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The effect of rehabilitation exercises with elastic bands for triceps brachii muscle injuries of the preferred arm in handball players

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Abstract
Sports injuries are the most dangerous indicator facing both teams and players. This research aims to study the effect of elastic band exercises in the rehabilitation of triceps brachii muscle injuries, which are common and impactful injuries, among handball players with injuries in their preferred arm. The research population was represented by players from Baghdad clubs who suffered from partial rupture of the triceps brachii muscle, numbering (10) injured players, who represent the original population. A rehabilitation program of 24 rehabilitation units was applied, with a focus on using various elastic bands and graduating the difficulty of exercises from easy to difficult, ensuring the recovery of the injured muscle and the restoration of its full function. The study results showed that rehabilitation exercises using elastic bands had an effective impact on improving muscle strength tests and reducing the degree of pain in the research sample. The results also confirmed that the development in muscle strength of the triceps brachii muscle is closely linked to the disappearance of pain, which indicates that the positive effect of rehabilitation exercises in reducing or eliminating pain led to a clear improvement in the range of motion of the injured joint.

Keywords: Resistance bands, Rehabilitation exercises, triceps muscle

Introduction
Sports injuries halt the progress of athletic performance for many players and prevent them from engaging in sports activities, affecting them and leading to distancing themselves from sports activities, which results in a decline in the players level (Alaa Mohammed Jasim Samher Salman Alwan n.d.). Triceps brachii muscle injury stands out as one of the most common and impactful of these injuries. Handball is a strenuous contact team sport that involves high-intensity short-duration activities, such as sprinting, jumping, turning, pushing, blocking, and throwing (Souhail *et al*.). It therefore seems that the ability to continuously perform intermittent high-intensity actions throughout the game is crucial for handball players (Póvoas *et al*. 2012) [10]. Handball coaches and scientists generally agree that throwing speed is determined by three key factors: correct technique, the optimal timing of sequential body movements, and the strength and power of both the upper and lower limbs. (Gorostiaga *et al*. 2006) [7]. handball throwing, just as they are in softball throwing. In contrast, the relation between the shoulder and elbow, backswing action, trunk twist, trunk direction, step length, and shifts in body weight were less important for handball throwing, likely due to the ball's diameter and mass. These findings highlight the importance of developing specific observation evaluation standards tailored to overhand throw movements using a large ball (Tadahiko Kato1, Kohei Murakami2, Kei Maeda3 2025) [14] Elastic resistance devices such as elastic bands (EBs) are being increasingly used for muscular conditioning for different aims and population types, as they are more affordable and more accessible (i.e., can be performed anywhere) than WMs (Hostler *et al*. 2001) [9]. Elastic bands are a popular choice in rehabilitation programs. They offer a safe and effective way to apply progressive resistance, making them suitable for a wide range of individuals, from inactive healthy people to patients of all ages undergoing rehabilitation (Colado and Triplett 2008) [6]. Sports injuries, of various types, require specialized rehabilitation care to ensure the player's return to their performance level prior to the injury. To achieve this, the need for scientifically correct and effective methods emerges. In this context, the use of rehabilitation exercises with elastic bands is one of these effective methods in rehabilitating players

injured with triceps brachii muscle injuries. The development of both strength and range of motion of muscles and joints is considered a crucial indicator for the player's return to the field and the completion of the rehabilitation process. From here, the importance of this research becomes clear in rehabilitating triceps brachii muscle injury of the preferred arm of handball players. This injury is considered one of the common types that handball players are exposed to due to internal or external reasons and the research aims to use rehabilitation exercises in their rehabilitation to bring them to the normal state they were in before the injury.

Material and Methods

The nature of the problem being studied determines the nature of the methodology. The researcher employed the experimental method using a one-group pre-test/post-test design. This methodology was sustained for three months. Injured players were registered for the first time through the monitoring of injuries that occurred during competitions and matches, and who were registered at the medical center.

Participants

The research population consisted of players from Baghdad clubs participating in the Iraqi Premier League for the 2024-2025 season, (Al-Mithaq, Al-Adalah, Al-Ain, Air Defense, Al-Siyaha), who suffered from partial rupture of the triceps brachii muscle. These players were registered with the Sports Medicine and Physical Therapy Department at the Ministry of Youth and Sports in Baghdad (age 21.10±2.46 years, weight 68.00±2.94 kg, height 1.77±1.41 m). The sample included 4) injured players whose injury was classified as a first-degree partial rupture of the triceps brachii in the preferred arm. Through medical examination and diagnosis. Before study implementation, written informed consent was collated from all participants.

Players were classified as; Back line players (CB;N=3), Front line players(WR;N=1) If a player fulfilled multiple playing positions during match-play, the player was categorized accordingly to each position. Prior to study implementation, written informed consent was collated from all participants

Procedure/Test protocol/Skill test trial/Measure /Instruments

The following tests were used to obtain the data:

1. Measuring Pain Level (Visual Analog Scale)

This method assesses the degree of pain a patient experiences. Patients are presented with a 1-10 numbered scale and asked to indicate their pain level during specific movements of the injured body part. A doctor then measures pain in three seated positions (full arm flexion/extension, lateral rotation with humeral stabilization and elbow flexion). The Numeric Pain Rating Scale (0-10) is used for evaluation: 0 (No pain), 1-3 (Mild pain), 4-6 (Moderate pain), and 7-10 (Severe pain). The unit of measurement is a "degree" on this scale (Wewers and Lowe 1990) [15].

2. Triceps Brachii Range of Motion Test (Goniometry)

This test is used to assess the range of motion of the elbow joint, which is necessary to evaluate the triceps brachii muscle responsible for extending this joint. This measurement is known as goniometry. To perform the test, the axis of the goniometer is placed on the lateral epicondyle of the humerus (the protruding bump on the outside of the elbow). The fixed arm of the goniometer is placed parallel to the upper arm, while the movable arm is placed parallel to the forearm. The patient is first asked to fully extend the elbow, then fully flex it, and the angles are recorded for both movements. The normal reading for elbow extension is 0° to −5° (slight hyperextension), while the normal flexion angle ranges from 140◦ and 150◦. Any deviation from these angles, or pain during movement, indicates a problem with the range of motion of the triceps muscle or the joint itself. (Coglianese 2006) [5].

3. Push-Up Test

The push-up test measures the number of elbow flexions and extensions a subject can perform. From a modified prone support position (knees on the ground for assistance), the subject performs as many repetitions as possible. The number of repetitions is recorded (Coglianese 2006) [5].

4. Medicine Ball Throw Test (2 kg)

This test measures the explosive strength (power-speed) of the upper limb muscles, focusing on the triceps brachii during rapid extension. A 2 kg medicine ball is used, suitable for early rehabilitation or individuals with lower strength. The patient stands with feet shoulder-width apart, holding the ball overhead with flexed elbows. They then forcibly and quickly extend their elbows to propel the ball forward/upward for maximum distance. Slight trunk or knee movement is allowed to aid force generation, but elbow extension must be the primary propulsion. The distance is measured from the starting line to where the ball first touches the ground. Typically, three attempts are made, and the best result is recorded. (Stockbrugger, Barry a.; Haennel n.d.)

Data collection and analysis / Statistical analysis

The information was collected from injured players at the medical center who were participating in the Iraqi Handball League. The medical examination and diagnosis were performed through a clinical examination by a specialist doctor who determined the type and degree of injury(Al-Badran 2025) [1], which was a simple first-degree injury.

To reach the best method for implementing field research procedures, the researcher conducted a pilot experiment from within the research community, numbering two injured individuals, on Sunday, December 5, 2024. The purpose was to confirm the means, measurements, tests, the safety of devices and tools used in performing the exercises, the availability of measurement tools, and to identify expected difficulties in implementation. Subsequently, pre-tests were conducted on the research sample, consisting of four players suffering from partial tears of the triceps brachii muscle, at the Sports Medicine Center / Ministry of Youth and Sports, on January 3, 2025. Afterward, the researcher prepared rehabilitation exercises, basing their preparation on modern scientific principles, sources, and research. The main goal of these exercises was to improve the partial triceps brachii muscle tear injury and eliminate pain, as well as to ensure the exercises were in a systematic and purposeful sequence. The exercises were applied from January 9, 2025, to February 23, 2025, divided as follows: the number of rehabilitation exercise sessions was three units per week (Sunday, Tuesday, Thursday), and the duration of each rehabilitation unit was 20 minutes. After completing the

rehabilitation program, post-tests were conducted for the experimental group on Thursday, February 25, 2025, at exactly ten in the morning.

Results

Table (1) Showing Pre and Post Tests (Balance -Single Leg Hop) - Means and Standard Deviations

Table 1: Means, Standard Deviations, Differences, Calculated t-value, and Significance for Pre and Post-Tests of the Research Sample

Variable		Unit of Measurement	Pre-Test Mean	Pre-Test Standard Deviation	Post-Test Mean	Post-Test Standard Deviation	t-value	Significance Level (p-value)
Visual Analogue Scale (Pain)		Degree	5.625	1.061	1.0	0.535	11.67	0.001
Range of Motion	Elbow Extension	Degree	11.75	0.95	7.25	0.93	9.00	0.003
	Elbow Flexion	Degree	44.25	4.71	137.50	6.45	31.26	0.000
Front Support		Degree	11.75	0.886	24.625	2.263	15.23	0.001
Medicine Ball Throw		Meter	5.125	0.835	11.625	1.685	10.91	0.001

N=4 DF (n-1) = 3 sig (0.05)

Table 1: Triceps Preventive Program Using Resistance Bands

Exercise	Execution Method	Repetitions	Rest Between Sets
1. Triceps Pushdown	Anchor the band high and press down, extending the elbow.	3x12	30 seconds
2. Overhead Triceps Extension	Anchor the band behind the back and extend arms upwards	3x10	30 seconds
3. Triceps Kickbacks	Anchor the band under the foot, lean slightly, and extend the arm backward.	3x12	30 seconds
4. Close-Grip Push-up	Anchor the band behind the back and push hands forward with a close grip.	3x10	30 seconds
5. Reverse-Grip Triceps Pushdown	Same as pushdown, but hold the band with a reverse grip (palm up).	3x12	30 seconds
6. Single-Arm Overhead Extension	Extend one arm overhead and pull the band upwards.	3x10 per arm	30 seconds
7. Two-Handed Triceps Pull	Hold the band with both hands and pull outwards, extending the arms.	3x15	30 seconds
8. Static Hold	Hold the arm extended against band resistance for a set time.	3x20 seconds	20 seconds
9. Push and Hold	Push down and hold the arm taut for a set time	3x20 seconds	20 seconds
10. Stretching Exercises	Stretch the triceps muscle using a band	3x30 seconds per arm	20 seconds

The statistical program was used SPSS V21.

Discussion

The findings presented in Table 1 clearly show significant differences between the pre- and post-test results across all variables. The researcher attributes these differences to the rehabilitation program followed by the sample individuals, which helped improve muscle strength as a result of their commitment to all aspects of the program and their attendance at the rehabilitation sessions. These exercises are designed to improve muscle strength through regular and gradual repetitions and rest periods between repetitions and sets, which contributed to this improvement and the development of the muscle strength of the triceps. This helped restore normal function because it reduced pain and thus allowed the exercises to be performed without pain, which led the injured person to complete his rehabilitation sessions regularly, as the duration of the program helped him gain strength in his muscle groups, and the variety of exercises used in the rehabilitation program helped improve this characteristic. The muscular applications of the exercises depend on the type of training used, which gives them strength that is reflected in their development. (Alaa Muhammad Jassim, Hardan Aziz Salman 2024) [3], These exercises played a role in developing rapid muscle response and reflect the degree of good coordination within the muscle by recruiting motor units for muscular action. The participation of motor units and the timing of their action means that the more units involved in contraction, the greater the level of muscular strength. (Hassanein 1998) [8]. The researcher emphasized the importance of muscle strength and its impact on movement, which is why it must be maintained and restored to its pre-injury state. This is achieved through regular muscle strength exercises, which greatly improve muscle strength, muscle tone, and ligament strength, thereby increasing the strength of both tendons and joints. Muscle strength helps improve health by increasing muscle and joint stability and enabling the body to cope with many of life's emergencies. (Ali 2013) [4]. The variety of rehabilitation exercises used during the rehabilitation period and the development of muscle strength, flexibility, and range of motion were the result of the disappearance of pain. Exercises must be performed carefully to include the level that prevents pain, especially in the first stage of performance. The rehabilitation exercises prepared by the researcher played a major role in improving and activating the muscles as a result of the injury and in reducing and alleviating the pain signals sent by the nervous system. With the start of the reconstruction phase, a range of motion characterized by vigorous activity and some strengthening exercises should be introduced to facilitate tissue reconstruction and re-employment. Pain will largely dictate the rate of progress. Although the pain is severe at the onset of the injury, it decreases and then disappears as treatment progresses. Any pain or swelling or other clinical symptoms that worsen during or after exercise or a specific activity reflects excessive stress relative to the level of tissue repair and rebuilding. The athletic trainer must be aware of the time required for the treatment process. (Razzaq 2013) [11]. The researcher applied the principle of gradual physical exertion in the rehabilitation exercises used during the rehabilitation program, in accordance with the severity of the injury and the players' ability to perform the exercises, based on sound scientific principles and the fundamental objectives of performing rehabilitation exercises that are appropriate for the exercises being followed. In addition,

exercises were selected that resembled the motor performance of the activity, as well as the time required to perform the exercises, which was one of the most important criteria for the success of rehabilitation for injured players. The disappearance of pain helped to advance muscle strength training, and the use of aids helped to improve the research variables and gradually eliminate the feeling of pain. The improvement in the injury, as the disappearance of pain is a good indicator of the degree of rehabilitation on the one hand and the intensity of the exercises on the other.

Practical Applications

The necessity of using rehabilitation exercises to rehabilitate triceps muscle tears and rehabilitate them in treatment and rehabilitation centers for sports injuries. Attention should be paid to the principle of diversifying exercises and the type of equipment used during rehabilitation to avoid boredom among the injured. Rehabilitation exercises play a very important role and must be performed in centers specializing in the treatment of sports injuries and rehabilitation, with a focus on diversifying exercises and equipment to prevent boredom and ensure player commitment throughout the rehabilitation process to achieve recovery and pain relief. Due to individual differences in susceptibility to injury rehabilitation and workload management for triceps injuries must be customized. The player's position, injury history and physical condition should be taken into account when designing the rehabilitation program, with monitoring of exercises and progression of exercise intensity through the integration of proactive monitoring with individualized and varied rehabilitation programs. Clubs can significantly enhance injury prevention and improve players' physical abilities and performance.

Conclusions

The results demonstrate that rehabilitation exercises have a direct and effective impact on improving muscle strength and reducing pain levels in the research sample. It was observed that the development of triceps brachii muscle strength is closely linked to the cessation of pain. This suggests that the positive effect of rehabilitation exercises in alleviating or eliminating pain directly led to a noticeable improvement in range of motion. Furthermore, pain indicators clearly and consistently improved after the researcher's designed rehabilitation exercise program was implemented**.**

Conflicts of Interest

The author declares that there is no conflict of interest.

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