehabilitation and their monitoring of patients with frozen shoulder, they observed that these patients suffer from chronic pain and severe limitation in the joint's range of motion. This affects their ability to perform even the simplest daily tasks, such as dressing, combing their hair, or raising their arm. Furthermore, they noted that many patients do not adhere to traditional rehabilitation programs due to the pain associated with the exercises and the slow pace of results. Despite the widespread use of therapeutic exercises in rehabilitating this condition, the researchers observed a scarcity of local studies that utilize cryotherapy as a complementary tool integrated with rehabilitation exercises in treating frozen shoulder, and that investigate its combined effect on both pain and range of motion. In addition, this study examines the use of therapeutic exercises in such cases, the slow rate of improvement that may occur in patients, and the scarcity of local studies utilizing cryotherapy.

The research problem is thus framed by the following question: Do rehabilitative exercises combined with cryotherapy have an effect on reducing pain and improving range of motion in patients with frozen shoulder? In addition, does this method outperform conventional rehabilitation exercises? In an attempt to answer these questions and keep pace with therapeutic advancements in this injury, the researchers.

Research Objectives

This research aims to:

- Develop rehabilitation exercises using cryotherapy for patients with frozen shoulder.
- Identify the effect of rehabilitation exercises combined with cryotherapy on pain relief and improved range of motion in the experimental group.
- Identify the effect of standard rehabilitation exercises on pain relief and improved range of motion in the control group.
- Identify the differences between the experimental and control groups in the post-tests for the variables of pain and range of motion.

Research Hypotheses

- There are no statistically significant differences between the pre-test and post-test results for the experimental group in the variables of pain and range of motion, favoring the post-test.
- There are no statistically significant differences between the pre-test and post-test results for the control group in the variables of pain and range of motion, favoring the post-test.
- There are no statistically significant differences between the experimental and control groups in the post-tests for the variables of pain and range of motion, favoring the experimental group.

Research fields:

- Human field: A sample of patients with frozen shoulder attending a physiotherapy and rehabilitation clinic, aged between 40 and 50 years.
- Time field: (15/10/2025) to (18/1/2026).
- Spatial field: The physiotherapy room at the Aspetar 2 Sports Rehabilitation Center.

Research Methodology and Field Procedures

Research Methodology

The researchers used an experimental design with two equivalent groups (experimental and control) using pre- and post-tests, as it was suitable for the nature of the research problem and its objectives.

Research Population and Sample

The research population consisted of (38) patients with frozen shoulder who were attending the rehabilitation center. The researcher selected a purposive sample of (30) patients, representing (62.5%) of the research population.

Reasons for selecting the research sample:

- 1- Diagnosis by a specialist physician
- 2- Absence of any previous conditions affecting the affected area, such as fractures or dislocations
- 3- No prior shoulder surgery. The sample was randomly divided (by lottery) into two equal groups: an experimental group (15 patients) and a control group (15 patients). (8) Patients were excluded for a pilot study, as well as due to their inability to adhere to the rehabilitation program.

The researchers ensured homogeneity among the sample members in terms of the variables (age, height, mass, and duration of injury) to control for variables that might affect the validity of the results. This was done by calculating the skewness coefficient, which was within (± 1), indicating homogeneity among the sample members in these variables.

Table (1) shows the homogeneity of the sample members in terms of the variables (age, height, mass, and duration of injury).

Variables	Unit of Measurement	Arithmetic Mean	Standard Deviation	Median	Skewness Coefficient
Age	Year	48.50	5.21	48.00	0.29
Height	cm	168.30	6.47	168.00	0.17
Body Mass	kg	78.10	8.05	77.50	0.34
Duration of Injury	Month	5.40	1.83	5.00	0.51

The skewness index is between ± 1 , indicating a normal distribution of the sample.

Data Collection Tools and Equipment

- 1- Arabic and foreign sources and references, and the internet.
- 2- Personal interviews and surveys of experts and specialists.
- 3- Cryotherapy unit for applying localized cooling.
- 4- Goniometer for measuring shoulder range of motion.
- 5- Optical symmetry scale.
- 6- Medical scale for measuring weight (kg) and height (cm).
- 7- Data entry and measurement recording forms.
- 8- One Lenovo laptop (Chinese made).

Field Research Procedures

Among the means that the researcher needs in his research procedures are tests. Tests are the means that help us to evaluate performance and compare levels and objectives. Therefore, it is necessary that they have a high degree of validity, reliability and objectivity, as they must measure the objective for which they were set. This quality is one of the most important qualities that tests should possess (Jasim & Shibeab, 2024).

Measurement of Shoulder Joint Ranges of Motion (Kenova)

- The effective ranges of motion of the shoulder joint were measured in degrees using a goniometer for the following movements:
- Purpose of the test: To determine and measure angles in the flexion, extension, abduction, and rotation positions.
- Equipment used: Video camera, paper and pen, and a laptop.
- Description of the procedure: From a standing position, the patient performs:
 - Flexion of the arm upwards to the highest possible level. Recording is done from the side of the body.
 - Extension of the arm backwards to the highest possible level. Recording is done from the side of the body.
 - Abduction of the arm. Recording is done from the front of the body.
 - External rotation: with elbow flexion (90 degrees) and forearm external rotation.
 - Internal rotation: with elbow flexion (90 degrees) and forearm internal rotation.
 - Lateral arm dimensions: The image is taken from the front of the body.
- Scoring: The image is entered into the program, and the angles are determined to calculate the maximum range of motion the shoulder joint can reach in each of the previously mentioned positions.
- Unit of measurement: Degree.

Pain Level Measurement (Visual Symmetry Scale)

The visual pain scale, consisting of a horizontal line 10 cm long, was used. It ranged from 0 (no pain) to 10 (maximum unbearable pain). The patient was asked to mark their pain level on the line during movement, and the distance was then measured in centimeters to represent the pain score.

Pilot Study

For the results of the pilot study to be considered valid, the same conditions and circumstances as those of the main study must be met. A mini-pilot study of the main study was conducted on a sample group of eight individuals who were excluded from the main study.

The purpose of the pilot study was:

To verify the safety and suitability of the equipment and tools used.

- To assess the competence of the support team.
- To determine the efficiency of the equipment used in the research.
- To determine the suitability of the prepared exercises for the patients' abilities and to specify the duration of each exercise and the rest period in the rehabilitation unit.

Main Experiment:

Pre-Tests:

The researchers, with the assistance of the support team, conducted the pre-tests on February 14, 2026, at 9:00 AM at the Physiotherapy Center (Aspetar 2) on the experimental group sample.

Sample Equivalence:

To ensure the equivalence of the two groups before commencing the experiment, the researchers performed statistical analysis of the pre-tests using the independent samples t-test, as shown in Table (2).

Table (2) shows the equivalence of the two groups (experimental and control) in the pre-tests.

Variables	Experimental		Control		T value	level Sig	Type sig
	Mean	SD	Mean	SD			
Pain scale	7.40	0.91	7.20	0.86	0.62	0.541	Non sig

Forward flexion	98.33	9.45	100.67	8.92	0.70	0.492	Non sig
Abduction	88.67	8.13	90.00	7.56	0.46	0.646	Non sig
External rotation	32.00	5.21	33.33	4.88	0.72	0.477	Non sig
Internal rotation	38.67	4.76	39.33	5.02	0.37	0.713	Non sig

Significance level ≤ 0.05 and degrees of freedom (28)

Rehabilitation Exercises and Device Used

The researchers applied a rehabilitation program to rehabilitate patients with frozen shoulder using cryotherapy and specific exercises. This included:

- 1- Use of the cryotherapy device with specific exercises.
- 2- The specific rehabilitation exercises were performed for six weeks, with three sessions per week (Saturday, Monday, and Wednesday).
- 3- The duration of cryotherapy sessions was 15 minutes.
- 4- The temperature of the air exiting the cryotherapy device ranged from -4°C to -20°C .
- 5- The duration of cryotherapy was three weeks, with three sessions per week, as prescribed by the treating physician.
- 6- The researcher used rehabilitation exercises before using cryotherapy.
- 7- The duration of each rehabilitation session ranged from 30 to 40 minutes in the first and second weeks.
- 8- The duration of each rehabilitation session ranged from 40 to 60 minutes in the third, fourth, fifth, and sixth weeks.
- 9- The exercises were introduced gradually to increase joint strength and flexibility.
- 10- The specific exercises used in the first week were passive exercises.
- 11- The specific exercises used in the second and third weeks consisted of ten exercises and were called active exercises, incorporating resistance training.
- 12- The specific exercises in the fourth week consisted of eight exercises and were called resistance training.
- 13- The rehabilitation exercises were implemented on the research sample starting on February 15, 2026, and were completed on March 27, 2026.

Post-Tests:

After completing the rehabilitation program using cryotherapy, the researcher conducted the post-test on the research sample on March 28, 2026. The researcher ensured that the conditions were suitable and similar to those of the pre-tests.

Statistical Methods:

The data were statistically analyzed using the following methods:

- Arithmetic mean
- Standard deviation
- Median
- Skewness coefficient
- Independent samples t-test
- Paired samples t-test.

Presentation and Analysis of Results

Pre- and Post-Test Results for the Experimental Group on the Studied Variables

Table (4) show the Pre- and Post-Test Results for the Experimental Group on the Studied Variables.

Variables	Pre- Test		Post-Test		T value	level sig	Type sig
	Mean	SD	Mean	SD			
Pain scale	7.40	0.91	2.13	0.74	18.42	0.000	Sig

Forward flexion	98.33	9.45	162.67	8.21	24.16	0.000	Sig
Abduction	88.67	8.13	158.33	9.04	22.78	0.000	Sig
External rotation	32.00	5.21	78.67	6.43	26.31	0.000	Sig
Internal rotation	38.67	4.76	65.33	5.88	17.94	0.000	Sig

Significant at 14 degrees of freedom and a significance level ≤ 0.05 .

Table (4) shows statistically significant differences between the pre-test and post-test for the experimental group in all variables, favoring the post-test. The sig values at 14 degrees of freedom were ≤ 0.05 , indicating the significance of the tests.

Control Group Results Between Pre-Test and Post-Test

Table (5) shows Pre-test and Post-Test Results for the Control Group in the Studied Variables

Variables	Pre- Test		Post-Test		T value	level sig	Type sig
	Mean	SD	Mean	SD			
Pain scale	7.20	0.86	4.27	0.96	9.78	0.000	Sig
Forward flexion	100.67	8.92	138.00	9.87	12.43	0.000	Sig
Abduction	90.00	7.56	130.67	10.21	13.06	0.000	Sig
External rotation	33.33	4.88	58.00	7.12	11.27	0.000	Sig
Internal rotation	39.33	5.02	52.67	6.34	8.41	0.000	Sig

Significant at 14 degrees of freedom and a significance level ≤ 0.05 .

Table (5) shows statistically significant differences between the pre-test and post-test for the control group, favoring the post-test. However, the degree of improvement was less than that shown in the experimental group.

Results of Differences between the Two Groups in Post-Tests

Table (6) show the Results of Differences between the Two Groups in Post-Tests for the Studied Variables

Variables	Experimental		Control		T value	level Sig	Type sig
	Mean	SD	Mean	SD			
Pain scale	2.13	0.74	± 4.27 0.96	0.96	6.84	0.000	Sig
Forward flexion	162.67	8.21	138.00	9.87	7.45	0.000	Sig
Abduction	158.33	9.04	130.67	10.21	7.86	0.000	Sig
External rotation	78.67	6.43	58.00	7.12	8.35	0.000	Sig
Internal rotation	65.33	5.88	52.67	6.34	5.68	0.000	Sig

Significant at 28 degrees of freedom and a significance level ≤ 0.05 .

Table (6) shows statistically significant differences between the two groups in the post-tests, favoring the experimental group in all variables.

DISCUSSION OF RESULTS

According to the results presented in Tables 4, 5, and 6, the researchers attribute the improvement observed in both groups in pain reduction and range of motion enhancement to the positive effect of structured and progressive rehabilitation exercises. Stretching exercises, pendulum exercises, and range-of-motion exercises work to lengthen the contracted joint capsule, gradually loosen adhesions, and improve the flexibility of the soft tissues surrounding the joint (Hussein & Shaker, 2020, p. 112).

This aligns with what (Al-Hashemi, 2018) emphasized: that regular rehabilitation exercises are the cornerstone of restoring the motor function of the injured joint.

The superiority of the experimental group over the control group in post-tests is attributed by the researcher to the physiological effect of cryotherapy applied before the exercises. Lowering the local tissue temperature leads to vasoconstriction and reduced capillary permeability, thus decreasing the inflammation and edema associated with the condition. Furthermore, the cooling slows the transmission speed in the nerve fibers that carry pain and raises the pain threshold, resulting in a local analgesic effect that reduces pain during exercise (Bleakley & Hopkins, 2020).

This reduction in pain and reflex muscle spasms allowed the patients in the experimental group to perform rehabilitation exercises with a wider range of motion and greater endurance. This, in turn, amplified the effectiveness of the exercises in lengthening the capsular joint and releasing adhesions, resulting in higher improvement rates compared to the control group. This aligns with the findings of (Hawk & Sims, 2022), which demonstrated that combining cryotherapy with stretching exercises improves the range of motion of the shoulder joint to a greater extent than stretching alone. The Mufti adds that in order to maintain the joint's range of motion, continuous movement of the joint is necessary, albeit with varying degrees of range (Kelley et al., 2021). Some researchers, such as (Umran & Abdul-Kareem, 2021), also emphasize that increasing the range of motion (angles) of each joint is an important requirement for achieving the correct performance or required movement.

Confirm that stretching and flexibility exercises, i.e., flexibility exercises, achieve lengthening and increase the elasticity of both ligaments and muscles. By developing these properties, the range of motion expands. Therefore, paying attention to muscle lengthening and shoulder joint flexibility, especially for those with upper limb injuries such as brachial plexus injuries, frozen shoulder, and others, is an important factor in preventing injuries or in cases of recurrent injury (Abu Al-Ala, & Nasr Al-Din, 2019; Al-Tikriti & Al-Ubaidi, 2017).

Also, indicate that performing exercises to improve muscle flexibility helps with smooth movement. Researchers also attribute the fact that rehabilitation exercises within a therapeutic environment help increase the patient's ability to improve body angles (Khalil & Abdalkarim, 2020). Pointed out that joints need continuous movement and a wide range of motion to maintain their appropriate range of motion.

This aligns with the findings of (Saeed et al., 2019). They indicate that consistently performing flexibility exercises in a regular and progressive manner develops and enhances flexibility, making it a crucial component of physical conditioning in training and rehabilitation programs (Abu Al-Ala, & Nasr Al-Din, 2019). Rehabilitation exercises and the use of cryotherapy were key factors in achieving these results, thus confirming the research hypotheses. (Huda Badawi, 2020). Adds that adhering to the rehabilitation program and exercises designed according to a well-studied scientific methodology, taking into account the severity of the injury had a clear impact on reducing pain. Continued practice of these exercises led to improved muscle strength and joint range of motion, which in turn significantly reduced pain. Muscle strength is the ability or tension that a muscle or muscle group can produce against resistance in a single, maximum voluntary contraction (Morad & Shabeeb, 2023).

The results of the current research are consistent with the findings of the systematic review by (Page et al., 2019) and with the treatment model proposed by (Kelley et al., 2021), as they confirmed that combining analgesic physical methods and therapeutic exercises achieves better results in treating adhesive capsulitis than using exercises alone, which fulfills the three research hypotheses and answers the research problem question.

CONCLUSIONS:

- Rehabilitation exercises combined with cryotherapy have a significant positive effect on pain relief and range of motion improvement in patients with frozen shoulder.

- Regular rehabilitation exercises have a significant positive effect on pain relief and range of motion improvement, but are less effective than the program combined with cryotherapy.
- The experimental group outperformed the control group in all research variables in the post-tests, confirming the effectiveness of adding cryotherapy to the rehabilitation program.

RECOMMENDATIONS

- Adopt the proposed rehabilitation program combined with cryotherapy for treating frozen shoulder in rehabilitation and physical therapy centers.
- Educate patients about the importance of adhering to and continuing structured rehabilitation programs to achieve the best results.
- Conduct similar studies on other shoulder injuries or other joints such as the knee and elbow.
- Conduct comparative studies between cryotherapy and other physical therapies (such as heat therapy or ultrasound) combined with rehabilitation exercises.
- Increasing the sample size and diversifying the age groups in subsequent studies to generalize the results.

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