

Effect of rehabilitation exercises and galvanic device on the flexibility of the shoulder joint and the performance of some hoop skills in rhythmic gymnastics for female students

Dr. Ihsan Ali Naser

Lecturer. Dr., College of Physical Education & Sports Sciences, Babylon University Hila, Iraq.

Dr. Rihab Nabeel Abdul

Lecturer. Dr. , College of Physical Education & Sports Sciences, University of Kufa, Kufa .

Dr. Ali Kadhim Ali

Assistant Lecturer, College of Physical Education & Sports Sciences, Babylon University, Hila, Iraq.

Dr. Watheq Hasan Mubdir Al-Araji

Assistant Lecturer College of Physical Education & Sports Sciences, Babylon University, Hila, Iraq.

Dr. Hussein Ali Khadir

Assistant Lecturer, College of Physical Education & Sports Sciences AL Mustaqbal University, Hila, Iraq.

Dr. Ammar Hamza Hadi

Prof. Dr, College of Physical Education & Sports Sciences, Babylon University Hila, Iraq.

Dr. Shimaa Mohamed Abuzaid

Assist. Prof. Dr. College of Physical Education & Sports Sciences AL Mustaqbal University ,Hila, Iraq.

Abstract

Purpose: This study investigates the effectiveness of combining rehabilitative exercises with the Galvanic device to restore shoulder joint flexibility and enhance hoop skills in female rhythmic gymnastics students. It emphasizes the role of sports medicine specialists in supporting injured athletes by designing targeted exercises for moderate tears in the posterior shoulder muscle and assessing their impact on flexibility and performance.

Materials and Methods: An experimental method was used, employing a control group design with pre-and post-tests. The study involved 35 third-year female students from the College of Physical Education and Sports Sciences at the University of Kufa, with five students identified as having moderate tears in the posterior shoulder muscle. Participants were selected based on medical examinations, with parental and institutional consent secured before the study began.

Results: The study found that rehabilitative exercises combined with the Galvanic device significantly improved shoulder flexibility, reduced pain, and enhanced hoop skill performance in female rhythmic gymnastics students with moderate posterior shoulder muscle tears.

Conclusions: The findings revealed that rehabilitative exercises combined with the Galvanic device significantly improved shoulder flexibility, reduced pain, and enhanced performance in rhythmic gymnastics skills. The researchers recommend integrating the Galvanic device with rehabilitative exercises to address similar injuries effectively.

Keywords

Rehabilitation exercises, Galvanic device, the flexibility of the shoulder joint.

Introduction

Development and scientific advancement have a great and clear impact on the development of all fields, and among these fields is the sports field, as it has taken a wide space in the lives of people and all their interests, which requires attention to the therapeutic sports movement, whether using modern theoretical and applied sports sciences or modern scientific and technical means in innovating. They have advanced treatment methods far from surgical intervention(Manolachi et al., 2022; Zhang et al., 2023).

Rehabilitation exercises are an important and successful means of treating many sports injuries, including musculoskeletal and joint injuries(Jacob, 2023). Recently, it has been observed that they are used extensively by specialists in medicine and sports rehabilitation due to their positive results in the health of the injured(Arden et al., 2022).

Modern techniques have been widely used in physical therapy due to the high rate of sports injuries and their complications, despite the tremendous development in sports and other societies, especially in physical therapy and elsewhere(Ba, 2020). The Galvanic device has an important role as a means of physical therapy for athletes after injury. It aims to improve vital functions, relieve pain, and accelerate recovery(Laskowska et al., 2021). It also contributes to stimulating muscles and nerves and stimulates repeated contraction and relaxation of the muscles(Zschorlich et al., 2024).

An injury to the shoulder joint is an important and complex injury with many causes, including neglecting a good warm-up, the tools used for exercise, and the exercise application method (Liaqat et al., 2024).

The moderate tear injury to the posterior shoulder muscle contributes significantly to limiting the movement of the joint and the loss of flexibility of the joint itself, and through the use of the Galvanic device and rehabilitative exercises for the injured female students are based on organized and codified scientific foundations and have helped in reducing complications, as these methods contribute to accelerating treatment, reducing pain, and increasing flexibility and movement of the joint(Seçkin et al., 2023).

Rhythmic gymnastics is one of the sports taught within the curricula of colleges and departments of physical education and sports sciences(Xaitbayeva, 2024). It has basic and complex skills with a high level of performance, among which are the skills of the hoop apparatus. Because these skills require the development of flexibility, multiple movements, and wide rotations, they need

A wide range of motion in the shoulder joint, limited joint movement, and lack of flexibility expose female students to many injuries and, thus the inability to participate in motor performance(Cejudo, 2022).

At present, shoulder joint injuries among female students have spread widely. The student's inability to engage in physical activity due to the injury has led to a moderate tear in the posterior muscle of the shoulder joint, resulting in weak movement of the joint and the inability to bend and extend the joint normally, thus affecting the elasticity of the posterior muscle of the shoulder joint(Mifune et al., 2020). Hence, the importance of research lies in rehabilitative exercises and the Galvanic device, which in turn contribute to restoring the elasticity of the posterior shoulder muscle for female students using the hoop apparatus in rhythmic gymnastics(Yasar et al., 2024).

Through the above, the research aims to prepare rehabilitation exercises and the Galvanic device and determine their effect in rehabilitating and restoring the flexibility of the shoulder affected by a moderate tear for female students in rhythmic gymnastics.

Materials and Methods

Subjects

The study targeted 3rd-grade female students aged 21 with a moderate tear in the posterior shoulder muscle, forming the research population. These participants were carefully and intentionally selected from the College of Physical Education and Sports Sciences at the University of Kufa. Out of a total population of 35 female students, an experimental group of 10 students was identified based on medical examinations confirming the diagnosis of moderate tears in the posterior shoulder muscle. Ethical approval was obtained before the study, including written consent from the student's parents and authorization from the college dean.

Methods

The researchers adopted a rigorous experimental methodology, chosen for its suitability to achieve the study's objectives. A one-group design with both pre and post-test was implemented. This design facilitated an accurate evaluation of the intervention's effectiveness by systematically comparing the participants' performance and condition before and after the experimental treatment.

Table (1) shows the experimental design of the sample.

Group	Pre-test	Program	Post- test	
experimental group	Measuring the degree of pain and range of the motion of the shoulder joint	Rehabilitation exercises accompanied by a galvanic device	Measuring the degree of pain and range of the motion of the shoulder joint	Differences between Pre and post- test
	Hoop skills in rhythmic gymnastics		Hoop skills in rhythmic gymnastics	

Homogeneity of the research sample

To avoid influences that may affect the research results due to the individual differences that exist among the affected students and the sample in the range of motion of the shoulder joint, which is considered influential, and to obtain a single and consistent level in the experiment, which must be controlled, and for this reason, homogeneity was conducted.

Table (2) homogeneity of the sampling

variables	Unit of measurement	mean	standard division	median	Torsion coefficient	significant
Shoulder Flexion	degree	119.25	2.217	119.00	0.482	S
Shoulder Extension	degree	20.25	2.754	20.25	-0.323	S
Abduction	degree	118.75	2.986	19.00	-0.423	S
Adduction	degree	15.25	3.304	15.00	-0.229	S
Internal Rotation	degree	90.25	4.113	90.50	0.958	S
External Rotation	degree	42.25	0.430	40.50	-0.363	S

Procedures:

Determine search variables:

1. Degree of pain.
2. Flexibility of the shoulder joint.
3. Basic skills with the hoop apparatus.

Description of physical tests

First description of the test to measure the degree of pain: a measure of the degree of pain using visual analogy scale: (1)

Description of performance: A scale with a numerical rating of (0-10). The patient is presented with a sheet of paper divided into ten squares, starting from left to right, and he is asked to determine the degree of pain he feels while moving the affected part in the determined position.

Calculate the grades: Record the pain the patient feels when moving the affected part to the maximum extent possible, and a grade (10) expresses the maximum degree of pain felt.

Second: Description of the test to measure the range of motion of the shoulder joint.

Objective of the test: to measure the range of motion of the shoulder joint in movements (basic 6)

Tools: Angle

Description of the test: The affected person performs the test by performing six different movements to measure the range of motion of those movements as follows:

- Shoulder Flexion: the normal range is from 0 to 180 degrees
- Shoulder Extension: the normal range is from 0 to 45 degrees
- Abduction: the normal range is from 0 to 180 degrees

- Adduction: the normal range is from 0 to 45 degrees
- Internal rotation: the normal range is from 0 to 180 degrees
- External rotation: the normal range is from 0 to 180 degrees

Recording: The degrees of the angles of the movements are recorded in the student's form, and he performs these movements to the maximum range of motion that the joint can reach and the feeling of pain stops.

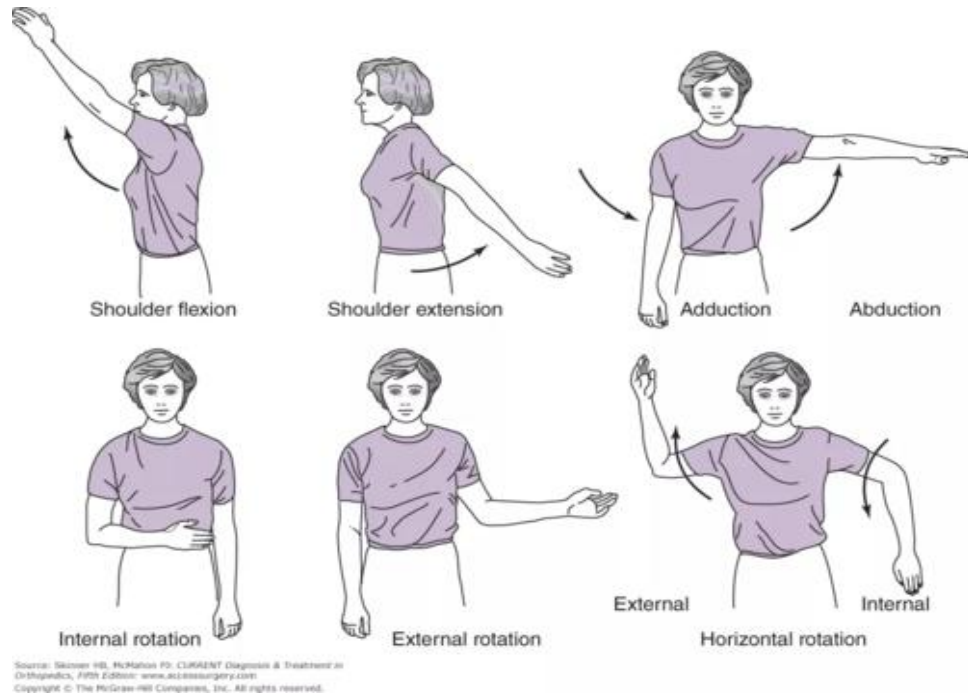


Figure (1) the shapes show the flexibility of the shoulder joint

Description of skill tests

Tests of hoop skills in rhythmic gymnastics:

First: Rotate the hoop into a figure (8).

Second: Forward pendulum swing.

Third: Side pendulum swing.

The technical performance of the hoop skills was evaluated based on the apparent appearance of the skill, using two Canon cameras to photograph the artistic performance of the hoop skills in rhythmic gymnastics and record it as a video via (CD) to present it to the evaluators represent, to analyze it and record the results of their evaluation of the artistic performance in the evaluation form that was prepared in advance for this purpose, table (3) description form of the skills evaluation. Before calculating the arithmetic mean of the top three scores provided by three evaluators, the researchers selected the best score from each student's two attempts, which were provided by the evaluator.

table (3) description form of the skills evaluation

N	The name of evaluator	Attempts	Degrees of the skills		
			Rotate the hoop into a figure (8)	Forward pendulum swing	Side pendulum swing
1		First			
		Second			
2		First			
		Second			
3		First			
		Second			

Exploratory experience:

A reconnaissance experiment was conducted with the assistant work team on (11/17/2023) on the affected female students from the same research sample, which numbered (3) students. The goal of the exploratory experiment was to familiarize the assistant work team with the method of using tools and devices and their suitability to determine the accuracy and the validity of the tests used in the research and know the time taken for the test and the suitability of the relief methods used for the affected shoulder joint, along with knowledge of the obstacles that would require caution in applying the main experiment and overcoming them. The researcher benefited from the observations, negatives, and positives.

Main test:**Pre-tests:**

-The first day: Technical performance tests for hoop skills in the gymnastics hall at the College of Physical Education and Sports Sciences - University of Kufa. The test was conducted on Sunday, 11/26/2023, as the researchers used a (Canon) camera to photograph the artistic performance and record it as a video via (CD). To be presented to the evaluators for analysis and to record the results of their evaluation of the technical performance through the evaluation form prepared for this purpose in advance.

-The second day: The researchers conducted tests on the research sample, which consisted of (7) female students with a tear in the posterior muscle of the shoulder joint. Pre-tests were conducted at the Trauma Rehabilitation Center in Najaf on (11/27/2023).

Preparing and implementing rehabilitation exercises:

The researchers conducted the main research experiment on the research sample, and the implementation of the qualifying exercises and the Galvanic device were prepared after reviewing some scientific references and various sources, the researchers' readings, and their continuous briefing and interviews with specialized professors. (5) exercises were prepared. After that, the rehabilitation units were formed based on the exercises, as (4) exercises were chosen in each rehabilitation unit, and the number of rehabilitation units was (24) rehabilitation units, at a rate of (3) units per week and according to the times for the selected exercises, as the number of repetitions in the units ranged between (1- 20) Repeats, rest between repetitions (30-40 seconds), and rest between groups (1 minute - 3 minutes). The time of the rehabilitation units they were ranged between (45-90) minutes. Simple exercises were used, which consisted of static and moving exercises characterized by their simple performance, to relieve pressure on the site of the injury.

As for the use of the Galvanic device, it was in the first half hour to prepare the muscles and the affected area for rehabilitative exercises at a higher intensity, as the injured student performed a different set of rehabilitative exercises (flexion and extension in different directions), with certain intensities, and these exercises were in different positions, as this stage lasted for four weeks. Each week includes three rehabilitation units. This phase included gradually increasing the intensity and difficulty of the exercises, including some resistance exercises without weights.

Post-tests:

After completing the qualifying units, the post-tests were conducted on February 24-25, 2024. The tests were conducted in the same place where the pre-tests were held, and the researchers were keen to provide the same conditions.

Statistical analysis

To know the results of the study, the researchers used the statistical package (SPSS)

Results and discussion

Table (4) shows the differences between the pre-and post-tests in the shoulder joint range of motion test for the research sample.

variables	unit	pre-test		post-test		T value	significant level	Statistical significance
		mean	sd	mean	sd			
Shoulder Flexion	degree	119.25	2.217	179.25	1.50	33.717	0.000	sign.
Shoulder Extension	degree	20.25	2.754	43.00	2.160	10.851	0.000	sign.
Abduction	degree	118.75	2.986	15.25	1.258	35.277	0.000	sign.
Adduction	degree	15.25	3.304	179.00	0.957	19.702	0.000	sign.
Internal Rotation	degree	90.25	4.113	178.75	4.414	35.559	0.000	sign.
External Rotation	degree	42.25	9.430	177.25	2.50	30.333	0.000	sign.

Discussing the results:

It is clear from Table (3) that there are significant differences between the values of the results of the pre-and post-tests of the individuals in the research sample in the variables of flexibility and basic skills with the hoop apparatus. This difference is due to the positive effect of the rehabilitation exercises and the Galvanic device, and the progression in these exercises was from difficult to easy

and within the limits of pain. It leads to a reduction and disappearance of pain in the affected part(Campbell et al., 2021). Rehabilitation exercises are an effective form of relieving pain and inflammation(Metsios et al., 2020). Rehabilitation exercises, with the use of auxiliary means, would contribute to reducing the severity of pain and developing the range of motion of the shoulder joint, thus returning injured women to what they were before the injury occurred(Vincent & Vincent, 2019). The exercises must be performed carefully to include the level that prevents the occurrence of pain(El-Tallawy et al., 2021). Especially in the first performance stage, the rehabilitative exercises increased blood flow to the injury area(Lilić et al., 2022). They helped remove waste and remnants of the injury, reducing the pressure and relieving pain (Kastenberger et al., 2020).

The researchers also attribute the reason for the great development that occurred in the research sample's performance of rehabilitative exercises with the help of the methods that were used, which are in line with the era of modernity and scientific development, and which effectively influenced the rehabilitation of the posterior muscle of the injured shoulder joint in the flexibility of the research sample. It was also the reason for the great development of the rehabilitative units and the device. Galvanic devices a major role in improving the flexibility of the posterior muscle of the shoulder joint, as a study pointed out that physical exercises lead to the activation of muscles, tendons, and ligaments after they had been afflicted with stiffness due to lack of movement and use(Ghorbani et al., 2023). Therefore, stretching exercises are anti-stiffness exercises(Arrate et al., 2022).

Researchers also believe using the Galvanic device is one of the most important rehabilitation and treatment methods(Tapia-Haro et al., 2020). This stimulation uses high-voltage, low-frequency electricity to penetrate deeply into the tissues. It relieves pain and improves blood flow, muscle spasms, and joint mobility(Milne et al., 2021; Xu et al., 2021).

By reviewing the studies conducted, researchers believe that using the Galvanic device to repair tissues, restore sagging muscles, increase blood flow, and relieve pain left negative effects due to not initially taking the correct treatment methods (Islam, 2020; Salamon, 2021). However, the role of rehabilitative physical exercises, which helped the affected muscle obtain a sufficient degree of flexibility, led to an improvement in the angle of the joint, as the joint's mobility increases as the flexibility in the muscle working on that joint increases, obtaining sufficient flexibility for the muscles, tendons, and ligaments. A specific joint or group of joints in a particular movement or activity depends on the amount and intensity of exercises performed in a wide range of motion and the degree of previously acquired flexibility of the individual(Salman, 2024).

The researchers concluded from the above that the diversity or multiplicity of using rehabilitative and auxiliary therapeutic methods contributed significantly to reducing the degree of pain and rehabilitating the injury to the shoulder joint and helped with the use of exercises to improve the injury and increase the range of motion of the joint, in which the loads were graduated to suit the condition of the injury, which helped improve the flexibility of the joint(Hryvniak et al., 2021; Zatsiorsky et al., 2020). The affected shoulder is allowed to flex, extend, turn inward, and turn outward gradually, consistent with the improvement of the functional performance of the affected joint(Roller, 2024). In addition, the nature of the rehabilitative exercises used and the noticeable development they achieved in the range of motion and how they were graduated, they were appropriate to the endurance of the affected muscle(Elmaghraby, 2023).

The correct selection of these exercises, determining the ratios and repetitions, and giving the appropriate rest between the exercises and is what the study emphasized, stating that "the therapeutic

approach has an effective effect in returning the affected part to normal work after the exercises are selected, effectively and based on scientific foundations in repetitions, performance and periods Comfort(Iversen et al., 2021). Therefore, it must be used rehabilitative exercises accompanied by the Galvanic device to eliminate joint damage and increase muscle elasticity, thereby emphasizing the A group of exercises for flexibility to achieve balanced joint development(Wilk & Arrigo, 2020).

This development in the skills of hoops in rhythmic gymnastics for female students is due to the use of qualifying exercises accompanied by the device and also to the role of the school in teaching skills, as rehabilitation and at the same time, the school's followed curriculum contributed significantly to improving the skill performance of the female students, and this, if returned, goes back to the qualifying exercises used to accompany them.

Conclusions

The researchers concluded that the combination of rehabilitative exercises and the use of the Galvanic device was highly effective in addressing injuries to the posterior muscles of the shoulder joint. This integrated approach accelerated the rehabilitation process and played a crucial role in restoring functionality and improving the overall range of motion in the shoulder joint. These improvements were particularly evident among female students involved in rhythmic gymnastics, which demands exceptional flexibility and strength. By targeting the specific needs of these athletes, the intervention provided a comprehensive and efficient solution for recovery, underscoring its value in enhancing performance and reducing the risk of long-term complications. This study highlights the importance of utilizing advanced rehabilitation techniques to support athletes in achieving optimal physical health and performance.

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Attachment (1) shows the exercise rehabilitation.

Attachment (2) shows an example of an exercise rehabilitation program

1st week: number of participants: 7

Duration: 42;23 minutes

Exercise symbol	duration	reputation	set	rest between rep	rest between set	rest between exercise	total time in exercise
A	15 sec	3	2	30 sec	60 sec	100 sec	490 sec
B	15 sec	3	2	30 sec	60 sec		490 sec
C	15 sec	4	2	30 sec	60 sec		520 sec
D	16 sec	2	2	40 sec	80 sec		444 sec
E	20 sec	2	1	40 sec	–		180 sec
Assistive devices were used in the rehabilitation aspect before performing the rehabilitation exercises for 15 minutes.							

	exercise rehabilitation
A	Raise the shoulders and roll them back in a large circular motion.
B	Lie on the floor on one side and put our heads on a foam ball. Bend the lower arm at a 90-degree angle so that it becomes perpendicular to the torso. hold 15 seconds
C	Keeping the shoulder blades down and back, we use the left hand to press the right hand towards the ground until we feel the back of the shoulder lengthen. Work with movement
D	sitting position on your knees, extend your arms over the chair while bending your neck and head down
E	Spread to the side from the forward bend position