

# REHABILITATION OF NECK INJURY USING SHOCKWAVE THERAPY DURING REHABILITATION EXERCISES IN STUDENTS WITH NECK MUSCLE INJURIES IN GYMNASTICS

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## Abstract

The rehabilitation exercises developed by the researcher were accompanied by a shockwave device which aims to enhance the efficiency of the muscle. It includes exercises that aid in adjusting the neck movement, enhances muscle effectiveness, alleviates discomfort and enhances flexibility when combined with shockwave therapy. To determine the impact of a shockwave therapy-based rehabilitation program on pain level and function in students with neck muscle injury. It also investigated the impact of this intervention to improve neck muscle range of motion among injured participants.

The research method was based on the characteristics of the phenomenon studied. Since the research problem and objectives are handled well using the experimental method, the experimental method was chosen. The sample of the research was deliberately selected, which is represented by students with neck muscle injuries from the Department of Physical Education and Sports Sciences at the Open Educational College, Al-Qadisiyah Center. In this case, the sample comprised seven male student only. The low effect of the present rehabilitation exercises was concluded by the realist researcher that the exercises prepared were efficient for reducing pain severity, increasing range of motion, and increasing muscular strength of injured gymnastics students.

**Keywords:** Shockwaves. Rehabilitation exercises. Pain.

## Introduction

Sport is now more than just a subject of interest for a developed sphere of society. It draws global attention for its rapid advances across many domains. This evolution has fuelled record breaking and increased demands in every sport. Such requirements stem from increased loads of exercise, prolonged exercise and the creation of movement modalities, frequency, and variability. These factors are likely to result in injury to various body parts that may prevent an athlete from engaging in the activity for some time. Such circumstance

created a demand for specialists to be able to find methods that can allow the athletes to return to their sport with necessary haste.

Sports rehabilitation sports medicine has taken a unique place between sports sciences with its significant role in rehabilitation and health care of both athletes and non athletes. It aims to get back to the playing fields and normal life as fast as possible but pain from injuries that disrupt active life is an hindrance. Most students are hurt during gymnastics class — including neck injuries. These are usually caused by a lack of flexibility and strength in your muscles.

Among the sports that are taught through college and departments of physical education and sports sciences (Bio, 15:3, 4), artistic gymnastics is included. It entails both simple and sophisticated capabilities performed at a high level. They require fast movement and quick changes of direction. This stresses the neck and muscles around it. Weakness in these muscles leaves students vulnerable to a plethora of injuries.

The neck is a critical body part in gymnastics activities. It serves as a main support when the body bears weight during skills performed on the floor exercise mat, such as rolls and headstands. During direction changes in gymnastics classes, the neck muscles are exposed to various types of strain and tearing. This reduces neck efficiency, increases pain, and limits the ability to move and extend the neck in different directions.

Rehabilitation exercises in length with contemporary tools including shockwave devices are the first-rate way of rehabilitation from damage whilst regaining usable appearance over ordinary. The effects of these techniques are numerous on the athlete body, and the goal is to restore what has been injured back to its optimum functioning. Use of contemporary therapeutic devices expedites the rehabilitation process.

Thus, therapeutics including shockwave therapy strengthen the performance of the neck surrounding muscles. Importantly, this strategy holds immense significance as we move forward into the era of the modern rehabilitation sciences. It speeds up therapy, alleviates pain, and improves the durability of joints and motion.

Thus, the researcher seeks to improve muscle efficiency through muscle rehabilitation exercises plus shockwave therapy for the following reasons. These lead to easier neck movement, increased efficiency, decreased pain and increased range of motion. This study is important in that rehabilitation program possible to have the patient return to perform and able to make the sports activities that deal with the part affected and return quickly to the normal physical activity using shockwave therapy.

## **2. Purpose of the Study**

1. To identify the effect of a rehabilitation program using shockwave therapy on students with neck muscle injuries.
2. To determine the effect of the rehabilitation program using shockwave therapy on increasing neck muscle range of motion in injured students.
3. To identify the effect of the rehabilitation program using shockwave therapy on reducing pain associated with neck muscle injuries.

### 3. Methodology and Procedures

The nature of the phenomenon studied determined the research methodology. The experimental approach was adopted due to its suitability for the research problem and objectives. The research population was intentionally selected and consisted of students with neck muscle injuries from the Department of Physical Education and Sports Sciences at the Open Educational College, Al-Qadisiyah Center. The sample included seven male students only.

After selecting the sample, the researcher established homogeneity of the main research sample according to the variables of age, height, weight, injury duration, and pain degree, as shown in Table 1.

Table 1 Homogeneity of the Experimental Group

No.	Variable	Unit of Measurement	Mean	Std. Deviation	Skewness	Result
1	Injury duration	Year	2.33	0.181	0.674	Homogeneous
2	Chronological age	Year	28.422	0.123	0.728	Homogeneous
3	Weight	kg	76.424	0.111	0.733	Homogeneous
4	Height	cm	168.406	0.136	0.724	Homogeneous
5	Muscle pain	Degree	6.53	0.14	0.70	Homogeneous

#### A. Main Experiment

The researcher ensured that the pre-tests were valid and based on correct scientific principles by choosing the appropriate place, time, and procedures. The pre-tests were performed on Wednesday, 2/10/2024, on all measurements and tests employed in this study, assisted by the research team responsible for implementation. The tests were implemented in the order of.

##### 1) 1. Measurement of Pain Intensity Using the Visual Analog Scale (VAS)

The Visual Analog Scale (VAS) was used to assess pain intensity by the researcher. It is easy to operate and has been a widely used scale in motor rehabilitation programs. It gives a number from 0 to 10 where 0 = no pain and 10 = very severe pain, the highest level of pain. The VAS is intended to provide a numerical value likely to reflect the ratio of pain severity, elimination of pain, or absence of pain against its maximum possible severity.

This test was approved after being presented to specialists in sports injuries. The test was applied as follows.

- Test name

Neck pain intensity measurement.

- Purpose of the test

To measure the maximum degree of neck pain.

- Method of application and measurement

The injured participant is asked to place a mark on the measurement line according to the degree of pain felt, after being theoretically instructed on how to indicate pain intensity using a specific mark. This is done after each range-of-motion test applied to assess

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cervical mobility in all directions: neck flexion and extension, lateral flexion to both sides, and rotation to both sides.

- Recording

The highest recorded pain score on the pain scale is selected.

The researcher notes that the pain perception scale was applied more than once to the injured students in order to assess the condition of each participant and monitor progress during the rehabilitation program. Due to the sensitivity of the injury, only the pre-test and post-test measurements were subjected to statistical analysis.

## 2) 2. Measurement of Cervical Range of Motion

Cervical range of motion was measured using a handheld goniometer.

### a) Measurement Conditions

1. The injured participant sits on a stable chair.
2. The body and head are fixed in a correct position to prevent movement of joints other than the one being measured.
3. Movement is continued to the maximum possible range without reaching the pain threshold.
4. The device must be set to zero before initiating movement in the direction being measured.
5. Three trials are given for each participant in each range-of-motion test, and the best attempt is recorded.

### b) A. Measurement of Cervical Range of Motion (Flexion–Extension)

Measurement procedure

The goniometer is placed over the midpoint of the shoulder joint. After fixing the auxiliary arm of the device vertically, the participant flexes or extends the head and neck in the required direction to the maximum possible angle, while moving the main arm of the device with the participant's head. The achieved angle is then recorded.

### c) B. Measurement of Lateral Cervical Range of Motion (Right–Left)

Measurement procedure

The goniometer is placed over the seventh cervical vertebra. After fixing the auxiliary arm of the device in the appropriate direction, the participant tilts the head and neck toward the direction being measured (right or left) to the maximum possible angle, while moving the main arm of the device with the head. The achieved angle is then recorded.

### d) C. Measurement of Cervical Rotation Range of Motion (Right–Left)

Measurement procedure

The goniometer is placed over the center of the head. After fixing the auxiliary arm in the direction of the participant's line of sight, the participant rotates the head toward the direction being measured (right or left) to the maximum possible angle, while moving the main arm of the device with the head and gaze. The achieved angle is then recorded.

**3) Tools Used**

**1. Goniometer**

Consists of two arms connected at one end, with a circular scale divided into degrees from 1 to 180. One arm includes an indicator.

**2. Adhesive tape**

Used to fix the arms of the device to the participant's limb.

**Procedure**

The examiner stands close to the participant and fixes one arm of the device with adhesive tape along the longitudinal axis of the humerus, parallel to it. The second arm is fixed parallel to the forearm, with the participant's arm fully extended at 180 degrees. The participant then flexes the elbow joint by bringing the forearm closer to the humerus. The recorded angle represents the joint angle, with maximum flexion recorded at 30 degrees. Two trials are given, and the best angle is recorded.

**4) 3. Measurement of Neck Muscle Strength**

Neck muscle strength was measured using an electronic dynamometer.

**a) Measurement Conditions**

1. The test is performed on a solid, stable, and level chair.
2. The participant must remain stable during measurement to isolate the target muscle groups.
3. Continuous effort is required without interruption and without reaching pain.
4. Body position is standardized for all participants.
5. No auxiliary force or extraneous movements are allowed.
6. Muscle contraction is maintained for 2–3 seconds.

**b) A. Measurement of Strength of Neck Flexor Muscles (Anterior)**

**Measurement position**

- Place the participant in a chair, with one end of the device fixed to the wall at the level of the forehead.
- The back of the participant is placed to the wall.
- That other end of the device is clipped onto a ring behind the head..

**Measurement method**

The participant slowly and forcefully attempts to flex the head forward and down. The Movements of the Indicator depends on the applied force. The reading is taken at the end of the contraction, there is no trunk movement.

**c) B. Measurement of Strength of Neck Extensor Muscles (Posterior)**

**Measurement position**

- This device was affixed to the wall at forehead level, while the participant was seated in a chair with the other end of the device.
- Will sitting on the wall side facing the wall.
- The other end of the device is connected through a clip on a ring at the front of the head..

**Measurement**

**method**

In this position, the participant tries to pull the head slowly and strongly backward. The

indicator spontaneously moves in the direction of the applied force and the impulse is recorded with restriction of trunk motion.

d) C. Measurement of Strength of Right Lateral Neck Flexors

Measurement position

- The testee reclines in a chair, while the sensor is attached to the wall.
- The participant faces left towards the wall.
- The other end of the device hooked by clip to a left head side ring.

Measurement

method

The test subject is attempting to slowly and aggressively flex the head to the right side the measurement is made at the end of the contraction, with trunk stability guaranteed.

e) D. Measurement of Strength of Left Lateral Neck Flexors

Measurement position

- The participant is seated on a chair, and the device is mounted on the wall.
- First, the participant sits on the right side wall.
- The other end of the device fastens with a clip to a loop on the right side of the head.

Measurement

method

Head is passively slowly and forcefully flexed to the left side by an unblinded participant.

This measurement is done at the end of the contraction which ensures a stable trunk.

f) E. Measurement of Strength of Neck Rotator Muscles (Left Rotation)

Measurement position

- The participant is seated on a chair with the wall to their right side.
- Its mounted on the wall and it works on the level of the head.
- The device is clipped onto the head protection ring on the right.

Measurement

method

The participant slowly and forcefully attempts to turn the head to the left side. This recording, with restricted trunk movement.

g) F. Measurement of Strength of Neck Rotator Muscles (Right Rotation)

Measurement position

- The participant sits on a chair with the left side facing the wall.
- The device is fixed to the wall at head level.
- The device is attached via a clip to the protective head ring on the left side.

Measurement

method

The participant attempts to rotate the head slowly and forcefully toward the right side. The reading is recorded while preventing trunk movement.

**B. Rehabilitation Program**

The Rehabilitation program (physical therapeutic and shockwave therapy) was carrying out by the researcher on the tested unit to alleviate pain and to allow an early return to sport activity. The competition schedule started on 02-10-2024 at 10 a.m. on the injured participants rehabilitation site.

It was an eight-week-long program with three 60-minute rehabilitation sessions per week. A total of 18 rehabilitation sessions were given. The session included three segments: the

introductory segment (10 minutes) the main segment (40 minutes) and the conclusive segment (10 minutes).

Over 8 weeks, the time spent in the rehabilitation program was 1,440 min. 240 mins of the 1400 mins were in the preparatory section = 17% of overall time in program This included 960 minutes of main section content, which was 66%. The final section took up 240 minutes — or 17%. Table 2 illustrates this distribution.

1) Table 2

Distribution of Time Across Rehabilitation Program Sessions

No.	Rehabilitation Session Section	Total Time	Percentage
1	Preparatory	240 min	17%
2	Main	960 min	66%
3	Concluding	240 min	17%
	Total	1440 min	100%

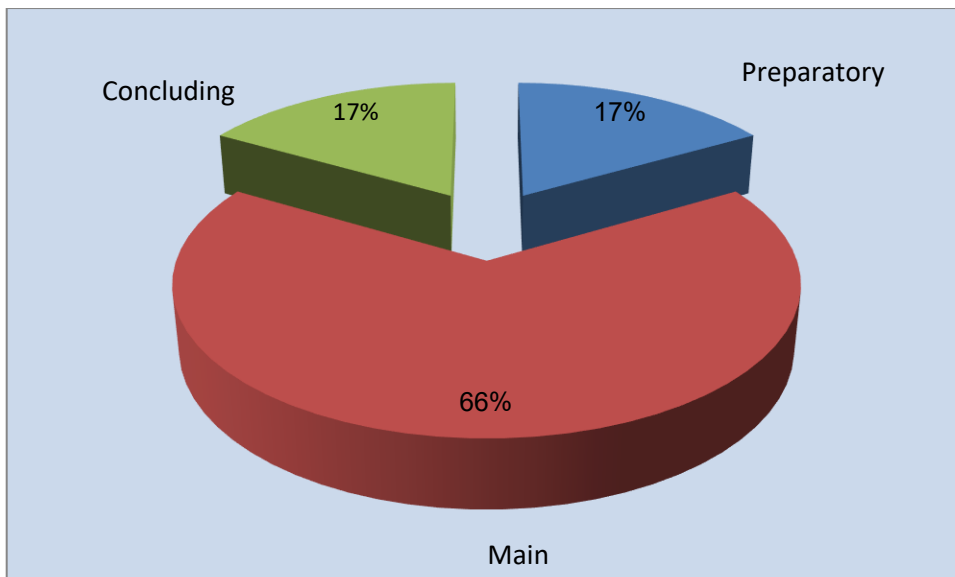


Figure (1) illustrates the distribution of the time sections of the rehabilitation units across the duration of the prescribed rehabilitation program.

After completing the rehabilitation program, post-tests were conducted for the research sample on Friday, 29/11/2024, following the same sequence as the pre-tests. The researcher ensured that the same conditions under which the pre-tests were conducted were maintained, particularly with regard to the order of the tests.

4. Results

Table (3) Shows the arithmetic means, standard deviations, calculated t-values for paired samples, and significance levels for the pre- and post-tests in pain intensity measurements.

Variable	Unit	Pre-test Mean	SD	Post-test Mean	SD	t-value	Sig. level	Difference
Pain intensity	Score	6.53	0.14	4.01	0.93	3.74	0.04	Significant

The table above indicates statistically significant differences between the pre-test and post-test means for the pain intensity variable among the injured students. The calculated t-value was 3.74, and the significance level reached 0.04, which is lower than the adopted significance level of 0.05. This result indicates the presence of statistically significant differences in favor of the post-test, reflecting a reduction in pain intensity following the rehabilitation program.

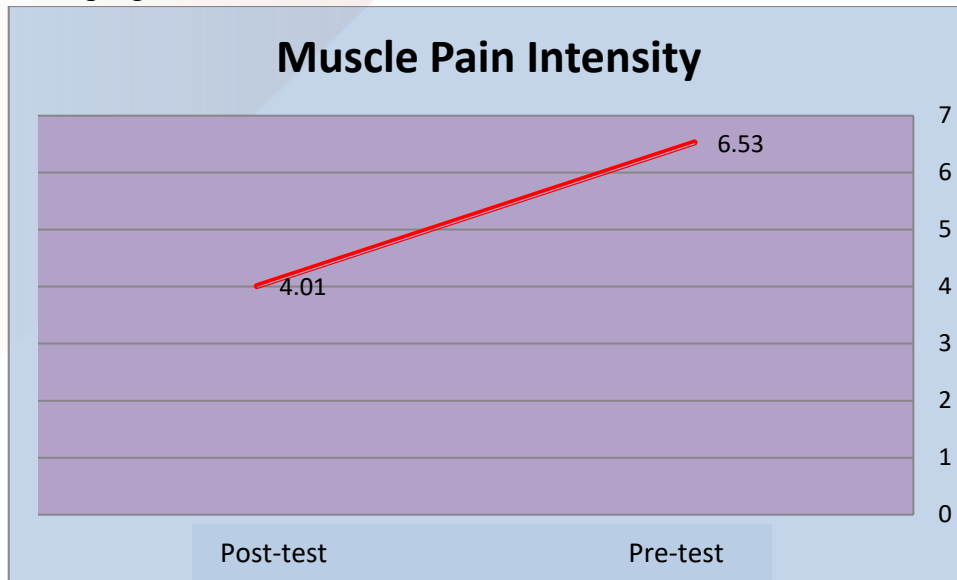


Figure (2) shows the differences between the pre-tests and post-tests of the main research sample in the muscle pain test.

2) Table (4)

Arithmetic means, standard deviations, calculated t-values for paired samples, and significance levels for the pre- and post-tests in range of motion measurements.

No.	Variable	Unit	Pre-test Mean	SD	Post-test Mean	SD	t-value	Sig. level	Difference
1	Cervical range of motion during forward flexion	Degree	21.39	2.44	29.31	1.44	5.25	0.000	Significant
2	Cervical range of motion during backward extension	Degree	30.56	3.29	38.48	2.72	3.84	0.008	Significant
3	Cervical range of motion during right lateral flexion	Degree	22.22	1.62	30.14	2.18	4.47	0.001	Significant
4	Cervical range of motion during left lateral flexion	Degree	24.73	1.77	32.65	1.56	4.74	0.001	Significant
5	Cervical range of motion during right rotation	Degree	32.06	2.58	39.98	1.58	4.14	0.001	Significant
6	Cervical range of motion during left rotation	Degree	32.29	1.84	40.21	1.93	5.13	0.000	Significant

Figure (3) illustrates the differences between the pre-tests and post-tests of the main research sample in cervical range of motion.

The table above shows that the pre-test mean value for cervical range of motion during forward flexion was 21.39 degrees, while the post-test value reached 29.31 degrees. The pre-test mean for backward extension was 30.56 degrees, increasing to 38.48 degrees in the

post-test. For right lateral flexion, the pre-test value was 22.22 degrees and the post-test value was 30.14 degrees. For left lateral flexion, the pre-test value was 24.73 degrees and the post-test value was 32.65 degrees.

Regarding cervical rotation, the pre-test mean for right rotation was 32.06 degrees, increasing to 39.98 degrees in the post-test. For left rotation, the pre-test mean was 32.29 degrees, while the post-test mean reached 40.21 degrees.

These results indicate statistically significant improvements in cervical range of motion in all measured directions in favor of the post-test following the rehabilitation program.

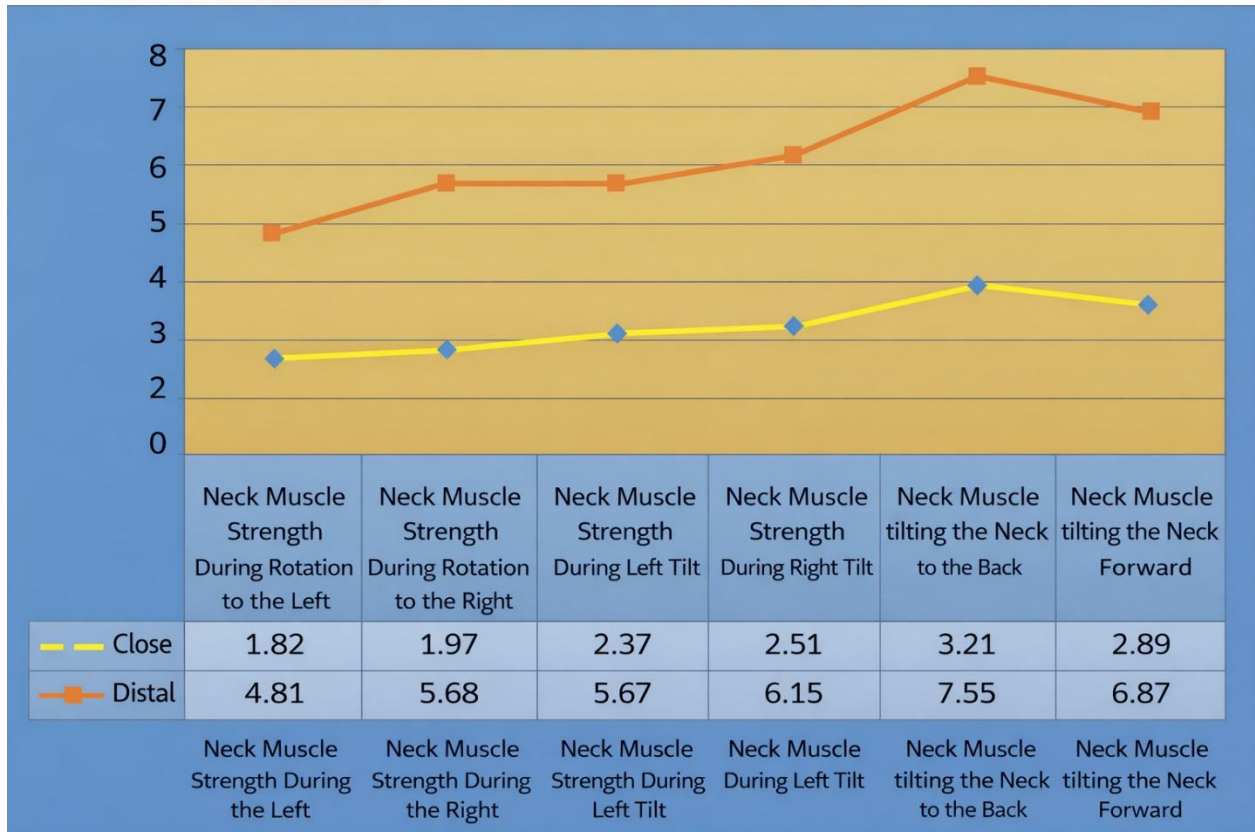


Figure (4) illustrates the differences between the pre-test and post-test measurements for the main research sample in neck flexion strength.

According to the table above, the pre-test value of muscle strength during anterior neck flexion was (2.89), while the post-test value increased to (6.87). The pre-test value of muscle strength during posterior neck extension was (3.21), which rose to (7.55) in the post-test.

With regard to right lateral neck flexion, the pre-test value was (2.51) and increased to (6.15) in the post-test, whereas left lateral neck flexion recorded a pre-test value of (2.37) and a post-test value of (5.68). For right neck rotation, the pre-test value was (1.97) and increased in the post-test to (3.98), while left neck rotation showed a pre-test value of (1.82) and a post-test value of (4.81).

### 5. Discussion

The data shown in the tables by the difference between the pre and post-test measurements in pain level, range of motion, and muscle strength were statistically significant pre-test vs

post-test with significance in favored of post-test. The researcher believes that the reason for the improvement in performance is the impact of rehabilitation exercises, with the addition of the shockwave device that was the main reason for reducing pain severity and increasing range of motion and muscle strength on the injured partials of the research sample.

It was based on very good scientific principles, and experts in rehabilitation and physical therapy were consulted in the program design. Shockwave therapy had a positive addition to the concomitant rehabilitation program by inducing the functional state of the injured area, by facilitating neural impulses, and by enhancing muscle strength.

The researcher also emphasizes that pain limits muscular performance and functional performance of the joint. Thus, therapeutic exercises were chosen according to the ability level of all participants and were performed in combination with shockwave therapy, enabling treatment progression as tolerated by injured subjects. Such activation leads to neuromuscular response and functional muscle strengthening through scientific structuring of training intensity, total volume and rest periods. This kind of organization is said to improve performance through motivation and stimulation of the neuromuscular functions (7: 330–331).

These are activities that are scientifically programmed to encourage healthy individuals as well as injured athletes to reach their physical potential by keeping their proper form maintained during exercises. Shockwave therapy, among other modern therapeutic modalities, plays a big role in restoring the range of motion in the neck and enhancing muscle strength, and alleviating pain. This aspect is especially important in how gymnastics is based on performing skills that require extreme flexibility and muscular strength. But the elder age of sportmen makes them more injury prone, while sport rehabilitation exists through modern therapy methods which can minimise pain and increase muscular flexibility.

The results were in agreement with the results reported by Majali et al. Al-Mansi Suleiman stressed the fact that flexibility is directly related to muscle condition and the techniques that promote relaxation of muscles enable a greater degree of freedom in movement (9: 207; 10: 2006).

Rehabilitation exercises are undoubtedly the most-practiced strategies for redeploying injured athletes to their normal or near-normal functional capacity. The neck muscle weakness that was revealed in the pre-test is because of limited motion, pain, and tension surrounding the cervical area (9: 74), which was also obvious at the beginning of the program. Therefore, a systematic and integrated exercise program was conducted focusing on neck flexors, extensors and lateral muscles.

The first phase was conduction of the static contraction exercises without resistance. The second and final phase included static and dynamic resistance exercises with progressive use of different types of resistance (body weight, therapist-applied, elastic bands, Swiss balls, and free weights). Such rehabilitation exercises subsequently improve muscle perfusion, promote capillary dilation, induce muscle hypertrophy, increase mitochondrial density and improve the composition of muscle proteins. Additionally, they augment

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hemoglobin, which, in turn, improves the efficiency of delivering oxygen to muscle tissues and strengthens atrophied muscles surrounding the cervical spine area (1: 96).

The rehabilitation exercises were employed up to tolerable levels of pain to increase neck region mobility and neck region muscle strength and to rehabilitate near functional status. These were aimed at decreasing pain, as therapeutic exercises, and both active and passive flexibility training help muscle extensibility and elasticity of the neck muscles and ligament, improving the range of motion .

Also, the use of shockwave devices at the start of the rehabilitation program was also effective for the relief of pain. These modalities create heat in cervical tissues, relax contracted neck muscles, enhance blood circulation (Benson 1975), and penetrate deeply into the muscles, tendons and ligaments (Lund 1994). They also help with the elimination of damaged tissue and also help with pain by releasing endorphins and contracting pain signals to the brain..

## **6. Conclusions**

1. The prescribed rehabilitation exercises had a substantial effect on reducing pain intensity, improving range of motion, and increasing muscle strength in injured gymnastics students.
2. Modern therapeutic devices, such as the shockwave device, contribute to accelerating recovery and restoring the injured area to its normal functional state in a shorter period for injured gymnastics students.

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